



City of Northglenn

Public Right-of-Way Standards and Specifications

2021 Update





REVISION HISTORY

Revision	Date	Description
2021 Update	4/8/2021	Final updates and formatting revisions



TABLE OF CONTENTS

Revision History	ii
Table of Contents	iii
Tables	v
Acronyms & Abbreviations.....	vii
Chapter 1. General Requirements	1
1.1 Authority & Purpose	1
1.2 General Conditions	4
Chapter 2. Submittal Requirements for Public Improvement Construction Plans	9
2.1 General	9
2.2 Submittals & Content	9
2.3 Final Plans – Public Improvement Construction Plans Only	10
2.4 Information Required for Public Improvement Construction Plans	11
2.5 General Formatting & Required Information	12
2.6 Sheet Title Names & Specific Requirements	13
Chapter 3. Permits.....	21
3.1 General	21
3.2 Application	22
3.3 Review & Acceptance of Submittals	22
3.4 Issuance of a Permit.....	22
3.5 Plans	22
3.6 Warranty & Guarantee.....	22
3.7 Permit Standards & Conditions	23
3.8 Stop Work Orders	26
3.9 Insurance Requirements.....	27
3.10 Contractor License	28
3.11 Right-of-Way Permit.....	28
3.12 Grading Permit	31
3.13 Temporary Water Service (Construction Meter)	31
Chapter 4. Public Infrastructure Acceptance Procedures & Warranty Requirements	33
4.1 Applicability	33
4.2 Acceptance/Warranty Inspection Criteria	37
Chapter 5. Design Report Requirements	40
5.1 General	40
5.2 Geotechnical Report	40
5.3 Drainage Report	46
5.4 Utility Study – Sanitary Sewer & Water	48
5.5 Responsibilities for Traffic Studies	49
5.6 Pavement Design Report	57
5.7 Pavement Evaluation Report.....	57
5.8 Pavement Design & Technical Criteria	58
5.9 Pavement Design Procedure	61
Chapter 6. Earthwork & Erosion Control	63
6.1 Introduction	63
6.2 Soils Investigations	63
6.3 Earthwork & Grading.....	63
6.4 Erosion & Sediment Control Plans	64



6.5	Erosion Control	67
Chapter 7.	Sanitary Sewer System	68
7.1	Introduction	68
7.2	Design Criteria - Planning	68
7.3	Materials & Facilities Requirements	71
7.4	Tests	77
7.5	Materials	80
7.6	Industrial Pre-Treatment Devices	84
7.7	Lift Stations Specifications	92
Chapter 8.	Water System	94
8.1	Introduction	94
8.2	Design Criteria	94
8.3	Construction Specifications	103
8.4	Materials	111
Chapter 9.	Storm Drainage & Other Concrete Facilities	123
9.1	Planning	123
9.2	Design	124
9.3	Construction Specifications	131
Chapter 10.	Concrete Sidewalks & Other Concrete Facilities	136
10.1	General	136
10.2	General Layout & Design Criteria	136
Chapter 11.	Roadways & Pavements	140
11.1	Introduction	140
11.2	Roadway Design & Technical Criteria	140
Chapter 12.	Traffic Operation Devices	147
12.1	Introduction	147
12.2	Design Standards	147
12.3	Traffic Signal Specifications	152
12.4	Construction Standards	175
12.5	Traffic Signing & Pavement Markings	175
12.6	Traffic Signs	176
12.7	Pavement Marking & Striping	178
Chapter 13.	Right-of-Way Grading & Erosion Control	181
13.1	Right of Way Grading & Erosion Control	181
Chapter 14.	Trenching, Backfilling, & Compacting - Utilities	190
14.1	General	190
14.2	Equipment	190
14.3	Trenching for Utilities	190
Chapter 15.	Street Construction Standards	196
15.1	General	196
15.2	Compaction in Utility Trenches	196
15.3	Excavation & Embankment	196
15.4	Subgrade Preparation & Grading	197
15.5	Subbase Construction	197
15.6	Base Construction	198
15.7	Bituminous Construction	198
15.8	Portland Cement Concrete Pavement	216
15.9	Materials & Construction Practices	218
15.10	Utility Pothole Repair	220
15.11	Bridges & Major Drainage Structures	220
15.12	Material Specifications	221



15.13	Bituminous Materials & Pavements	221
15.14	Portland Cement Concrete Pavement -- Materials	222
15.15	Portland Cement Concrete Pavement -- Equipment	223
15.16	Portland Cement Concrete Paving -- Mixing	225
15.17	Concrete for Sidewalk & Crosspans.....	227
15.18	Underground Facilities for Traffic Signals.....	232
Chapter 16.	Temporary Traffic Control	237
16.1	Construction Traffic Control	237
Chapter 17.	Revegetation & Seeding	239
17.1	General	239
17.2	Erosion Control - General.....	241
17.3	Topsoil	241
17.4	Seed	242
17.5	Fertilizer.....	242
17.6	Straw Mulch.....	242
17.7	Straw Bales.....	242
17.8	Temporary & Permanent Planting of Exposed Soils	242
Glossary	244
Resource Standards for References	249
Appendix A	Plan Development Checklist	A-1
Appendix B	General Notes.....	B-1
Appendix C	Construction Notes	C-1
C.1	Standard Grading and Erosion and Sediment Control Construction Plan Notes	C-1
C.2	Sanitary Sewer Construction Notes.....	C-2
C.3	Additional general sewer notes; any of the following notes may be omitted when not applicable:.....	C-3
C.4	Water Construction Notes.....	C-4
C.5	Storm Drainage Construction Notes.....	C-5
C.6	Street Improvements Construction Notes	C-5
C.7	Traffic Signing and Pavement Marking Construction Notes.....	C-6
Appendix D	Certification of As-Builts	C-1
Appendix E	Checklist for Right-of-Way Permits.....	E-1
Appendix F	Design Forms	F-1
Appendix G	Standard Drawings	G-1
G.1	Erosion Control Standard Drawings.....	G-1
G.2	Sanitary Sewer Standard Drawings.....	G-1
G.3	Storm Drainage Standard Drawings.....	G-1
G.4	Street Standard Drawings.....	G-2
G.5	Traffic Standard Drawings	G-3
G.6	Water Standard Drawings	G-3

TABLES

Table 2.1: Submittals & Content	10
Table 2.2: General Formatting & Required Information	12
Table 2.3: Cover Sheet Requirements.....	14
Table 3.1: Submittal Requirements	29
Table 5.1: Required Test.....	42
Table 5.2: Minimum Pavement Thickness	60
Table 7.1: Service Line Size and Slope	69
Table 7.2: Cast-in-Place Manhole Details.....	73
Table 7.3: Manhole Grouting	74



Table 7.4: Squeegee Sand Grading	76
Table 7.5: Sanitary Sewer Appurtenances	77
Table 7.6: Air Test Specs	78
Table 7.7: Minimum Pipe Wall Thickness for Gravity PVC Pipe	82
Table 7.8: Minimum Pipe Wall Thickness for Pressure PVC Pipe	82
Table 7.9: General Manhole Design Requirements.....	83
Table 7.10: Mortar Guidelines	84
Table 7.11: Manning’s Roughness Coefficient	86
Table 7.12: Minimum Slope.....	87
Table 7.13: Grease Factor	88
Table 7.14: Grease Storage.....	89
Table 8.1: Water System Analyses Criteria.....	95
Table 8.2: Fire Flow	95
Table 8.3: Main Crossing Scenarios.....	97
Table 8.4: Pipe Sizing Suppliers	99
Table 8.5: Required Service Tab Sizes Based on the Diameter & Type of Pipe.....	107
Table 8.6: Acceptable Corporation Stops	118
Table 8.7: Compression Couplings.....	119
Table 8.8: Acceptable Setters.....	120
Table 9.1: Minor Storm Allowable Pavement Spread	125
Table 9.2: Major Storm Allowable Pavement Spread	125
Table 9.3: Limits of Cross Street Flow	126
Table 11.1: Curb Radii Criteria.....	141
Table 11.2: Street Design Criteria.....	141
Table 11.3: Stopping Sight Distance	144
Table 12.1: Conduit Schedule	154
Table 12.2: Conductor Schedule	156
Table 14.1: Flowable Fill Mixtures	192
Table 14.2: Pipe Bedding Gradation	194
Table 14.3: Crushed Rock Gradation.....	194
Table 14.4: Backfill Gradation	194
Table 15.1: Aggregate Properties	200
Table 15.2: Dense Graded HMA Gradation Range.....	201
Table 15.3: SMA Aggregate Gradation Range Properties	201
Table 15.4: Properties of Performance Graded Binders.....	202
Table 15.5: Rap Aggregate Uniformity Tolerance.....	203
Table 15.6: Superpave Mixture Properties for Dense Graded HMA.....	205
Table 15.7: Superpave Mixture Properties for Open Graded SMA	207
Table 15.8: Minimum Voids in Mineral Aggregate (VMA) for Dense Graded HMA & Open Graded SMA, %	207
Table 15.9: Mix Design Verification Tolerances	208
Table 15.10: Mixture Discharge Temperatures	210
Table 15.11: Minimum Air & Surface Temperatures Limitations or Mix Placement(HMA)	211
Table 15.12: Job Mix Formula Tolerances	215
Table 15.13: Aggregate Base Course Materials & CDOT Specification	218
Table 15.14: Classification Table for Subbase.....	221
Table 15.15: Classification Table for Aggregate Base Course	221
Table 15.16: Concrete Cylinder Test Requirements	223
Table 15.17: Concrete Placement Temperature Protection Requirements	229
Table 15.18: Concrete Cylinder Test Requirement.....	231
Table 17.1: Classification Table for Amended Soil	239
Table 17.2: Classification Table for Topsoil	240

ACRONYMS & ABBREVIATIONS

AASHTO American Association of State Highway and Transportation Officials

AASHTO "Green" A Policy on Geometric Design of Highways and Streets, Latest Edition. American Association of State Highway and Transportation Officials

ACI American Concrete Institute

AISC American Institute of Steel Construction

ANSI American National Standards Institute

APWA American Public Works Association

ASA American Standards Association

ASTM American Society for Testing and Materials

ATSSA American Traffic Safety Services Association

AWWA American Water Works Association

CDOT Colorado Department of Transportation

CMP Corrugated Metal Pipe

CMPA Corrugated Metal Pipe Arch

CUHP Colorado Urban Hydrograph Procedure

CWCB Colorado Water Conservation Board

DIP Ductile Iron Pipe

DRCOG Denver Regional Council of Governments

FEMA Federal Emergency Management Agency

FHWA Federal Highway Administration

FIRM Flood Insurance Rate Map

HERCP Horizontal Elliptical Reinforced Concrete Pipe

IMSA International Municipal Signal Association

ITE Institute of Transportation Engineers

MHFD Mile High Flood District

MUTCD Manual on Uniform Traffic Control Devices

NEC National Electric Code

NEMA National Electric Manufacturers Association

NFIP National Flood Insurance Program

NPDES National Pollution Discharge Elimination System

NRCS National Resources Conservation Service

ODP Official Development Plan

OSHA Occupational Safety and Health Association

PDP Preliminary Development Plan

PUD Planned Unit Development

PVC Polyvinyl Chloride

RCBC Reinforced Concrete Box Culvert

RCP Reinforced Concrete Pipe

ROW Right-of-Way

SCS Soil Conservation Service

SPP Structural Plate Pipe



SPPA	Structural Plate Pipe Arch	USDCM	Urban Storm Drainage Criteria Manual (MANUAL)
UDFCD District	Urban Drainage and Flood Control	USGS	United States Geological Survey
UNCC	Utility Notification Center of Colorado		

Chapter 1. GENERAL REQUIREMENTS

1.1 Authority & Purpose

1.1.1 Title

These regulations, together with all future amendments, shall be known as the City of Northglenn PUBLIC RIGHT OF WAY STANDARDS AND SPECIFICATIONS, Latest Edition, and may be cited as such and will be referred to herein as the STANDARDS AND SPECIFICATIONS.

1.1.2 Applicability

These STANDARDS AND SPECIFICATIONS shall apply to construction, enlargement, alteration, relocation, removal, conversion, demolition, repair, and excavation of any public improvements or private improvements of common ownership specifically regulated herein. The provision of these STANDARDS AND SPECIFICATIONS applies to City contracts as well as to contracts made for the development of property in the City and other construction within the Right of Way. In the case of City capital improvement contracts, the project specifications may supersede or modify these STANDARDS AND SPECIFICATIONS.

The City's review and acceptance of any plans, reports or drawings or the City's inspection and approval of any improvement constructed by the Developer or by City contracted Designers and Contractors in accordance to these Standards, does not constitute a representation, warranty, or guarantee by the City that such improvements are free from defects or will operate adequately for the purpose intended.

Alterations, additions, or repairs to existing improvements shall comply with all requirements of these STANDARDS AND SPECIFICATIONS unless specifically exempted, in writing, by the City. The City retains the right to require additional information, criteria, or requirements as conditions may warrant.

The chapters and appendices that make up these standards pertain to planning, design, review and acceptance, construction, inspection, testing and documentation of infrastructure improvements. The intent of this manual is to establish the minimum acceptable standards for the design of infrastructure public improvements in the City.

1.1.3 Resource Standards

The following Resource Standards (the latest editions unless otherwise stated) may be used as reference material when certain design or construction methods and materials are not specifically addressed in these STANDARDS AND SPECIFICATIONS and require approval of the Engineering Division.

List of Resource Standards for References

- Colorado Department of Transportation, Standard Specifications for Road and Bridge Construction.
- Colorado Department of Transportation, Standard Plans (M & S Standards).
- Colorado Department of Transportation, Roadway Design Manual.
- American Public Works Association, Standard Plans.
- American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets.
- Institute of Traffic Engineers (ITE), Trip Generation Volumes 1 through 3.

- National Cooperative Highway Research Program (NCHRP) Report 279, Intersection Channelization Design Guide, 1985.
- Institute of Traffic Engineering, Highway Capacity Manual.
- ASTM, American Society for Testing and Materials.
- The American with Disabilities Act, (A.D.A.) Regulations.
- US Department of Transportation, Manual on Uniform Traffic Control Devices (M.U.T.C.D.)
- Federal Highway Administration, Roundabouts: An Informational Guide.
- American Association of State Highway and Transportation Officials, Guide for the Development of Bicycle Facilities.
- Urban Drainage and Flood Control District, Standards.
- EPA Drinking Water Standards
- NSF Standards for Water Treatment Systems
- ANSI Standard, Wastewater Treatment Systems
- Clean Water Act
- Denver Water Board, Engineering Standards of the Board of Water Commissioners

1.1.4 Authority

These STANDARDS AND SPECIFICATIONS have been enacted pursuant to the City of Northglenn Municipal Code (Municipal Code) and Title 31 of Article 16 of the Colorado Revised Statutes and shall have the same force and effect as all other ordinances of the City.

It shall be the duty of the Engineering Division to implement and enforce the provisions of these STANDARDS AND SPECIFICATIONS.

1.1.5 Purpose

The purpose of these STANDARDS AND SPECIFICATIONS is to provide MINIMUM standards to safeguard life, health, property, and public welfare by regulating and controlling the design, construction, quality of materials, use, location, and maintenance of all public improvements and private improvements of common ownership including, but not limited to, sanitary sewer systems, water supply systems, storm drainage systems, streets, open space, parking lots, and appurtenances thereto.

The purpose of these STANDARDS AND SPECIFICATIONS is also to ensure that the City receives public facilities which are constructed with the care and materials such that the facility meets or exceeds the normal service life requirements for similar installations and to ensure that when said facilities are transferred to the City's ownership that they will be free from all defects and in suitable working order to provide the service capabilities anticipated with such a facility.

1.1.6 Interpretation

In the interpretation of the provisions of these STANDARDS AND SPECIFICATIONS the following shall govern:

- In its interpretation, the provisions of these STANDARDS AND SPECIFICATIONS shall be regarded as the minimum requirements for the protection of the public health, safety, comfort, convenience, prosperity, and welfare of the residents of the CITY.
- Whenever a provision of these STANDARDS AND SPECIFICATIONS or any provision in any law, ordinance, resolution, rule, or regulation of any kind, contain any restrictions covering any of the same subject matter, whichever standards produce higher quality shall govern.
- These STANDARDS AND SPECIFICATIONS shall not abrogate or annul any permits or accepted drainage reports and construction plans issued or any easement or covenant granted before the effective date of these STANDARDS AND SPECIFICATIONS. However, if the review and acceptance of construction plans, specifications, and associated engineering reports by the City has occurred more than twelve (12) months prior to execution of the Public Improvements Agreement/or commencement of construction activities, the City shall have the right to require another review process for the plans, specifications, and reports to ensure compliance with these STANDARDS AND SPECIFICATIONS.

1.1.7 Violations

No person, firm, or corporation shall construct, enlarge, alter, repair, relocate, improve, remove, excavate, convert, or demolish any public improvements or private improvements in common ownership or permit the same to be done in violation of these STANDARDS AND SPECIFICATIONS. Whenever any work is being done contrary to the provisions of these STANDARDS AND SPECIFICATIONS, the Engineering Division may order the work stopped by a written notice in accordance with **Chapter 3 - Permits**, of these STANDARDS AND SPECIFICATIONS.

1.1.8 Variances

The provisions of these STANDARDS AND SPECIFICATIONS are not intended to prevent the use of any material or method of construction not specifically prescribed by these standards, provided any alternate has been previously approved and its use authorized in writing by the City. Whenever there are practical difficulties involved in carrying out the provisions of these procedures, the City may grant a variance for individual cases, provided that the City shall first find that a unique reason makes these standards impractical and that the modification is in conformity with the intent and purpose of these standards, and providing that such variance does not lessen any design requirements or any degree of structural or operational integrity. The City shall require that sufficient specifications, evidence, justification and/or proof be submitted to substantiate any claims that may be made regarding the alternate material, detail, or technique. The City, in its sole discretion, will decide upon the acceptability of any proposed variance.

1.1.9 Amendments & Revisions

These STANDARDS AND SPECIFICATIONS may be amended as new technology is developed and/or if experience gained in the use of these STANDARDS AND SPECIFICATIONS indicate a need for revision. The City shall have full power and authority to promulgate rules, regulations or new standards of a technical nature, which rules, regulations or standards shall be effective immediately upon their approval and certification by the Engineering Division. It is the responsibility of the Consultant/Contractor/Developer to obtain all revisions to these STANDARDS AND SPECIFICATIONS.

1.1.10 Severability

If any section or article of these STANDARDS OR SPECIFICATIONS is found to be unconstitutional or illegal by any court, the said section or article shall have no bearing on the effectiveness of the rest of these STANDARDS OR SPECIFICATIONS.

1.2 General Conditions

1.2.1 Responsibility for Design & Construction

The City shall have full authority to review and accept all submittals and construction for compliance with these STANDARDS AND SPECIFICATIONS. An approval or acceptance by the City does not relieve the Owner, Designer or Contractor from responsibility for ensuring that the calculations, plans, specifications, construction, and record drawings are in compliance with these STANDARDS AND SPECIFICATIONS. Any approval or acceptance by the City shall not result in any liability to the City or its employees for any claim, suit, loss, damage, or injury resulting from the use or implementation of the accepted documents. Nothing in these STANDARDS AND SPECIFICATIONS shall be construed to circumvent the Municipal Code pertaining to responsibility for reports, studies, designs, and construction.

1.2.2 Pre-Design Meetings – Capital Improvement Projects

Prior to the Designer beginning design of the construction documents, the City may require a pre-design meeting to discuss any potential design or construction issues on the specific project. This meeting shall be attended by the Designer, the Designer's subconsultants and the City.

1.2.3 Pre-Application Meetings – Development Projects

Prior to the Designer beginning design of the construction documents, the City shall require a pre-application meeting to discuss any potential design or construction issues on the specific project. This meeting shall be organized by the Planning Department when requested by the Developer or Designer.

1.2.4 Pre-Construction Meetings

In conjunction with the "Notice to Proceed" for a development or City Capital Improvement Project, the Contractor shall arrange a "pre-construction meeting" which shall be attended by the Owner/Developer/Designer, all of the Developer's/Contractor's subcontractors, affected utility companies and the appropriate City representatives. This meeting shall be held before any construction related activities can commence on said development and its purpose is to introduce all of the "parties" involved in the development as well as establish guidelines that the City feels are appropriate for the development.

1.2.5 Work Conditions

Pre-Design & Investigative Work

Contractor shall coordinate with the City prior to the commencement of all pre-design work inside the City Right of Way. Contractor shall be responsible for the cost of all City locates including but not limited to water, sewer and traffic signals for all pre-design and investigative work. Contractor will be required to pull all applicable permits for pre-design and investigative work inside City Right of Way. Contractor shall remove all utility locate marks at the sole discretion of the Engineering Division.

Emergency Work

When, in the opinion of the City, the Contractor has not taken sufficient precautions for the safety of the public or the protection of the work to be constructed or if adjacent structures or property which may be damaged by processes of construction on account of such neglect and an emergency arises and immediate action is considered necessary in order to protect private or public interests, the City, WITH OR WITHOUT NOTICE to the Contractor or the Developer, may provide suitable protection by causing work to be done and material to be furnished and placed as the City may consider necessary and adequate. The cost and expense of such work and material so furnished will be borne by the Contractor or Developer and will be paid within 30 days of presentation of the bills. The City may also draw from the Developer's surety to cover any non-payment, including accrued interest and applicable overhead costs. The performance or non-performance of such emergency work under the direction of the City will in no way relieve the Contractor of responsibility for damages which may occur during or after such precaution has been taken.

The Contractor is required to apply for a Right of Way permit within 72 hours of the emergency.

Final Clean Up

Upon completion of the work and prior to any inspection by the City, the Contractor shall remove from the project area all surplus and discarded material, rubbish and temporary structures and leave the project area in a neat and presentable condition. The Contractor shall restore all work which has been damaged by his operations to general conformity with the specifications for the item(s) involved. The Contractor shall inspect the interior of all manholes and catch basins within the construction limits for construction materials, dirt, stones or other debris and remove same prior to any inspection by the City. The Contractor shall remove all utility locate marks at the sole discretion of the Engineering Division. Additional street sweeping may be required at the sole discretion of the Engineering Division. All final clean up and restoration work to be completed in a timely fashion as determined by the Engineering Division.

1.2.6 Control of Work & Materials

Authority of City

The City will have the authority to stop work whenever such stoppage may be deemed necessary. The Engineering Division will resolve all questions which arise as to the quality and acceptability of materials furnished, work performed, interpretation of the plans and specifications and acceptable fulfillment of the requirements of these STANDARDS AND SPECIFICATIONS.

City inspectors are authorized to inspect all work and all material furnished. Inspections may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector is not authorized to revoke, alter or waive any requirements of these STANDARDS AND SPECIFICATIONS. They are authorized to call the attention of the Contractor to any failure of the work or materials to conform to these STANDARDS AND SPECIFICATIONS. The Inspector will have the authority to reject materials until any questions at issue can be resolved by the City.

The Inspector will, in no case, act as foreman or perform other duties for the Contractor nor interfere with the management of the work done by the Contractor. Any "advice" or "opinion" which the inspector may give the Contractor will not be construed as binding upon the Engineering Division or the City in any way or release the Contractor from fulfilling all of the terms of these STANDARDS AND SPECIFICATIONS. The presence or absence of the inspector will not relieve, in any degree, the responsibility or the obligation of the Contractor, Owner or Developer.

The Engineering Division will, at all times, have reasonable and safe access to the work as it progresses, and the Contractor will provide proper facilities for such access and inspection.

Responsibilities of the Contractor

In case of suspension of work for any cause, the Contractor, before leaving the job site, will take such precautions as may be necessary to prevent damage to the project, provide for public safety, normal drainage and erect any necessary barricades, signs or other facilities at his expense as directed by the City and required by these STANDARDS AND SPECIFICATIONS. The Contractor is responsible for ensuring that all construction and construction activities and materials are in compliance with these STANDARDS AND SPECIFICATIONS. The Contractor shall be solely responsible for all construction means, methods, techniques, sequences, and procedures. The Contractor shall be responsible for the acts and omissions of his employees, subcontractors and their agents and employees. The Contractor shall be solely responsible for locating all existing underground installations, including service connections, in advance of excavating. City utility maps are intended to be used for general information only and the location of any utilities or property lines as shown on the utility maps are not necessarily accurate.

Unauthorized &/or Unacceptable Work

Work which does not conform to the accepted construction plans and these STANDARDS AND SPECIFICATIONS and results in an inferior or unsatisfactory product will be considered unacceptable work. Unacceptable work, whether the result of poor workmanship, poor design, use of defective materials, damage through carelessness or any other cause which is found to exist prior to the final acceptance of the work will be immediately removed and replaced or otherwise satisfactorily corrected by and at the expense of the Developer or Contractor. This expense includes total and complete restoration of any disturbed land or surface to original or better condition that existed before the repairs or replacement.

Samples & Tests

To ascertain that materials and procedures comply with contract requirements, testing will be taken at the source or at the job destination at the discretion of the City and as often as the City deems it advisable or necessary. Taking of samples will be in accordance with standard practices except where methods and procedures for sampling materials are otherwise set forth in these STANDARDS AND SPECIFICATIONS.

The Contractor will furnish, without charge, all samples and test results required by the City and will afford such facilities as may be necessary for collecting and forwarding them. The Contractor may be required to furnish, when requested by the City, a written statement giving the origin, composition, and process of manufacture of a material.

Whenever any of the provisions of these STANDARDS AND SPECIFICATIONS or evidence that any material or construction does not conform to the requirements herein, the City may require that the Contractor have tests performed, at his expense, which will be used as proof of compliance. Test methods will be as referenced by these STANDARDS AND SPECIFICATIONS. If there are no recognized and accepted test methods for the proposed alternate, the City will determine the test procedures. All tests will be made by an agency approved by the City. Reports and results of such tests will be retained by the City.

Storage of Materials

Materials will be stored so as to ensure the preservation of their quality and suitability for the work. Stored materials, even though approved prior to storage, will be subject to inspection prior to their use in the work and will meet all requirements of these STANDARDS AND SPECIFICATIONS at the time they are used. Stored materials will be located so as to facilitate inspection. With the prior written approval of the City, portions of the Right of Way not required for public travel may be used for storage purposes and for the placing of the Contractor's plants and equipment, but any additional space required will be provided by the Contractor at his expense.

Defective Materials

Materials not in conformance with requirements of these STANDARDS AND SPECIFICATIONS will be considered defective and will be rejected. Rejected materials will be removed from the work site at the Contractor's expense, unless otherwise permitted by the City.

1.2.7 Protection of Public Interest**Public Convenience & Safety**

Unless otherwise specified, the Contractor will give written notice, to the proper authorities in charge of streets, gas and water pipes, electric service, cable television and other conduits, railroads, poles, manholes, catch basins and all other property that may be affected by the Contractor's operations at least 72 hours prior to any construction. The Contractor will not hinder or interfere with any person in the protection of such property or with the operation of utilities at any time. The Contractor must obtain all necessary information in regard to existing utilities, protect such utilities from injury and avoid unnecessary exposure so that they will not cause injury to the public.

The Contractor will obtain all necessary information in regard to the planned installation of new utilities and cables, conduits and transformers, make proper provision and give proper notification so that new utilities and appurtenances can be installed at the proper time and location without delay to the Developer or Contractor, nor cause unnecessary inconvenience to the Owner or the public. New underground utilities and appurtenances will not be covered with pavement prior to the City's inspection of such facilities. When the work involves excavation adjacent to any building or wall along the work, the Contractor will give property owners due and sufficient written notice thereof, with a copy to the City.

Protection of Property & Monuments

The Developer and Contractor will use every reasonable precaution to prevent the damage or destruction of public or private property such as, but not limited to poles, trees, shrubbery, crops, fences, monuments, and all overhead structures such as, but not limited to wires or cables which are either within or outside of the Right of Way. The Contractor will protect and support all water, gas, sanitary sewer, storm drainage, electrical pipes, conduits and all railway tracks, buildings, walls, fences, or other properties which are liable to be damaged during the execution of his work. The Contractor will take all reasonable and proper precautions to protect persons, animals and vehicles from injury or damage and wherever necessary or as directed by the City, will erect, and maintain a fence or railing around any excavation and place a sufficient number of amber lights about the work and keep them operational from twilight until sunrise. The Contractor will employ one or more watchmen as additional security whenever they are needed or required by the City. The Contractor will not prevent the flow of water in the gutters of the street and will use proper means to permit the flow of surface water along the gutters while the work is in progress.

The Contractor will protect and carefully preserve all land boundary and City survey control monuments until the Owner's authorized registered land surveyor has referenced their location for replacement. All monuments disturbed or removed by the Contractor through negligence or carelessness on his part or on the part of his employees or subcontractors will be replaced by a land surveyor registered in the State of Colorado, at the Contractor's expense. The Developer and Contractor will be responsible for the repair of any damage or destruction of property resulting from neglect, misconduct or omission in a manner or method of execution or non-execution of the work, defective work, or the use of unsatisfactory materials. The Contractor will restore such property to a condition equal to or better than that existing before such damage or injury was done by repairing, rebuilding, or replacing it as may be directed by the City or they will otherwise make amends for damage or destruction in a manner acceptable to the City. The Developer and Contractor will be responsible for the repair of underground pipes, wires or conduits damaged by them or their subcontractors.

The Developer and Contractor will be liable for all damage caused by storms and fire until the work is accepted into warranty.

Installation of Survey Monuments

Permanent survey monuments and lot pins shall be set at locations approved by the City provided that such monuments shall be set not more than 1,400 feet apart along any straight boundary line; at all angle points; and at the beginning, end, and points of change of direction or change of radius of any curved boundary. In addition, 5/8-inch steel pins, or larger, shall be set at all lot corners. Affixed securely to the top of each monument shall be an aluminum cap marked with the Colorado registration number of the land surveyor responsible for the establishment of the monument.

The Professional Land Surveyor will assure that the monuments he/she establishes or re-establishes conform both in location and physical character with the specifications called for in Section 38-51-104, Colorado Revised Statutes. Each found monument verified in location shall be restored or rehabilitated as necessary so as to have it readily identifiable and reasonably durable.



Protection of Streams, Lakes, and Reservoirs

The Developer and Contractor will take all necessary precautions to prevent pollution of streams, lakes and reservoirs by sediment, fuels, oils, bitumen, calcium chloride, fertilizers, insecticides, or other harmful materials. They will conduct and schedule their operations to avoid or minimize siltation of streams, lakes and reservoirs. A plan for erosion protection shall be submitted and accepted by the City. All required erosion control measures shall be in place before starting work. All work must conform to all applicable local, state, and federal regulations.

Chapter 2. SUBMITTAL REQUIREMENTS FOR PUBLIC IMPROVEMENT CONSTRUCTION PLANS

2.1 General

2.1.1 General Submittal Criteria & Procedures

This chapter gives criteria and procedures for submitting engineering drawings as required for these STANDARDS AND SPECIFICATIONS and including all planning reports. All other requirements for planning can be found in the City of Northglenn Municipal Code.

2.1.2 Authorization/Certification

Designer's Signature

All documents, including plans and other submittals noted below, shall be prepared, stamped, signed, and dated by a Colorado Professional Engineer. Each sheet in the plan set shall contain the Designer's Statement as shown in this chapter and shall be signed and stamped by the Designer and submitted to the City. The City may reject any construction requests or work that is not designed by a Colorado Professional Engineer.

Additional Requirements

The Designer should be aware that whenever unusual or serious problems are anticipated or encountered for a proposed construction project, additional information, and analysis beyond the minimum requirements of these STANDARDS AND SPECIFICATIONS will be required to be provided to the City.

Final Authorization

No plans are considered final and ready for construction until signed and stamped by the Designer and accepted by the City officials. No construction of public improvements in City of Northglenn, whether in the Right of Way or easements is permitted until and unless all required Permits are issued including, but not limited to, Right of Way permits (Refer to **Chapter 3 - Permits**) and Grading permits (Refer to **Chapter 3 - Permits** and **Chapter 6 - Earthwork and Erosion Control**).

Construction Traffic Control Plans

Plans for traffic control during construction of projects must be accepted and approved by the City of Northglenn prior to any issuance of permits. (Refer to **Chapter 16 - Temporary Traffic Control** and the **Manual on Uniform Traffic Control Devices**.)

2.2 Submittals & Content

Table 2.1 describes the submittals and content requirements.

Table 2.1: Submittals & Content

Submittal	Description
Checklist	The Engineering Division has provided a checklist that identify the specific information requirements for each of the design documents including plans and reports. Refer to Appendix A for the checklist.
Public Involvement Construction Plans	Refer to Information Requirements for Construction Plans in Section 2.4 of this chapter, for further description and requirements.
Soil Investigation Report	Refer to Chapter 5 - Design Report Requirements , for the content and requirements for the Geotechnical Report requirements.
Pavement Design Report	Refer to Chapter 5 - Design Report Requirements , for the content and requirements for the pavement design report.
Utilities Report (Water and Sewer)	Refer to Chapter 5 - Design Report Requirements , for the content and requirements for the utilities report.
Drainage & Hydrologic Reports	The Designer is required to submit drainage, erosion control, and hydrologic reports. (Subsurface water – See Chapter 5 - Design Report Requirements)
Traffic Impact Study	For Traffic Impact Study Requirements, process, and report contents, refer to Chapter 5 - Design Report Requirements .
Opinion Costs	As a separate attachment to the Plans, an Opinion of Costs for all Public Improvements will be required. The Opinion of Costs shall include, but not be limited to, the items listed below. The items shall be identified by unit price and total cost for each item for each type of Project. These costs shall be used in determining the value to use for surety requirements.

2.3 Final Plans – Public Improvement Construction Plans Only

- All final plans shall include all plans, profiles, notes, and details of improvements.
- The plans shall be submitted electronically and, if requested by Engineering Division, printed on 11" x 17" sheets.
- Includes Record Drawings and Construction Plans.
- Digital record drawings files are to be saved in AutoCAD, latest version, the DWG file shall be submitted on thumb drive or via email or online file sharing.
- Each record drawings shall be plotted and submitted on paper and submitted electronically in .pdf format.

2.3.1 Record Drawings

Updating Plans with Design Changes

The Public Improvement Construction Plans shall be updated with all design changes that occurred after plan acceptance. Record utility (water, sewer, drainage) drawings shall document the size and invert elevation of all pipes (including pipe class), inlets, riprap, headwalls, detention pond volumes, swale cross-sections, manholes, valves, PRVs, and all other utility infrastructure shown on the construction plans, including those improvements located in areas outside of the public Right of Way if appropriate. Record drawings shall also show all pipe and/or drainageway/swale grade percentages.

Street construction record drawings shall identify the actual pavement type and grade or mix type used; if the subgrade was treated; and document changes to widths, lengths for streets, sidewalks, curbs, crosspans, and ramps. The Record drawings shall identify all signage, striping and traffic signal controller and pole locations as actually placed.

Record drawings shall verify other information as specifically requested by the Engineering Division.

Minor Design Changes

Minor changes are not required to be included on the Record Drawings. Minor changes include incorrect references and grade changes less than 0.1 foot.

Submittal of Record Drawings

The Designer, a Colorado Professional Engineer, shall update and stamp the Record Drawings for the Public Improvement Construction Plans and submit the plans electronically, and on 11" x 17" paper, if requested, to the City for acceptance prior to the release of the Warranty Guarantee. No Certificate of Occupancy will be issued before the Designer submits Record Drawings.

2.4 Information Required for Public Improvement Construction Plans

2.4.1 Plan Set

The Developer/Designer is required to submit a complete Plan covering the design for all Public and Private Improvements in the Project. This plan set shall include as a minimum one cover sheet with general notes, construction notes sheet, improvement design sheet(s) (one for each improvement), cross sections (every fifty feet (50') and appropriate detail sheets.

2.4.2 Expiration of Plan Set

The Public Improvement construction plans shall be valid for a period of one year from the date of acceptance by the City. If construction has not started at one year, the Developer may be notified to update and re-submit plans prior to any issuance of a Right of Way permit or Grading permit.

In case a Developer/Contractor unusually stops construction for a period of more than one year (after the commencement of construction), the City has the right to require the Developer/Contractor to ensure a safe site by adding traffic control, fencing and other such measures as required by the City. In order to re-start such a project, the Developer/Contractor shall meet with the Engineering Division and determine if a new Right of Way permit is required.

If the construction site transfers ownership, the new Owner/Developer will be required to meet all requirements for a new permit.

2.5 General Formatting & Required Information

The following information included in Table 2.2 is provided for the Designer when determining Plan format and design requirements. This information should be considered the minimum information to be provided.

Table 2.2: General Formatting & Required Information

Information Required	Description
Checklist	The City requires the review and use of the checklist of all plan requirements for the development of the plans. Refer to the Appendix A .
Size of Plan Sheets	All sheets in the construction plan set shall be scaled for 24-inch x 36-inch sheets unless requested from the City at 11" x 17". The text on the smaller plan set shall be readable.
Title Block	<p>A title block is required on every sheet and cover sheet submitted for review and acceptance. The title block shall be located in the extreme lower right-hand corner, the right-side margin or along the bottom edge of the sheet. The required information includes:</p> <ul style="list-style-type: none"> • The subdivision or project name and filing number or project number, if applicable. • Type of Improvements. • Designer's Name, address, email, and phone number. • Developer's name, Address, email, and phone number. Refer to the Unified Development. • Ordinance Administrative Manual) • Sheet Number (Consecutive, start with cover sheet).
Incomplete Plans	Incomplete plan submittals will not be reviewed but returned to the Applicant.
Stamped Plans & Designer Statement	All sheets shall include the Designer's signature, stamp and date and stamped and signed in accordance with the latest regulations established by the State of Colorado Board of Registration.

Scale	General <ul style="list-style-type: none"> Horizontal. 1 inch = 20, 30, 40 or 50 feet. Vertical. 1 inch = 5, 10 feet. Overall Plan. 1 inch = 100 feet. Cross Sections. Vertical exaggeration ratio shall be 5:1.
	Bar Scale <p>Show bar scale on each sheet.</p>
	Key Map <p>The key map should be at 1 inch = 1,000 feet.</p>
	Vicinity Map <p>The vicinity map should be at 1 inch = 1,000 – 1,500 feet.</p>
Dates	All sheets shall have dates shown in the Title Block for both Plan preparations and subsequent revisions. An electronic date shall appear on all electronic files to be submitted.
North Arrow	All design sheets shall have a north arrow oriented towards the top or right side of the applicable sheets
Background Facilities	Each sheet shall show all existing facilities in a ghosted or alternate line weight or type.
Private Improvements	Private Improvements, such as roadways, driveways, utilities, etc. shall be clearly shown and labeled as such on each sheet of the Construction Plans.
Legend of Symbols	Each sheet shall include a legend that identifies the symbols pertaining to the sheet.
Key Map	For plan sets that include three or more plan and profile sheets, each plan and profile sheet shall provide a key map showing the location of the improvements being detailed.

2.6 Sheet Title Names & Specific Requirements

This section outlines the minimum required information to be included on specific sheets of the Plan set. The following sheets are listed in the order they should appear in the Plan set. Some sections of the Plan set may have more than one sheet but should be labeled alike.

2.6.1 Cover Sheet

All sets of construction drawings shall include a cover sheet with the following information provided in Table 2.3:

Table 2.3: Cover Sheet Requirements

Information Required	Description
General Construction Notes	General Notes shall be shown on this sheet. They are listed in Appendix B .
Vicinity Map	<p>Information to Include The vicinity map shall show the location and name of all Arterial roadways within one mile of the proposed construction, and all other roadways within 1/2 mile of the proposed construction. The project area shall be indicated by shading. The vicinity map shall show all Arterial roadways and major drainage ways. Section, Township, and Range shall also be shown.</p> <p>Size Minimum size of vicinity map shall be 10 inches x 10 inches and to a scale.</p>
Designer/Owner Contacts	The name, address, and phone number of the Developer (owner) and Designer (Developer's engineer) shall be listed on the cover sheet.
Index	Each cover sheet shall include an index of all sheets within the Plan set.
Indemnification Statement	<p>The indemnification statement shall be shown on the cover sheet. Annotate the following on Cover Sheet only:</p> <p>These plans have been reviewed by the City for concept only. The review does not imply responsibility by the reviewing department, the Public Works Director, or the City for accuracy and correctness of the calculations. Furthermore, the review does not imply that quantities of items on the plans are the final quantities required. The review shall not be construed for any reason as acceptance of financial responsibility by the City for additional quantities of items shown that may be required during the construction phase.</p>
Preamble (Project Title)	<p>The project title and general location shall be shown in the top middle of the page. The title shall begin as follows and shall be in bold/large font:</p> <p>PUBLIC IMPROVEMENT CONSTRUCTION PLANS</p> <p>For <Name of Project> CITY OF NORTHGLENN, CO</p>

2.6.2 Construction Notes

Refer to **Appendix C** for standard construction notes that are to be included on each set of Public Improvements Construction plans.

2.6.3 Right-of-Way Grading & Erosion Control

The Plans sheet shall be drawn at a legible scale (1" = 10' to 1" = 50') which will clearly convey design and construction intent. Plan sheets shall display a legend of symbols as shown on Standard Drawings for Erosion Control. All erosion control devices (temporary and long term) shall be included, as well as revegetation methods with specific notes. Plan must show grades of all drainage facilities. All project limits shall be designated.

2.6.4 Utility Improvements

The Plans shall include Plan and Profile views for each utility proposed in the development or project as well any or all existing utilities. If two utilities cross within two vertical feet (2') of each other, the distance shall be noted on the plan.

Plan View

The plan view shall include, but not be limited to, the following:

- Stationing shall read in ascending order in the direction of the north arrow or to the right.
- Station and critical elevation (flowline, invert of pipe, etc.) of all existing and proposed utility or drainage structures. Location of utilities shall be identified with horizontal and vertical dimensions as measured from roadway centerline profile grade.
- Location of all manholes, valves, inlets, pump stations, PRVs or any other proposed appurtenances for the utilities.
- All utility easements shall be shown.
- Storm drainage flow direction arrows, particularly at intersections and all high and low points.
- Match lines, stations, and consecutive sheet numbers, beginning with cover sheet.
- Existing utilities and structures (shown as phantom lines), including, but not limited to:
 - Storm sewer and appurtenances.
 - Fence lines and gates.
 - Water lines and appurtenances.
 - Ditches or swales.
 - Electric lines and appurtenances.
 - Curbs and gutters.
 - Sewer lines and appurtenances.
 - Pavement limits.
 - Telephone lines and appurtenances.
 - Bridges or culverts.

- CATV lines and appurtenances.
- Gas lines and appurtenances.
- Easement.

Profile

All proposed utilities shall be shown on profile with conflicts noted.

Key Map

A key map is required highlighting the sheet being shown.

2.6.5 Street Improvements

The Plans shall include Plan and Profile views for each street proposed in the development. Cross-section sheets are required for all Arterial and some Collector roadways. Cross sections will be provided for every fifty feet (50'). In addition to the requirements set forth elsewhere in these STANDARDS AND SPECIFICATIONS, the following information shall be shown on all Roadway plans submitted for review and approval.

2.6.6 Street Improvements

The Plans shall include Plan and Profile views for each street proposed in the development. Cross-section sheets are required for all Arterial and some Collector roadways. Cross sections will be provided for every fifty feet (50'). In addition to the requirements set forth elsewhere in these STANDARDS AND SPECIFICATIONS, the following information shall be shown on all Roadway plans submitted for review and approval.

Plan View

The plan view shall include, but not be limited to, the following:

- Existing and proposed Property and/or Right of Way lines, easements, and/or tracts. Type and dimension of easement or tract is to be clearly labeled. Dimensions of property and right-of-way lines are to be marked.
- Survey lines and stationing lines shall normally be based on centerline of street; other profiles may be included but shall be referenced to centerline stationing. Stationing in cul-de-sacs shall be on the centerline to the center of the bulb with flowlines dimensioned within the bulb. Survey lines and stationing lines shall deviate from centerline of street to parallel the roadway for situations where two sides of a divided roadway are not parallel.
- Stationing shall read in ascending order in the direction of the north arrow or to the right.
- Roadways and Roadway names.
- Existing utilities and structures (shown as phantom lines), including, but not limited to:
 - Storm sewer and appurtenances.
 - Electric lines and appurtenances.
 - Fence lines and gates.
 - Curbs and gutters.
 - Water lines and appurtenances.
 - Sewer lines and appurtenances.
 - Ditches or swales.
 - Pavement limits.

- Telephone lines and appurtenances.
 - Bridges or culverts.
 - CATV lines and appurtenances.
 - Guardrails.
 - Signs.
 - Gas lines and appurtenances.
 - Limits of work.
 - Any easements.
- Station and critical elevation (flowline, invert of pipe, etc.) of all existing and proposed utility or drainage structures. Location of utilities shall be identified with horizontal and vertical dimensions as measured from roadway centerline profile grade.
- Storm drainage flow direction arrows, particularly at intersections and all high and low points.
- Match lines, stations, and consecutive sheet numbers, beginning with cover sheet.
- Station and elevation of all horizontal curves including PI's, PC's, PT's, etc.; high or low point and PI of all vertical curves; existing and proposed, centerline bearings, distances, and complete curve data.
- Curb return radii, existing and proposed. Stations and elevations of all curb returns; mid-point elevations and additional locations necessary, flowline-flowline intersection elevations, and percent of grade from the P.C.R. to flowline-flowline intersections of all crosspans.
- Mid-block handicap ramp locations at "T" intersections.
- Centerline stations of all proposed driveways and all intersecting roadways.
- Survey tie lines to section corners or quarter corners, consistent with that shown on the plat.
- Typical roadway cross-section for all roadways, existing or proposed, within and adjacent to the proposed development. These cross-sections shall appear on the detail sheet, or if no detail sheet has been used, the first sheet of the submittal showing roadway design.
- Intersections. Any roadway intersections shall include construction and lane details for the new construction and existing facilities for a minimum of 150 feet beyond the limits of construction.
- Basis of plan view and profile elevations shall be the same, i.e., flowline and flowline, top of curb and top of curb, etc.
- Cul-de-sacs. High point and grades shown with percent arrows at critical points (cross-slope and flow line).

Profile

Profiles shall include, but not be limited to, the following:

- All streets shall be designed to show profile of center line and flow lines. This requirement may be waived by the Engineering Division when profile grades exceed 1.0% for flow lines and standard cross sections and cross slopes are used. In such cases, additional vertical data may be required at intersections and on curves.
- Original ground (dashed) and design grade (heavy, solid). Both grades are to be plainly labeled for all centerline and flowline profiles.

- Design elevations shall be provided for the centerline and for curb and gutter flowlines. The basis of Record Drawing information shall be the same as the design and grade (flowline and centerline, etc.).
- Stationing shall be depicted as a continuous line for the entire portion of the Roadway shown in the plan view, with the centerline station of all proposed driveways and all intersecting roadways clearly labeled.
- All existing curbs, gutters, sidewalks, and pavement adjacent to the proposed design. The existing profile grades shall be measured by survey. Previously approved designs or Record Drawings are not an acceptable means of establishing existing grades.
- Existing and New Utilities. Elevation and location of all utilities in the immediate vicinity of the construction shall be shown on the plans.
- Station and elevation of all vertical grade breaks, existing (As-Built) and proposed.
- Distance and grade between Vertical PIs (curves).
- Vertical curves, when necessary, with VPI, VPC, and VPT, high or low point (if applicable) stations and elevations. All vertical curves shall be labeled with length of curve (L) and $K=L/A$ where A is the algebraic difference in slopes, in percent.
- Profiles for all curb returns (except medians).

Typical Street Section(s)

Provide any applicable horizontal or vertical dimensions, in addition to providing a section of all improvements within the Right of Way. A section should be provided for each roadway type planned within the project.

Cross-Sections

Roadway cross-sections shall be provided at intervals deemed necessary by the City to effectively evaluate connection with the existing facilities, (typically every 50 feet horizontally).

Cross-sections shall be required on arterials and any other roadways as deemed necessary by the Engineering Division. The cross-sections shall indicate:

- Profile grade design point (centerline, flowline, top of curb, lip of gutter, etc.).
- Roadway width.
- Right of Way.
- Pavement cross slope.
- Pavement thickness.
- Structural material components of the pavement, base, and subbase, together with specifications for treatment of subgrade and installation of pavement structural members.
- Tie in of proposed improvements with existing ground.

Key Map

Clearly depict each sheet's relative position compared to the overall project. The Roadway or area that the design pertains to will be shaded.

Minimum scale is 1 inch = 500 feet, showing the location and name of all roadways within and adjacent to the proposed construction and all future roadways. Scale should be indicated. The key map should be oriented consistent with detail in the sheet, i.e., same north.

2.6.7 Street Improvements Details

All pertinent details related to street improvements shall be shown on a detail sheet (or sheets) for the Project.

2.6.8 Traffic Signing & Pavement Markings

All permanent and temporary traffic signing, and pavement markings shall be shown on the signing and striping plan, with the existing and proposed street system used as the base layout. Locations of signs and pavement markings shall be indicated by station/offset, or other specific dimensions indicating exact locations. This sheet shall also contain any construction or application notes, (e.g., application temperatures, surface cleaning methods to be used prior to application, etc.).

Area Map

Separate signage and striping plans are to consist of an overall area map noting all specific use areas, such as schools, parks, recreation centers, library, commercial, industrial, etc.

Road Segment Pages

The pages following the area map are to be broken down into road segments, for notation of signage and striping details.

Signing Plan

The permanent signing plan should:

- Show the general longitudinal location of each sign (horizontal offset and station).
- Specify the sign legend and sign type (from MUTCD).
- Specify the sign size.
- Provide the construction drawing with installation dimensions (height, distance from curb, etc.).
- Detail post and base dimensions and installation plan (showing sleeves, depth below surface, and materials used, according to the standards in **Chapter 12 – Traffic Operation Devices**).
- Specify the blank gauge of the sign.
- Note the reflectorization provided.

Striping Plan

The striping plan must show:

- Color and type.

- Lane widths, taper lengths, storage lengths, etc.
- Striping/skip interval.
- Typical treatments for acceleration/deceleration lanes, turning lanes, and crosswalks.
- Type of material (epoxy, latex, thermoplastic).
- Station and offset or dimensions to all angle points, symbol locations, and line terminations.

2.6.9 Landscape/Revegetation Plan

Landscape Plan sheets shall show all Plan views and details necessary for construction. The Landscape/Revegetation Plan sheets shall include all existing and all proposed plantings, shrubbery, trees, and all irrigation systems and appurtenances.

All utilities shall be shown on the landscaping plans to ensure there are no conflicts.

Irrigation System. The construction plan set should include any planned irrigations systems. In addition to plan view, the details shall be shown as well as irrigation tap details.

If tree lawns exist between curb and detached sidewalk, the landscape treatments and plans shall be clearly delineated.

Chapter 3. PERMITS

3.1 General

This chapter pertains to Northglenn's Public Works permits required for any and all work in the City's public Rights-of-Way and any work affecting public infrastructure. All Contractors, public utility agencies and property owners installing public or private improvements, or storing materials or equipment, within any public Right of Way or easement must obtain the required permit(s) prior to the commencement of the work. The following are permits required prior to doing certain described activities in the public Right-of-Way. The Applicant/Contractor are responsible for obtaining the necessary permits prior to any work in the Right-of-Way.

3.1.1 Right-of-Way Permits

Work in Right of Way

All work in public Rights of Way and easements must be permitted in accordance with the criteria outlined here. It is unlawful for any person to perform work within a public way of the City of Northglenn without first obtaining a valid permit from the City.

Small Cell Antennas

If a small cell antenna is being installed, the Contractor shall submit plans for review and acceptance by the City of Northglenn Planning Department prior to applying for a Right-of-Way Permit for installation.

Grading Permits

Earthwork (excavation, grading, clearing, grubbing, or filling) on private or public property within the City of Northglenn is governed by the City. A permit is required for most earthwork construction on private property to ensure management of drainage from one property to the next as designed. Any grading project over one acre is required to apply for a grading permit. See **Chapter 6 – Grading and Erosion Control** for the requirements of the grading permit and policies. Grading Permits necessarily include a City accepted drainage report, City accepted construction plans for grading, erosion control and final seeding plans and traffic control plans.

Temporary Water Service Permit (Construction Meter)

To service construction projects requiring the use of water, the Engineering Division may issue temporary water service permits (for construction meters) to the Contractor for the use of City water. The Engineering Division will charge the Applicant/Contractor for the cost of water serviced based on the meter's reading and actual water used and a refundable deposit.

Overweight Permits

When an Applicant finds it necessary to haul overweight equipment or materials on State Highways or City streets an Overweight Permit is required. For overweight hauls on State Highways require a State Highway permit is approved through the Colorado Department of Transportation. For Overweight Permits for city streets, the Applicant/Contractor shall contact the Engineering Division. The Applicant/Contractor shall be prepared to provide the route, information regarding the load and size for the City. The City's roadway weight limits are provided in the City of Northglenn's Municipal Code

3.1.2 State & Federal Permits

The construction of public infrastructure and land development projects at times require permits from the State or Federal agencies. Including, but not limited to Construction Stormwater or Dewatering discharges, Stormwater Management plans (SWMP), Section 404 permits for impacts to wetlands or waterways and Air Emission Permit from

Colorado Department of Public Health and Environment, or other permits from the Colorado Department of Transportation. The Designer should anticipate discussions of these permit requirements in the Pre-Application Meeting to ensure compliance to the various State and Federal Agencies.

3.1.3 Other City Permits

This section does not address other City permits required such as Building permits, Special Use permits or Peddler's Licenses, etc. Those permits are addressed separately in the City's Municipal Code.

3.2 Application

Applications for any of these permits are available at the public counter of the City at the Maintenance & Operations Facility at 12301 Claude Court, Northglenn, CO 80241 or they can be obtained at www.northglenn.org/row. The application form must be completed and submitted to the office or through email (row@northglenn.org) along with the required items stated on the permit application. Email submittals are preferred. Refer to **Appendix E** for Right-of-Way permit checklist requirements. The Applicant may pay for the permit over the phone or in person at the City Maintenance and Operations Facility.

3.3 Review & Acceptance of Submittals

The application will be reviewed by the Engineering Division. If additional information is required, the Applicant will be contacted and required to supply the necessary information. In the review, the Engineering Division will ensure that the Applicant has provided the applicable bond, license, traffic control plans, construction plans and insurance documents. The Engineering Division will not review or process any incomplete applications for permits. The review of permits will require five (5) working days.

3.4 Issuance of a Permit

The Permit is issued to the Applicant after all fees have been collected and applications and other applicable documents are submitted, reviewed, and accepted. This permit issuance is only temporary in nature and any changes in schedule or work must be submitted in writing to the Engineering Division for review and acceptance for the permit to remain valid. The schedule changes or work changes may be submitted at row@northglenn.org. Work cannot proceed after expiration of permit without approval of the Engineering Division.

3.5 Plans

At times, the Engineering Division may require construction plans for the work included in permits issued by Public Works Department. Any plans required shall clearly indicate the proposed work and its location as well as standard information listed in **Chapter 2 - Submittal Requirements for Public Improvement Construction Plans**. All work within the City's travelled ways including utilities, roads, sidewalks, and bikeways, will require traffic control plans for review and acceptance.

3.6 Warranty & Guarantee

The City requires a two-year warranty on all work constructed in the public Rights of Way and easements. The Guarantee (surety, bond, or letter of credit) will be submitted for the entire construction period and the two-year Warranty Period. The Guarantee, if required, will remain in place for the construction of all Public Improvements. At Initial Acceptance, the Guarantee may be changed to a Warranty Guarantee.

All development projects shall be a letter of credit only. Bonds will not be accepted.

3.7 Permit Standards & Conditions

3.7.1 General Requirements

The Applicant shall be responsible for the following requirements which are relevant for the Project:

- **Approval of Permit.** Permits are issued subject to the approval/acceptance of the City, State, or other governmental agencies having either joint supervision over the section of road, or authority to regulate land use by means of zoning and/or building regulations.
- **Other Agency Approval.** Permit Applicants/Contractors are responsible for obtaining separate permits or permission as may be required. Examples may be when work is proposed within the state highway, railroad or irrigation company Rights of Way or private property. The Designer is responsible for coordinating with respective agency(ies) to ensure their standards and/or specifications are met.
- **Easements.** It shall be the Applicant's responsibility to obtain required Easements and approvals that may be required.
- **Submittals & Fees.** Applicant shall pay all required fees, provide insurance, guarantee (if required), and provide appropriate plans, if necessary.
- **Coordination of Utility Work.** The Applicant shall be responsible for coordinating any utility work including relocation of the utilities (e.g., power poles, transformers, signals, etc.).
- **Affected Area.** The Applicant is responsible for returning the areas affected by construction to equal or better condition. The Applicant is responsible for repairing any damage to private or public property or other adjacent Right-of-Way that occurs during construction.
- **Not Transferable.** The permit may not be transferable or assignable except as agreed to by the City. The Applicant may subcontract some of the work, however, the subcontractor must obtain their own Right-of-Way permit as well as provide their own insurance and bonding.
- **Supplemental Permit.** The Contractor must receive a subsequent approval from the Engineering Division for any work outside of the scope of the approved permit. It is the Applicant's responsibility to notify the Engineering Division of the changes (visit the City Maintenance and Operations Facility or row@northglenn.org). The Engineering Division will inform the Applicant whether they must apply for a supplemental permit or a new permit prior to undertaking the additional work. If the changes are significant, the Engineering Division may require additional payment on the existing permit for the additional work or require a new permit for the additional work.
- **Time for Approval & Issuance.** In general, the Engineering Division may require up to five (5) working days for approval of the permit after receipt of the complete application package. If a project is larger or more complex than typical such as a utility boring project or development projects, the Engineering Division may require additional review time.
- **Public Display.** All required permits and approved plans must be available on the job site at all times during construction and during placement of traffic control devices. Failure to comply with this provision shall be grounds for a revocation of the permit and the issuance of a stop work order.
- **Erosion Control Inspector.** The Engineering Division must be notified at least 24 hours prior to any planned placement of erosion control devices or construction. Refer to **Chapter 6 - Grading and Erosion Control**, for additional detail.

- **No Reimbursement of Fees.** In general, once the permit is approved and fees are collected, no permit fee will be reimbursed, even if the permit has expired before construction takes place.

3.7.2 Requirements to Preserve Infrastructure Quality & Traffic Flow

- **Traffic Control Plans.** A Traffic Control Plan (TCP) shall be submitted with the permit application for a proposed work for acceptance by the Engineering Division, if applicable. All plans, barricades, signs, traffic control devices shall be placed in accordance with MUTCD, Part VI and **Chapter 16 – Temporary Traffic Control**.

All work with traffic control in the field shall be performed by a certified Traffic Control Supervisor unless otherwise waived by the City in the application review process. The plan shall detail all devices, hours of work, days, dimensions of tapers and barricades, limits of work area, requirements of closure of lanes, roads, access points to commercial or residential properties. The City requires electronically generated plans for complex projects. For small projects, the Engineering Division would prefer electronically generated plans but if hand drawn, the plans must be legible and accurate.

- **Traffic Flow During Peak Hours.** No interference of traffic during peak hours will be accepted. Each permit will acknowledge hours in which the Contractor can work on a particular road or Right-of-Way. Unless acknowledged by the Engineering Division as an emergency, no traffic control can be on the Engineering Division roadways prior to 8:30 a.m. and after 3:30 p.m. unless otherwise stated on the permit.
- **Barricades, Warning Lights & Signal Lights.** Any person performing work in the public Right-of-Way shall place barricades, warning lights, and any other safety devices at the location sufficient to warn the public of the hazard and which are in compliance with the MUTCD. The Applicant/Contractor shall be responsible for the maintenance of all barricades and other safety devices at all times.
- Protection of Existing Improvements
 - *Existing Installations.* The Contractor shall take proper precautions and be responsible for the protection of existing street and alley surfaces, driveway culverts, street intersection culverts or aprons, irrigation systems, mailboxes, driveway approaches, curb, gutter, and sidewalks, and all other identifiable installations that may be encountered during the entire period of construction.
 - *Utilities.* The Contractor shall always take proper precautions for the protection of existing utilities, the presence of which are known or can be determined by field locations of the utility companies including traffic signals. The Contractor shall contact the UNCC (One Call) at 1-800-922-1987 for utility locates a minimum of two (2) working days prior to his proposed start of work. The Contractor may contact 811 to have locates marked for the project.
 - *Existing Improvements.* Existing improvements to adjacent property such as landscaping, fencing, utility services, signs, driveway surfaces, etc., that are not authorized for removal, shall be protected from injury or damage resulting from the Contractor's operations.
 - *Survey Markers.* The Contractor shall take proper precautions for the protection of any property pins/corners and survey control monuments encountered during construction. Any damaged or disturbed survey markers or pins shall be replaced by a registered land surveyor at the Contractor's expense.
 - *Responsibility for Repair.* The repair or replacement of any damaged improvements as described above shall be the responsibility of the permit holder.

- *Minimizing Inconvenience.* The Contractor shall abide by the requirements set forth by the permit to minimize inconvenience to traffic and any inconvenience to adjacent property owners.
 - *Adjacent Property Notification.* The Contractor may be required to notify adjacent residents and businesses if utilities or access to roadways are affected by construction.
- **Permanent Pavement Patches.** All permanent pavement patches and repairs shall be made with original type of existing materials. For example, concrete patches in concrete surfaces, full depth asphalt patches with full depth asphalt, concrete pavement with asphalt overlay patches will be expected in permanent “overlaid” concrete streets, etc. In no case is there to be an asphalt patch in concrete streets or concrete patch in asphalt streets. Any repair not meeting these requirements will be removed and replaced by the Contractor at their expense.
- **Backfill**
 - *FlowFill.* Use of flowfill or flash fill is to be used to backfill a trench at the discretion of the Engineering Division.
 - *Squeegee.* For a minimum of 12” above the pipe and bedding below the pipe; squeegee shall be used.
 - *Concrete.* The Engineering Division requires concrete around sewer tap. Refer to **Standard Drawing SS - 5**.
 - *Inspection.* The Engineering Division requires inspections of squeegee, flowfill, and preparation before patch. If any required inspection is not requested, the Engineering Division may require removal and replacement of any work to ensure work is inspected for quality and conformance to the STANDARDS AND SPECIFICATIONS.
- **Conformance to Standards.** All work is to be constructed in accordance with these STANDARDS AND SPECIFICATIONS.
- **Work to be Done in Expedient Manner.** All work shall be done in an expedient manner. Repairs shall be made as rapidly as is consistent with high quality workmanship and materials. Use of fast setting concrete and similar techniques may be required and are encouraged whenever possible without sacrificing the quality of repair. Completion of the work including replacement of pavement and cleanup shall be accomplished immediately after the repair work or activity involving the cut is done. Extension of time for completion requires written approval of the Engineering Division. If the repairs are not completed in the allotted time, the City has the right to repair the street and bill the full cost of work and administrative expenses to the Contractor. The City requires a reasonable continuous, diligent effort from the Contractor to complete work and daily cleanup. The Contractor shall have 48 hours to complete the patching of the street.
- **Inspection Requests.** It shall be the responsibility of the person performing the work authorized by the permit to notify the Engineering Division. The Engineering Division requires that every request for inspection be received at least 24 hours before such inspection is desired. Such requests may be in writing or by telephoning or emailing the Engineering Division.
- **Removal and Replacement of Unsatisfactory Work.** Removal and replacement of unsatisfactory work shall be completed within fifteen days of written notification of the deficiency unless deemed an emergency requiring immediate action. If deemed an emergency for health/safety reasons, the Contractor must complete the work immediately.

In the event the replacement work has not been completed, the Engineering Division will take action against the Contractor's surety or bond to cover all related costs. The Engineering Division may bill the Developer/Contractor for actual costs plus 15% administrative fee. If the Developer/Contractor does not pay for outstanding fees, the Engineering Department may notify the Guarantee holder that they may require the Guarantee to be paid out to the City.

- **Road Closures.** Road closures will require the written approval of the Engineering Division. Proper posting and public notification will be required seven (7) days in advance of any closure. Forms of notification may include door hangers, variable message signs and press releases.
- **Start Work Notification.** The Contractor shall notify the Engineering Division of their planned start of work at least twenty-four (24) hours in advance of the work.
- **Cold Patch or Metal Plate.** After construction work is completed for the day but the project is not finished, the Contractor shall backfill base material and cover their excavation with cold patch or a metal plate with cold patched edges at the discretion of the Engineering Division. To use a metal plate, the Applicant/Contractor is required to have prior approval on the permit. Generally, the Engineering Division does not approve metal plates between October and April due to snow removal. Cold mix may be used for temporary use only and be in place no longer than one week.

If the Contractor does not replace the cold mix within a week or outstanding work remains, the Engineering Division may restrict the Contractor's ability to receive any new permits unless this work is appropriately completed or request payment through the Contractor's surety.

- **Non-Emergency Holiday, Weekend or After-Hours Work.** If a Contractor would like to work on holidays, weekends or after hours, they must request that work through the city website online request form. The Contractor shall make the request at least one week prior to the requested work dates.

3.8 Stop Work Orders

Any person, corporation, quasi-governmental agency, special district, public utility, or private utility company that has performed work without first having obtained a permit or has performed work in the Right-of-Way that is considered a safety hazard or has non-conforming items that have not been addressed will be issued a notice to stop work. All specified work shall be discontinued until such time that the appropriate repair or permits are in place. The Engineering Division or Inspector is authorized to issue Stop Work Orders. The stop work order shall contain a written statement of the violations that caused the issuance. Immediately upon receipt of a stop work order, the Applicant shall consult with the Engineering Division to resolve the violations. If weekend work due to emergency occurs, the Contractor shall forward pictures to the Engineering Division and notify the Engineering Division Inspector.

3.8.1 Stop Work Fines

Any Applicant who does not immediately discontinue work upon issuance of a stop work order shall be subject to fines. The Applicant may be fined up to \$1,000 per day in accordance with City code requirements.

3.8.2 Typical Reasons for Stop Work Order

Any permit may be revoked or suspended by the Engineering Division for the following typical reasons:

- Violations of any condition of Public Improvements Agreement or of the approved construction drawings or specifications; or
- Violation of any provision of these STANDARDS AND SPECIFICATIONS; or

- Violation of any other ordinance of the City, state law or federal law pertaining to the work; or
- Existence of any condition or the occurrence of any act which may constitute or cause a condition endangering health, life safety or serious damage to property.
- No Right-of-Way Permit or Failure comply with Permit.

3.8.3 Immediate Effects of Stop Work Order

A suspension or revocation by the City and stop work orders shall take effect immediately upon notice to the person performing the work in the field and shall remain in effect until such time as the City cancels the order in writing. A failure to abide by the terms of the suspension or revocation will be considered a violation of the Municipal Code.

Upon receipt of a stop work order, the Contractor shall be responsible for taking such precautions as may be necessary to prevent damage to the project, prevent inconvenience or hazardous conditions for the general public, provide for normal drainage and to erect any necessary barricades, signs or other facilities which may be necessary or directed by the Engineering Division.

3.8.4 Mitigation Expenses

In cases where the Engineering Division deems it necessary to affect a remedial action or repair to mitigate any dangerous or unsafe circumstances, due to emergencies or untimely performance by the Applicant, the Engineering Division may bill the Applicant for any of its costs. Untimely performance occurs when the Contractor has not performed the remedy within twenty-four (24) hours of notification. Emergency repairs are expected to be implemented immediately.

Costs for Repairs

Mitigation repair costs shall include, but not be limited to the following:

- Administrative charge.
- All labor costs (at City rates).
- All material costs.
- All equipment costs.

Stoppage of Work

Once a Stop Work Order has been issued, no specified work may continue under the permit and no subsequent permits will be issued until the Engineering Division receives full payment for permit, City incurred expenses and/or poor workmanship or safety issues have been resolved.

3.9 Insurance Requirements

The insurance requirements are intended to protect the public, as well as the Contractor who is providing any construction services in the public Right-of-Way.

3.9.1 Listing of Specific Requirements

The Applicant is responsible to provide insurance prior to the issuance of the permit in accordance with the following requirements:

- The Applicant and/or the Applicant's Contractor shall present proof of carrying a liability and property damage insurance policy or policies known as Commercial General Liability, for the period of time required for complete installation of facilities authorized by the permit, including the repair and restoration of the road facilities, and also, during such future periods of time when operations are performed involving the repair, relocation or removal of said facilities authorized by the permit. Coverage shall be provided against any claim, demand, suit, or action for the property damage, personal injury, or death resulting from any activities of the applicant, his officers, employees, agents, or contractors in connection with the construction, installation, repair or removal of the said facilities authorized by the permit.
- The policy shall include as named insured: The City, Engineering Division, Risk Management, its officers, agents and employees, except as to claims against the applicant, for personal injury to any members of the Council, its officers, agents and employees, or damage to any of its or their property. The said insurance shall provide coverage of property damage insurance, public liability insurance, and bodily injury insurance in the amount of not less than \$1,000,000 each, or such other maximum amount as may be specified in the Colorado Governmental Immunity Act and protecting the City against any and all claims for damages to persons or property resulting from construction and/or installation of any required improvements pursuant to the permit.
- The policy will provide that the City shall be notified at least 30 days in advance of any reduction in coverage, termination, or cancellation of the policies. Such notice shall be sent to the Engineering Division by certified mail, return receipt requested.
- The Applicant shall also obtain and keep in force during the duration of all work covered under the permit a policy of Automobile Liability insurance with similar terms as mentioned above. This policy shall insure the Applicant against any liability for personal injury, bodily injury or death arising from the use of motor vehicles and shall cover operations on or off the site of all motor vehicles controlled by the Applicant.
- All Contractors shall have proof of workman's compensation on the Certificate of Insurance.

3.10 Contractor License

The Engineering Division requires the contractors who plan to work in the City's Right-of-Way to have a Contractor license with the City. Refer to the City's Municipal Code for these requirements. The Contractor licenses shall take up to ten (10) days to process. During the licensing process, the Engineering Division may require proof of work experience in the area of contracting that they are requesting on the license application. Additionally, the Engineering Division may require experience, references, or resumes as well.

3.11 Right-of-Way Permit

3.11.1 Uses for Right-of-Way Permit

A Right-of-Way Permit is required prior to beginning any repair or modification of existing public infrastructure or private improvements within the public Right-of-Way. It is also used to authorize the construction of minor public or private improvements that do not require a separate review and acceptance of public improvement construction plans, but instead is shown on an approved site plan. The Right-of-Way permit also applies to three additional types of work:

Storage of Materials & Equipment in the Right-of-Way

A Right-of-Way Permit shall be required for the storage of materials and equipment (roll off or construction trailer) within the public Right-of-Way adjacent to a work site. This also includes borrow pits and fill material stockpiles.

Excavation in the Right-of-Way

A Right-of-Way permit shall be required for all excavation performed within the public Right-of-Way.

Aerial Work

A Right-of-Way permit shall be required for all aerial work in the Right-of-Way such as small cell antennas.

3.11.2 Application

The permit application and application information are available at the public counter in the City's Maintenance and Operations Building or online at www.Northglenn.org/row. See Appendix for application and permit example.

3.11.3 Submittal Requirements

The information included in Table 3.1 describes the submittal requirements for a right-of-way permit.

Table 3.1: Submittal Requirements

Submittal Requirement	Description
Plans	Plans that clearly show the proposed work must be included with the permit application. The plans must be drawn to a proper scale to show the location and position of the proposed work, including street Right-of-Way (features, names, dimensions, and property lines), existing utilities, topographic and man-made features, existing drainage patterns and any other information needed to clearly present the proposed work. The plans shall show any pothole locations and bore depths. Any plans that propose changes in the original design, other than constructing improvements in accordance with standard construction drawings, are required to be prepared by a Professional Engineer and conform to the requirements of Chapter 2 - Submittal Requirements for Public Improvement Construction Plans of these Standards.
Small Project Repair	Professional Engineer stamped plans may not be required for small projects at the Engineering Division's discretion.
Right-of-Way Permit Requirements	When a Right-of-Way Permit is required, it has to be issued before any work can occur on the Grading Permit.
Subsurface Utility Engineering (SUE)	For all projects requiring a Professional Engineering stamp, the project shall include the investigation and depiction of existing underground facilities that meet or exceed the ASCE 38 Standard. If the project has the following: 1) Construction Contract with a public entity; 2) involves primarily horizontal construction and does not involve buildings; and 3) project anticipates excavation footprint that exceeds two feet in depth and is contiguous for 1,000 feet or involves utility boring then the utility owner shall respond in ten days providing location of utility.
Work Area Traffic Control Plan	A work area traffic control plan shall be submitted with application for work within, or any access to, a public Right-of-Way. The traffic control plan shall be a minimum of 8-1/2 x 11 inches. The plan shall detail the work zone location, dimensions and the traffic control devices (including dimensions of tapers, closure area, etc.) proposed as well as construction traffic routing requirements. The plan may require additional detail at the discretion of the Engineering Division due to unique or unusual conditions. Refer to Chapter 16- Temporary Traffic Control Devices .

Submittal Requirement	Description
Proposed Project Schedule	A time schedule stating the desired time when the work will commence, be performed, and be completed shall be submitted. The Contractor schedule shall be updated with the Engineering Division if conditions change due to weather or unforeseen conditions. Updates shall be completed before the end of permit (48 hours) or Applicant shall apply for a new permit and fee. The updated schedule should be sent to the Engineering Division email (row@northglenn.org).
Project Quantities & Estimates	An estimate of quantities and costs for all public improvements as well as private improvements that are required to be inspected by the Engineering Division in accordance with Public Improvements Cost Estimate shall be submitted. These costs are used in the determination of permit fees that are based on the cost of the improvements.
Certificates of Insurance	Certificates of insurance for commercial general liability, workers compensation and automobile liability shall be submitted with the application.
Hours of Construction	The standard hours of inspection are 8:30 a.m. to 3:30 p.m. Construction work hours will be limited on the permit. Depending on the location of the work on the permit, the Engineering Division may require different working hours for the completion of the permitted work.
General Conditions	The construction shall be done in accordance with these Standards and the General Notes in Appendix B.
Backfilled Trenches	All street excavations must be backfilled with base material if work is not complete or flowfill (if work is completed) prior to leaving the site at the end of the workday. The Contractor may use cold patch as a temporary measure when returning the next day to complete the work.
Safety of Work	All work within the permit shall be completed in a safe manner for workers and travelling public.
Inspection of Work	The Engineering Division shall inspect and accept or reject all aspects of the work performed.
Warranty Inspection	The work is ready for inspection and the second inspection will be made 30 days prior to the expiration of the two-year warranty period. At any time prior to completion of the two-year warranty period, the Engineering Division may notify the permittee of any needed repairs. Such repairs shall be completed within twenty-four (24) hours if the defects are determined by the Engineering Division to be an imminent danger to the public health, safety and welfare. Non-emergency repairs shall be completed within ten (10) days after notice.
Approval & Expiration	A minimum of five (5) working days is required for the Engineering Division's approval for projects with no excavation; five (5) days for work with excavation; and ten (10) days for utility boring projects. The permit expires 15 days from date of approval unless otherwise stated on the permit.
Guarantee	All Contractors will provide a guarantee for actual costs of construction in cash, letter of credit or bond. This guarantee shall remain in place until the end of Warranty Period. Refer to Chapter 4 -

Submittal Requirement	Description
	Public Infrastructure Acceptance Procedures & Warranty Requirements for warranty and final acceptance requirements.
Suspension of Contract Work	If a contractor does not complete the work, repair warranty items, or in other ways does not repair or replace work that is deficient, they will be suspended from working on any other projects in the City's Rights of Way until such time as the work is completed or replaced to the satisfaction of the Engineering Division.
Extension of Work	The Engineering Division may allow for up to 30 days of extension on the permit when requested in writing.

3.12 Grading Permit

- The fee for this permit shall be as established by the Municipal Code.
- The grading permit is required for any Contractor to begin overlot grading, excavation, clearing and grubbing within a particular development or project before the Development Agreement is executed and good and sufficient surety is provided to the Engineering Division regardless of whether a Right-of-Way permit is required.
- It should be noted that the Engineering Division is under no obligation to issue a Grading permit prior to the execution of the Development agreement or prior to any other agreement. However, if the Engineering Division has approved the Development Plan, completed at least one review of the construction drawing package, and believes that the necessary revisions to that package are minor and that the review process is progressing in an acceptable manner, the Engineering Division may issue a grading permit.
- In addition, the Owner/Developer will be required to sign a letter acknowledging that he is doing the grading, excavating and/or clearing and grubbing at their own risk, and that any subsequent changes to that grading that may be required as a result of additional review comments will be their sole responsibility. Prior to the issuance of a grading permit, all provisions of these STANDARDS AND SPECIFICATIONS shall be complied with. Refer to **Chapter 6 – Earthwork & Erosion Control** for the requirements for grading.
- The requirements for grading permit must meet the requirements of the building code as well as **Chapter 6 – Earthwork & Erosion Control** of these STANDARDS AND SPECIFICATIONS.

3.13 Temporary Water Service (Construction Meter)

- All water used in the Engineering Division for construction purposes is to be metered and charged to the user.
- The application for temporary water service shall be made to the Engineering Division.
- The application and fee for each temporary meter shall be in accordance with the Municipal Code.
- A deposit must be made to the Engineering Division when the application is made. The deposit will be refunded to the applicant, less water usage charges and any consequential damages to the City provided

equipment once certification of water usage has been made. In such cases where water usage charges and equipment damages exceed the deposited amount, additional charges will be billed to the applicant.

- Water usage rates are established by the Municipal Code. In the event a water metering device cannot be provided to the applicant by the City other means will be established by the Engineering Division to estimate water usage.
- Any damage to the street or surrounding area because of the water location shall be brought up to condition prior to use.
- Construction meters not returned or damaged in possession of the Contractor shall cause the Engineering Division to keep the construction meter security deposit.

Chapter 4. PUBLIC INFRASTRUCTURE ACCEPTANCE PROCEDURES & WARRANTY REQUIREMENTS

4.1 Applicability

Before the City will assume ownership and maintenance responsibility for newly constructed public improvements, the public improvements shall be formally accepted by the Engineering Division. The Developer (Development Projects) and/or the Contractor (Capital Improvement Projects) is responsible for the proper installation of all improvements.

Failure by the City's representatives to detect improper installations or defects during the construction of improvements or during subsequent inspections does not relieve the Developer or Contractor of the responsibility to correct such defects at a later date. There shall be no partial acceptances of public improvements within new developments. The Developer and/or Contractor is fully responsible for maintenance and operation of any constructed public facilities until such time as the City formally accepts the public improvements. The Developer and/or Contractor is responsible for a two-year warranty of the public improvements constructed. The two-year warranty starts with Initial Acceptance.

4.1.1 Acceptance Process for Public Improvements

The Developer/Contractor shall be required to meet the following process prior to the City's final acceptance of the public improvements and any operations or maintenance.

Completion of Work

Completion of all Public Improvements required in the Public Improvements Construction Plans, Specifications and Agreements in accordance with these STANDARDS AND SPECIFICATIONS. The Engineering Division shall approve plans in accordance with the checklist in **Appendix A**.

Written Request

The Developer and/or Contractor shall notify the City Engineering Division, in writing, of the completion of the Public Infrastructure for the specific Project. The Developer/Contractor shall only make this request after all work is completed on the Project. If the work is not completed when request is submitted, the City shall reject the request for acceptance until all work is completed.

Inspection & Creation of Deficiencies List

Water, sewer and storm drainage utilities shall be inspected throughout installation and upon completion of installation and prior to paving operations, a deficiencies list shall be generated stating all discrepancies that relate to water, storm drainage and sewer utilities. After the completion of the utilities punch list and the remaining improvements can be completed.

Once a written request for acceptance, the certification of storm drainage detention and record drawings have been received, the Engineering Division will instruct the Engineering Construction Inspector to schedule an inspection of all required improvements. The Developer/Contractor will be invited to accompany the City's representative on all such inspections. The construction of public improvements will be inspected for conformance with the approved Public Improvement Construction plans, the Official Development Plan (if applicable), the Public Improvements Agreement (if applicable), Project specifications, these STANDARDS AND SPECIFICATIONS and Municipal Code. If, due to excessive dirt or snow on streets, poor weather conditions, inaccessibility, or other reasons the inspection cannot be performed, the Developer/Contractor will be notified of the need to postpone these activities until the cause of the delay can be

rectified. Deficiencies noted during the inspection will be compiled in a corrections list to be emailed or mailed to the Developer and/or Contractor for repair, replacement, or correction.

Correction of Deficiencies

Deficiencies list items shall be corrected within sixty (60) days of the date this list is sent to the Developer/Contractor. If all noted deficiencies are not corrected within this time, the public improvements may be re-inspected, and any new defects may be added to the deficiencies list. Public improvements will not be accepted until all noted deficiencies are corrected within the proper time frame. The Engineering Construction Inspector shall be notified before any corrective work commences and immediately upon the completion of the repairs.

Record Drawings

A complete set of “as-constructed” drawings of the public improvements shall accompany the request for acceptance. Upon acceptance by the City, the Developer/Designer will be required to submit a certified set of electronic “as-constructed” drawings on a thumb drive or through email. The submittal shall include a PDF set and AutoCAD .dwg files. These drawings shall be prepared on twenty-four-inch by thirty-six-inch (24" x 36") sheets, and lettering should be no smaller than one-eighth inch (1/8"). The City may request printed drawings at 11" x 17". The text must be readable. At a minimum, Record Drawings shall indicate the horizontal or vertical layout of all underground water, sanitary sewer, and storm drainage facilities (including distances between valves, fittings, manholes, etc.), profiles of streets, sanitary sewer mains and storm drainage mains, details of special or unusual installations and detention pond volumes. The Designer shall GPS all points including Manholes, Valves, inlets, and other pertinent infrastructure and provide the GPS data on Record drawings. If significant corrections to the improvements are noted during the acceptance inspection, the Record Drawings may be returned to the Developer or Designer for revisions. The final submittal of Record Drawings shall have each sheet of the signed and sealed by the Professional Engineer registered in the State of Colorado who is responsible for the preparation of the Record Drawings.

Certification of Storm Drainage Detention

A land surveyor registered in the State of Colorado shall affirm the as-built detention pond volumes and surface areas at the design depths, outlet structure sizes and elevations, storm drainage sizes and invert elevations at inlets, manholes, discharge location, representative open channel cross-sections and dimensions of all the drainage structures. Refer to **Appendix D** for the Certification form.

All storm detention and all permanent stormwater quality Control Measures (BMP's) facilities must be certified after final landscaping is implemented. This certification is required before a certificate of occupancy will be issued for any private development or redevelopment, or prior to final payment on any public improvement project. A Colorado licensed Professional Engineer shall certify the following:

- The detention pond and all permanent stormwater quality Control Measures (BMP's) are built according to the approved plans and specifications.
- The required detention volume, including the WQCV, when used, are met by the completed facilities.
- The surveyed elevations of critical design components, including inverts, of outlet structures geometry, overflow spillways or weirs and freeboard reflect the final constructed values, the finished pond depths, storage volumes and release rates are in substantial conformance with the approved design, and actual release rates conform to applicable regulatory agency rules and regulations and section 37-92-602(8), Colorado Revised Statutes (C.R.S.). - The certification shall include a copy of the City's plan acceptance letter to assist City staff in their review of the certificate. Detention ponds used as sedimentation basins through a phased construction development shall also be required to have the detention facilities recertified prior to each phase of the development's final certificate of occupancy.

The following note shall appear next to each detention pond plan and permanent stormwater quality BMP on the construction drawings:

"The developer shall have a licensed Professional Engineer certify each stormwater detention pond and/or water quality Control Measure is built according to the approved plans and specifications and the required detention volume, including the WQCV when used, is met. The certification shall also verify all pertinent dimensions, elevations, required outlet orifice plates for detention and WQCV and other permanent Control Measure requirements are installed per the approved plans and specifications, and shall show the as-built volumes for the 100-year and 10-year storm events, and for the WQCV and other pertinent dimensions, elevations and capacity requirements associated with the water quality control measure used. The certification shall be provided to the City of Northglenn before a certificate of occupancy will be issued, or before final payment on public improvement projects."

- **Registered Professional Engineer.** The responsible Designer shall state that "I have inspected the drainage facilities and to the best of my knowledge, belief and opinion, the drainage facilities were constructed in accordance with the design intent of the approved drainage report and construction drawings."

Written Notice of Initial Acceptance

Upon the completion of all items on the Deficiencies list and payment of all outstanding fees, reimbursements and other items owed to the City, the Engineering Division will issue a written Initial Acceptance of the Public Improvements and start the Warranty Period.

Warranty Period

The Developer/Contractor shall post a warranty surety for the two-year warranty period prior to the issuance of the Initial Acceptance Letter.

Inspection Prior to End of Warranty Period

After the Developer/Contractor has submitted a written request for final acceptance. A new deficiency list shall be developed and provided to the Developer/Contractor for appropriate replacement or repair.

Written Notification of Release and Final Acceptance

When the Warranty Period is completed and all defects in workmanship or material is completed, the City will issue a Final Acceptance Letter to the Developer or Contractor.

Release of Surety and Contractor Responsibilities

With the completion of all deficiency lists, appropriate notifications and inspections, the surety will be released signifying all responsibility of the Developer/Contractor for repairs and maintenance is completed.

4.1.2 Initial Acceptance

Recommendation for Initial Acceptance

The Engineering Construction Inspector shall recommend granting or denial of Initial Acceptance based on re-inspection for compliance to the written deficiency list, previously provided to the Developer/Contractor.

Initial Acceptance Letter

The Engineering Division shall issue a letter to the Developer/Contractor within ten (10) days of acceptance re-inspection. The Initial Acceptance Letter shall specify the date on which the Contractor is eligible to request Final Acceptance. The City will not release building permits until the Developer/Contractor has achieved Initial Acceptance.

Adjustment of Collateral

Upon written notification of Initial Acceptance, the collateral for Public Improvements in Development projects may be reduced to the percentage required by the City during the warranty period of the total required collateral for the project as defined in **Chapter 3 - Permits**.

Adjustment of Retainage for Contractor

Upon written notification of Substantial Completion, the retainage for the Capital Improvement Project may be reduced to the percentage acceptable to the City and in accordance with the specific contract.

4.1.3 Warranty Period

Duration

All public improvements shall be subject to a warranty period of at least two (2) years after the date of the letter of Initial Acceptance (Substantial Completion) from the Engineering Division. It starts at Initial Acceptance and ends with the Final Acceptance of the Public Improvements. If the Developer/Contractor requests and is granted an extension to repair deficiencies, the surety and deficiencies list will remain in place for that additional period of time.

Maintenance Responsibility

The Developer/Contractor shall be responsible for the maintenance of all public improvements during the warranty period. The Engineering Division will notify the Developer/Contractor of any maintenance that may be necessary during this time. Routine maintenance normally performed by the Developer/Contractor includes, but shall not be limited to, the cleaning of streets, patching of potholes and removal of blockages from water, storm, and sanitary sewer facilities. The cost of any routine maintenance not performed by the Developer that must be performed by the City will be billed to the Developer at cost plus fifteen percent (15%). If the Developer does not pay for these costs in sixty (60) days, the City may pull the surety to recover costs.

Emergency Repairs

In the event of a water main break, sanitary sewer main blockage, street or bridge failure, or other emergency that may occur during the warranty period, it may become necessary for the City to undertake immediate repairs to the facilities and/or make the area safe to residents, pedestrians, or motorists. The City will attempt to contact the Developer or Contractor in the event of such emergency. However, if the Developer or his representative cannot be contacted quickly or if the Developer or Contractor is unable to take immediate action to relieve the urgent situation, the City may proceed with such action as deemed necessary by the Engineering Division, and the Developer/Contractor will be billed for all costs of these actions at cost plus fifteen percent (15%).

4.1.4 Final Acceptance of Public Improvements

Preparation of Corrections List

At approximately one (1) year and nine (9) months into the warranty period, the Engineering Construction Inspector will schedule and perform an inspection of the public improvements within the development/Capital Project limits. The Developer or his representative and/or Contractor will be invited to accompany the City's representative on all such inspections. The City shall develop the punch list of repairs and deficiencies and deliver to the Developer and/or Contractor. The City will provide an opportunity for an optional meeting to discuss issues. The condition of the public improvements will be inspected for conformance with the accepted plans, the Official Development Plan (if applicable), the Public Improvements Agreement (if applicable), these STANDARDS AND SPECIFICATIONS and Municipal Code. If due to excessive dirt or snow on streets, poor weather conditions, inaccessibility, or other reasons the inspection cannot be performed, the Developer/Contractor will be notified of the need to postpone these activities until the cause of the delay can be rectified. Deficiencies noted during the warranty inspection will be compiled in a corrections list to be emailed to the Developer/Contractor.

Correction of Deficiencies

Warranty correction list items should be corrected within two (2) months of the date of the warranty correction list, unless authorized by the Engineering Division and all corrections must be completed no later than ten (10) working days prior to the scheduled end of the warranty period. If all of the noted deficiencies are not corrected within this time, the public improvements may be re-inspected, a revised correction list may be issued, and the end of the warranty period may be adjusted at the discretion of the Engineering Division to allow ample time for the completion of the corrections. The end of the warranty period will not be acknowledged until all noted deficiencies are corrected within the proper time frame. The appropriate Engineering Construction Inspector shall be notified before any corrective work commences and immediately upon the completion of the repairs.

Written Acknowledgment of End of Warranty

Upon completion of the correction of all deficiencies noted in the warranty correction list, the Engineering Division will issue a written acknowledgment of the end of the warranty period for the public improvements. Surety or Warranty Bond for public improvements may be released in its entirety at this time.

4.2 Acceptance/Warranty Inspection Criteria

4.2.1 General

All public and private improvements shall be installed in conformance with the approved Public Improvements Construction plans, the Official Development Plan (if applicable), the Public Improvements Agreement (if applicable), construction agreement (if applicable), and these STANDARDS AND SPECIFICATIONS. The Engineering Division shall be the final authority in the determination of defects and required corrections to public and private improvements. The following lists of items is not necessarily the entire list of items to be checked in the inspection process.

Grading & Seeding

Finished grades shall be in conformance with the approved plans and the Official Development Plan. Detention pond grading shall provide, at a minimum, the required volume as defined in the approved final drainage study. Unless otherwise approved, no slopes shall exceed a grade of four (horizontal) to one (vertical) (4:1). Approved seed mix shall be applied (unless other landscape improvement materials are approved) and grass shall be established in conformance with **Chapter 6 – Earthwork & Erosion Control** and **Chapter 17– Revegetation & Seeding** of these STANDARDS AND SPECIFICATIONS.

Water Systems

The required inspection and testing of water mains and appurtenances that shall be performed before systems can be released for service is outlined in **Chapter 8 – Water System** of these STANDARDS AND SPECIFICATIONS. At the time of acceptance and warranty inspections of all public and private improvements, additional aspects of water system construction that shall be inspected include, but shall not be limited to, the following:

- **Water Appurtenances.** All valves, blow-off installations and fire hydrants shall be operable.
- **Valve Box Risers.** Valve box risers shall be vertical and shall be adjusted to within one-eighth inch (1/8") below grade in paved areas or one inch (1") above grade in landscaped areas.
- **Valve Operating Nuts.** Valve operating nuts shall be accessible with a six-foot (6') valve key with between eighteen inches (18") and four feet (4') of clearance between the handle of the key and finished grade.
- Fire hydrants shall be vertical and shall be adjusted to a minimum of eighteen inches (18") from the center of the nozzle to finished grade.

- A minimum of five feet (5') of clearance for operation shall be provided around all fire hydrants and water valve risers.
- Manhole rims and covers for water valve vaults shall be adjusted to within one-eighth inch (1/8") below grade in paved areas or one inch (1") above grade in landscaped areas.
- The construction and operation of any required pumping systems shall be in conformance with the specifications issued and approved for that specific installation.
- All mains and manholes shall be free of construction debris, dirt, trash, and other foreign material.

Sanitary Sewer System

The required inspection and testing of sanitary sewer mains and appurtenances that shall be performed before systems can be released is outlined in **Chapter 7– Sanitary Sewer System** of these STANDARDS AND SPECIFICATIONS. At the time of acceptance and warranty inspections of all public improvements, additional aspects of sanitary sewer system construction that shall be inspected include, but shall not be limited to, the following:

- All mains and manholes shall be free of construction debris, dirt, trash, and other foreign material.
- The Contactor's TV inspection of all sanitary sewer mains shall be completed prior to the acceptance of public and private improvements.
- Manhole rims and covers shall be adjusted to within one-eighth inch (1/8") below grade in paved areas or one inch (1") above grade in landscaped areas.
- Manhole steps shall be properly spaced and aligned.
- The construction and operation of any required sewage lift systems shall be in conformance with the specifications issued and approved for that specific installation.

Storm Drainage System

The required inspection and testing of storm drainage mains and appurtenances that shall be performed are outlined in **Chapter 9 – Storm Drainage & Other Concrete Facilities** of these STANDARDS AND SPECIFICATIONS. At the times of acceptance and warranty inspections of all public improvements, additional aspects of storm drainage system construction that shall be inspected include, but shall not be limited to, the following:

- All pipes and manholes shall be free of construction debris, dirt, trash, and other foreign material.
- The Contractor's video inspection of all storm drainage mains shall be completed prior to the acceptance of public and private improvements.
- Manhole rims and covers shall be adjusted to within one-fourth inch (1/4") below grade in paved areas or one inch (1") above grade in landscaped areas.
- Manhole steps shall be properly spaced and aligned.
- Inlets shall be properly aligned to within one-eighth inch (1/8") below grade next to sidewalk or curb and gutter.

Concrete

The required inspection and testing of concrete that shall be performed are outlined in **Chapter 15– Street Construction Standards** of these STANDARDS AND SPECIFICATIONS. At the time of acceptance and warranty inspection of all public improvements the aspects of concrete construction that shall be inspected include, but shall not be limited to the following:

- Breakage or cracking greater than 1/32” at other than construction joints.
- Ponding of any size.
- Settlement affecting drainage, pedestrian, or traffic safety.
- Surface spalling or deterioration.
- Longitudinal cracking

Roadway

The required inspection and testing of roadways that shall be performed are outlined in **Chapter 15 – Street Construction Standards** of these STANDARDS AND SPECIFICATIONS. At the time of acceptance and warranty inspection of all public improvements, the aspects of roadway construction that shall be inspected include, but shall not be limited to, the following:

- Breakage or cracking greater than 1/8”
- Ponding of any size
- Settlement affecting drainage, pedestrian or traffic safety
- Surface segregation of fines or aggregate
- Hazardous conditions
- Alligatoring
- Improper grade or inverted crown

Chapter 5. DESIGN REPORT REQUIREMENTS

5.1 General

The purpose of this chapter is to provide the requirements for all reports required through the plan review process for new developments or as required in capital project processes. This chapter includes Geotechnical reports, traffic reports, utility reports including sanitary sewer and water, storm drainage report, pavement design, and pavement evaluation.

5.2 Geotechnical Report

Geotechnical report content may vary by project size and producing agency, but all geotechnical reports should contain certain basic information including summary of all subsurface exploration data, interpretation, and analysis of the subsurface, specific engineering recommendations for design, and discussion for solution of anticipated problems. Specifics and details outlined in following chapter.

5.2.1 Basic Report Requirements

A geotechnical report shall be submitted with the preliminary plat in the development process (for any project over 10,000 s.f.) or submitted with preliminary design plans for capital projects. The report shall show results from all required testing in the appendices. The report shall also include a description of site characteristics, e.g., topography, drainage features, etc.

5.2.2 Detailed Report Requirements

In addition to the basic report requirements, each soils report shall include the following items:

List of Required Items:

- Site location and description
- Laboratory test reports with evaluations
 - a) Visual classification
 - b) Liquid limit - AASHTO T89 or ASTM D4318
 - c) Plastic limit - AASHTO T90 or ASTM D4318
 - d) In-situ moisture content
 - e) Percent passing No. 200 sieve - AASHTO T11 or ASTM C117-90
 - f) Gradation of granular (sand & gravel) materials - AASHTO T27, ASTM D422 or ASTM C136
 - g) AASHTO classification and group index - AASHTO M145
 - h) Standard Penetrations Test
 - i) Swell Evaluation
- Boring logs.

- Soil and groundwater conditions. The expected seasonal elevation variation shall be summarized.
- Depth to bedrock. To indicate shallow bedrock. Include mitigation requirements if bedrock is within three feet.
- (3') of subgrade.
- Percentage of soluble sulfates.
- Mitigation plans.
- Elevation of groundwater encountered in each boring.
- Additional tests. These may be required for trench backfill evaluation, fill evaluation, etc.
- Recommendations and discussions.
- Engineer seal and signature. Required.

5.2.3 Soil Borings for Geotechnical Report

Timing of Soil Borings

- **Initial Borings.** The information from the initial soil borings must be summarized in the geotechnical report. The entire site shall be sampled for initial testing. This is required because street locations may be determined at this stage or may change.
- **Structures.** Soil borings for design of structures shall be taken prior to the design of the structure.
- **Imported Fill for Right-of-Way Grading.** All fill material shall be tested by the Contractor and approved by the City prior to its use on the project. The material should meet minimum requirements and be better than or equal to existing conditions. No material shall be imported which has a liquid limit greater than 40 and plasticity index greater than 20, unless otherwise approved by the City.

5.2.4 Frequency of Soil Borings

Basic Requirements

A minimum of two (2) borings shall be provided for each project. The number of borings should be dependent on project size and geotechnical Engineer's recommendations. The Engineering Division may require more frequent testing.

Structures

Testing frequency for structures shall satisfy AASHTO Bridge Design requirements and CDOT Materials Testing requirements.

5.2.5 Soil Boring Depth

Basic Requirements

Samples shall be taken to a minimum depth of 10 feet below the finished grades. Use standard care in determining the number of samples that are needed to characterize soils.

Groundwater or Bedrock

Borings shall extend deeper if needed to determine if bedrock or high groundwater levels are design concerns. Minimum depth to bedrock shall be three (3) feet below the finished subgrade surface.

Structures

Samples for structures shall be taken to a minimum depth of 10 feet below the footing elevation. Additional depth may be required for piers or piles.

5.2.6 Soil Testing

Required Tests

The tests marked with an “X” are required for the subgrade soils investigations or final pavement design testing. Refer to **Chapter 11- Roadways & Pavements**.

Classification Testing

Soils shall be classified visually and tested to determine the properties. Sands and gravel samples shall be analyzed for gradation where needed to comply with classification requirements.

Subgrade Support Testing

Individual subgrade or composite samples shall be tested for subgrade support value. The geotechnical report shall clearly state whether or not the subgrade soil is capable of supporting the proposed construction and design traffic loads. The top one foot (1') of subgrade shall have an R-value of 20 or greater. Recommendation for subgrade stabilization, if required, shall also be provided. The final pavement report shall contain specific mitigation. Refer to other sections of this chapter for requirements.

Right-of-Way Fill Material Testing

- **Test Prior to Use.** All imported fill material shall be evaluated for swell and R-value and approved by the Engineering Division prior to use in the Right-of-Way.
- **R-value and Plasticity Index.** All imported fill shall have an R-value and plasticity index better than or equal to the subgrade material within the Right-of-Way. Refer to 5.2.1.
- **Expansion Potential.** Imported fill shall not have a liquid limit greater than 40 and plasticity index greater than 20.

Table 5.1: Required Test

Test	Geotechnical Report	Final Pavement Design Report
Visual	X	X
Liquid Limit	X	X
Plastic Limit	X	X
Moisture	X	X

Percent Passing 200	X	X
Gradation (Granular Soils)	X	X
AASHTO Classification	X	X
Subgrade Support	X	
R-Value	X	
Swell Evaluation (Preliminary Considerations)	Indicator: Low/Moderate/High for Moderate or High, Run Swell Tests	Mitigation and Detailed Analysis
Percentage of Soluble Sulfates	X	X
Standard Penetration Test	X	X
Groundwater	X	X
Bedrock Level	X	X
Corrosion Potential Resistivity	X	
Soluble Sulfate	X	X

5.2.7 Soil Grouping

General

To simplify subgrade support testing, soil samples may be combined to form soil groups consistent with the AASHTO classification, group index, and location for the area investigated. Groupings shall not mix samples with different AASHTO classifications. (For example, soils with swell potential greater than two (2) percent may not be grouped).

Composite Samples

Composite samples may be obtained by mixing portions of each sample within a soil group to provide a uniform sample of the soil group. The composite samples shall be representative of the worst-case subgrade soils for the project site unless separate designs are proposed for distinct soil groups and sufficient field sampling is conducted to determine the special limits of each soil unit identified. Composite samples used for Hveem, subgrade strength testing (R-values) shall not be improved in R-value strength by mixing soils with a higher sand content with material of less strength. Appropriateness of the composite sample shall be evaluated through the comparison of soil gradation and Atterberg limits and soil gradations for the site soils as compared with the subject composite sample.

Specific Tests for Composite Samples

Composite samples shall be classified using the methods described in above. Composite samples remolded in the laboratory shall not be used for swell/consolidation testing.

Soluble Sulfate Test

A minimum of one (1) soluble sulfate test shall be run on each composite sample.

5.2.8 Subsurface Water Investigation**Criteria**

If groundwater or bedrock is encountered or predicted to be encountered within five (5) feet of the original or proposed ground surface, a subsurface water investigation report shall be submitted for acceptance by the Engineering Division. This report is required to ensure mitigation of high groundwater effects upon public improvements within the Right-of-Way. This information may be a separate report or may be included in the geotechnical report.

Waiver

A subsurface water investigation may be waived if the Applicant and Designer certify that the street subgrade elevations will be a minimum of three (3) feet above the “maximum” predicted (seasonal highest) water table.

Exception

A subsurface water investigation is not required for temporary dewatering activity needed to facilitate construction of buried utilities. However, all applicable state requirements must be followed.

Report Requirements

The subsurface water investigation report shall include the following information.

List of Required Information

- Site location and description. Include locations of any irrigation ditches and wetlands.
- Elevation of water table, direction of flow, flow rates, groundwater barriers, and seasonal high-water level.
- Potential sources of groundwater. Include proximity to irrigation ditch systems.
- Water rights.
- Other relevant subsurface information such as water ownership (water rights), groundwater quality (contamination or other undesirable characteristics).
- Potential future groundwater conditions.
- Subsurface drainage recommendations, including its effects on all conditions, including sensitive habitat.
- Cone of influence.
- Control measures and designs.

1. **Subsurface Drains.** If subsurface drains are recommended, the drains must have a gravity discharge without any possibility of back flow or blockage of the outlet. Any subsurface drain system shall be

owned and maintained by the Contractor or the Contractor's assigned successor(s). These drains may discharge into the City's storm drainage system, including inlets or detention ponds, upon approval of the Public Works Director. The underdrains may not drain to the gutter/flowline of public streets. Anticipated impacts to the groundwater table on adjacent properties must be quantified. The plat and construction plans shall clearly state that the City / County has no maintenance responsibility for this utility and any damage caused by said maintenance shall be repaired by the entity in charge of maintenance to preexisting conditions or better.

2. **Drain Lines.** The drain lines may be installed in the sanitary sewer trench, at an elevation of one sewer diameter lower than the sanitary sewer line, except in Loveland (city limits only). Flexible pipe will not be accepted.
3. **Drain Line Separation from Sewer.** The drain line shall be marked to specifically distinguish the drain from the sanitary sewer line.
4. **Pipe.** The drain line shall be an approved material pipe, for long-term 100 years minimum design life, with appropriate cleanouts.
5. **Drain Outlet.** The outlet of the drain into an inlet structure or detention pond shall be designed to prevent any possibility of backflow and blockage of the drain line.
6. Professional Engineer's seal and signature.

5.2.9 Soil Mitigation

Mitigation Plans

All problems found in soils investigation (e.g., expansion, frost, soluble sulfates, shallow bedrock, heave, groundwater, soil instability, utility backfill, etc.) shall be addressed in the mitigation plans. All mitigation procedures must be approved by the Engineering Division prior to their implementation.

Mitigation for Swell

If the swell of any subgrade soils is two (2) percent or greater, the pavement design report must provide mitigation measures. Soil swell testing shall be conducted with soil samples that have an initial moisture content equal to or less than four (4) points below optimum moisture. The mitigation measures shall reduce destructive swell potential to an acceptable level of less than two (2) percent at 150 pounds per square foot surcharge. The swell test report shall specify sample conditions, surcharge pressures, and other key testing factors.

Methods of Mitigation

Possible measures for mitigation may include the following:

- **Over-Excavation.** Over-excavation and replacement with suitable non-expansive or low-expansive material to a depth sufficient to mitigate expansion is a common mitigation method.
- **Chemical Treatment.** Chemical treatment may be used to mitigate soil condition. The addition of lime, fly ash, or cement treatment shall follow an approved mix design process. Additional testing is required to verify no swell is introduced during chemical treatment.
- **Subdrains.** Subdrains may be effective at reducing the groundwater, thereby reducing swelling. However, subdrains will be subject to all of the subsurface drain requirements in these STANDARDS AND SPECIFICATIONS.

- **Moisture Treatments.** Condition with moisture and compact to an appropriate level of compaction for the expansive condition, including stability requirements. The geotechnical engineer shall specify the target moisture content based on laboratory testing. Moisture content of the prepared subgrade soils shall be tested within 24-hours prior to paving. If unstable paving conditions due to over moistened soils appear, the contractor shall cease paving and the geotechnical engineer shall develop other forms of mitigation. Moisture treatment alone may not be sufficient. If soil problem mitigation is made, the soil treatment shall extend to the back of curb, or to the back of walk for attached or monolithic walk. For detached walk, separate mitigation procedures may be required.
- **Other Procedures.** Other procedures may be proposed for review and approval by the Engineering Division. The chosen method must work for the full life expectancy of the project.

5.3 Drainage Report

The storm drainage system shall be designed by a professional engineer registered in the State of Colorado utilizing the most current technical standards along with good, sound engineering judgment throughout the design process. The design process includes the submittal of a drainage report consistent with the requirements and recommendations in the Mile High Flood District Drainage Criteria Manual, Volumes 1 through 3 and construction drawings for review and acceptance by the City. The following note shall be incorporated into the drainage report:

"We acknowledge that the City of Northglenn's review of this study is only for general conformance with submittal requirements, current design criteria and standard engineering principles and practices."

This drainage report on new development of (greater than a half an acre) shall be submitted through Planning.

If a drainage report is over twelve months old before it is implemented, the Engineering Division will have to re-certify existing drainage report.

5.3.1 Preliminary Drainage Report/Letter

The purpose of the Preliminary Drainage Report is to identify problems and propose solutions to convey storm drainage through any proposed construction. The effects of off-site drainage areas on the development and the effects of the development on downstream properties must be thoroughly assessed. The Preliminary Drainage Report shall address the entire property boundary for new plats or site plans, whichever is greater.

A Preliminary Drainage Letter will only be allowed with prior approval and must be for projects within areas that have a previously approved drainage plan. It will usually be for pad sites within previously approved commercial sites or for minor changes to existing properties.

All applicable applications for a Right-of-Way Permit, Building Permit, or a Grading Permit shall include information related to stormwater runoff and water quality. The specific requirements vary by type and size of the proposed construction. All applications will include a Preliminary Drainage Plan and Report or letter to document the drainage, water quality and floodplain impacts of the proposed improvements as follows:

- Submit one (1) report and plan sheet to the Public Works Engineering Division for review. This submittal will be in paper report form and electronic form. Engineering personnel will sign the Development Application Form for a plat or site plan when requested, provided the report has been received, the report/letter review fee paid and a copy of the plat or site plan accompanies the Development Application. Contact Public Works for the fee amount.

- The report/letter will be reviewed by Engineering and will be returned to the consultant with comments. The consultant or local representative will be notified by phone or email when the submittal is ready to be picked up.
- The consultant will make necessary revisions and resubmit according to the instructions provided with the report/letter review comments. Each resubmittal must include all previously reviewed reports/letters with prints. Incomplete submittals or non-responsive resubmittals may be rejected and returned without review.
- When indicated by the City of Northglenn, the consultant will submit a finalized report/letter drainage plan for signatures. The approved copy will remain on file in the Engineering Division.
- The review and revisions cycle normally corresponds closely to the Planning Department schedule for plat and other site plan review.

5.3.2 Final Drainage Report

The Final Drainage Report shall be a detailed study and analysis of the proposed development. It shall include calculations for all runoff and for all drainage structures or facilities within the project site. Final drainage reports must be prepared by a qualified Professional Engineer licensed in the State of Colorado, or under their direct supervision, whose seal and signature shall be affixed to the report and all plan sheets.

The Final Drainage Report must be submitted with civil construction plans for water, sewer, streets, and grading as a complete package. The submittal can be made during the processing of planning documents or prior, if desired. Acceptance of the civil plan package is required prior to approval of building permits for development projects. The procedure is as follows:

- Request a pre-submittal meeting with the Public Works Engineering Division. The submittal package, including the final drainage study and plan, will have an initial review for completeness of the submittal. After this meeting the plans will either be returned for additional information or be allowed to be submitted. All meetings with prospective developers are designated as a Planning Division activity.
- Submit one (1) set of civil construction plans (or, the number of sets requested in the pre-submittal meeting), the Final Drainage Reports and the civil plans review fee to the Engineering Division to be logged in for review. The plans will be routed to other departments as necessary. If necessary, plans will be routed to Urban Drainage and Flood Control District or other applicable agencies for review to ensure compliance with their criteria. Contact the Public Works Engineering Division for fee amounts.
- The civil construction plan package will be returned to the consultant with comments and requested revisions.
- The consultant will make necessary revisions and resubmit according to the instructions provided with the City of Northglenn comments. Each resubmittal must include all previously reviewed prints/reports.
- The consultant will submit a clean report and all construction plans for signatures. The approved copies will remain on file in the Engineering Division. Approval of the Final Drainage Report and Civil Construction Plans by all departments is required for Engineering Division approval of building permits.
- The review and its revision cycle are based on the Development Review Process for the City of Northglenn. Quality plans meeting all City of Northglenn standards and criteria will save time for all involved. If the civil plans and drainage report cannot be approved with the third submittal, the review of the plans will start over and a new review fee will be required.

5.3.3 Drainage Report Requirements

General

All reports shall be typed on 8 ½-inch x 11-inch paper and properly bound with durable covers. The cover shall include the full subdivision plat name, the Owner's name, address, phone number, point of contact, the Designer's name, address, phone number, point of contact and approval block. Supporting calculations, charts, and design aids shall be included in the appendix of the report. Plan sheets shall be included in a pocket at the back of the report. The reports shall also be submitted electronically.

5.3.4 Report Format & Required Information

Appendices 5.1 – 5.4 are detailed lists of the required information for Preliminary Drainage Reports and Letters, and for Final Drainage Reports.

5.4 Utility Study – Sanitary Sewer & Water

The following note shall be incorporated into the utility study:

"We acknowledge that the City of Northglenn's review of this study is only for general conformance with submittal requirements, current design criteria and standard engineering principles and practices."

5.4.1 Sanitary Sewer System Study

- The study shall include, as a minimum, the following information and shall be typed and bound in an 8 ½-inch x 11-inch report binder:
- Text, which addresses, a minimum of project location and description, project concept, discussion of any information that would affect the City's ability to serve the new area, and any recommendations and conclusions of the analysis.
- The area, in acres, which could be served by gravity by the new sewer, shown on a topographic map which delineates the basin boundaries.
- The estimated population densities and total population based on land use projections to be served by the new sewer.
- The estimated quantity and quality of any industrial wastes to be discharged to the system.
- Design flow rates, minimum and maximum flow velocities, minimum and maximum pipe slopes, and infiltration allowances.
- The impact of the additional flows on the existing sanitary sewer system at all critical points between the proposed site and the major interceptor.
- A utility map which includes, a minimum of, the following information:
 1. Location of all proposed and existing easements and/or Right of Ways.
 2. Existing and proposed sanitary sewer lines and appurtenances with sizes and slopes shown.
 3. Basin delineation.
 4. All other existing and proposed utilities.

All other requirements for the CDPHE approval when applicable.

5.4.2 General – Water Report

The water system shall be designed by a professional engineer registered in the State of Colorado utilizing the most current technical standards along with good, sound engineering judgment throughout the design process. The design process includes the submittal of a utility study and construction drawings for review and approval by the City. The following note shall be incorporated into the utility study:

"We acknowledge that the City of Northglenn's review of this study is only for general conformance with submittal requirements, current design criteria and standard engineering principles and practices."

Water Study

The Study shall include the following information and shall be bound in an 8 ½-inch x 11-inch report binder:

- Text, which addresses, a minimum of, project location and description, project concept, discussion of any information that would affect the City's ability to serve the new area and any recommendations and conclusions of the analysis.
- The area which could be served by the new water line and any pressure zones, shown on a topographic map which delineates these pressure zones. The pressure zones shall be in conformance with the "Northglenn Treated Water System Modeling Evaluation", latest edition.
- The estimated population densities and total population, based on land use projections, to be served by the new water line.
- Design flow rates, minimum and maximum system residual pressures and head loss in the distribution main.
- A utility map which includes, a minimum of, the following information:
 1. Location of all proposed and existing easements and/or rights of way.
 2. Existing and proposed water lines and appurtenances with sizes, flows, node pressures and demands shown.
 3. Existing pressure zones.
 4. All other existing and proposed utilities.

5.5 Responsibilities for Traffic Studies

Traffic studies may be required by the City to adequately assess the impacts of a development proposal on the existing and/or planned street system. The primary responsibility for assessing the traffic impacts associated with a proposed development shall rest with the Developer, with the City serving in a review capacity. The assessment of these impacts shall be contained with a Traffic Impact Study report as specified in this chapter.

5.5.1 Traffic Impact Letter

For projects generating under 100 new vehicle trips, a Traffic Letter will be accepted to review the traffic impacts. The letter shall provide the City with the knowledge that the new development shall have limited impacts to the adjacent streets.

5.5.2 Full Traffic Impact Report

A written traffic impact study meeting the criteria contained in this chapter shall be required for a development proposal or a capital project improvement project when trip generation during the AM or PM peak hour is expected to exceed 100 vehicles, as determined by the City. This study shall be the responsibility of the applicant and shall be prepared by a Professional Engineer registered in the State of Colorado, with adequate experience in transportation engineering. Upon submission of a draft traffic study, the Engineering Division will review the study data sources, methods, and findings. Comments shall be provided in a written form. The Developer and the project engineer will then have an opportunity to incorporate necessary revisions prior to submitting a final report. All studies shall be accepted by the Engineering Division. The following submittals may require traffic studies:

- A rezoning application or an application for annexation into the City.
- A preliminary map or final plat if the property has already been rezoned for the proposed use and no traffic study was required for the rezoning, or the land use assumptions at the time of platting will result in trip generation increasing by more than 15 percent compared to trip generation estimates made for the traffic study at the time of rezoning.
- Prior to issuance of a building permit, if the property has already been zoned/platted and no previous traffic study less than two (2) years old exists.
- The applicant shall be required to submit a new traffic study if, after submitting the original traffic study for any of the above submittals, the trip generation is increased by more than 15 percent or the land use is changed so that trip generation is increased by more than 15 percent.

All previous traffic studies relating to the development that are more than two (2) years old shall be updated, unless the Engineering Division determines that conditions have not changed significantly. Where access points are not defined or a site plan is not available at the time the traffic study is prepared, additional traffic analysis may be required when a site plan becomes available or the access points are defined.

The applicant will be notified at the pre-planning stage if a traffic study will be required, provided sufficient information is available for the City to determine whether the trip generation criterion has been met. If insufficient information is available but the property appears to involve a sufficiently intense land use, the applicant will be informed that a traffic study is required.

Transportation consultants are required to discuss projects with the Engineering Division prior to starting the study. As a minimum, topics for possible discussion at such meeting shall include trip generation, directional distribution of traffic, trip assignment, definition of the study area, intersections requiring capacity/level of service analysis and methods for projecting build-out volume. This will provide a firm base of cooperation and communication between the City, the owner or developer, and the project's consultants in forecasting future traffic characteristics which realistically define traffic movement associated with the proposed development. Specific requirements will vary depending on the site location.

5.5.3 Types of Improvements Evaluated in Traffic Impact Studies

Vehicular Traffic Improvements

Types of capacity and safety improvements for vehicular traffic include road widening, turn lanes, acceleration and deceleration lanes, intersection through lanes, traffic signals, stop signs, design speed adjustments, and modifications to access points.

Pedestrian Traffic Considerations & Improvements

Pedestrian traffic segment includes review of narrow roadway, short blocks, low traffic speeds, tree-lined sidewalks, well defined crosswalks, median refugees, channelized islands, and underpasses or overhead structures.

Bicycle Traffic Improvements

The addition of on-street bicycle lanes or off-street bicycle paths may be needed to achieve connectivity between the proposed project and the existing bikeway system.

Transit Traffic Improvements

Transit improvements includes accommodation of public transit facilities such as buses, bus stops, bus bays, stations and transit stop facilities.

5.5.4 Traffic Study Format

In order to provide consistency and to facilitate staff review of traffic studies, the following format shall be followed in the preparation of such studies by transportation consultants.

Introduction

The introduction portion of the report must contain the following:

- A note stating the following: "We acknowledge that the City of Northglenn's review of this study is only for general conformance with submittal requirements, current design criteria, and standard engineering principles and practices."
- A brief description of the size of the land parcel, general terrain features, the location within the jurisdiction and the region shall be included in this section. In addition, the roadways that afford access to the site and are included in the study area shall be identified. The exact limits of the study area should be based on engineering judgment and an understanding of existing traffic conditions surrounding the site. In all instances, however, the study area limits shall be mutually agreed upon by the developer, his engineer and the Engineering Division. A vicinity map that shows the site and the study area boundaries in relation to the surrounding transportation system shall be included.
- The existing and proposed uses of the site shall be identified in terms of the various zoning categories of the City. In addition, the specific use for which the request is being made shall be identified, if known, since a number of uses may be permitted under the existing ordinances. It shall be the intent of the traffic study to evaluate the worst-case traffic impacts for the proposed development allowed by the zoning. If several different uses are permitted by the zoning, the highest trip generation shall be assumed for the study.
- A complete description (including a map) of the existing land uses in the study area, as well as their current zoning and use, shall be included. In addition, all vacant land within the study area and its assumed future uses shall be identified. This latter item is especially important where large tracts of undeveloped land are in the vicinity of the site and within the prescribed study area. Generally, much of this information can be obtained from the City's Planning Division staff.
- Within the study area, the applicant shall describe and provide volumes for existing roadways and intersections, including geometrics and traffic signal control, as well as improvements contemplated by all affected government agencies. This would include the nature of the improvement project, its extent, implementation schedule, and the agency or funding source responsible. A map shall be provided showing the location of such facilities.

Trip Generation & Design Hour Volumes

A summary table listing each type of land use, the size involved, the average trip generation rates used (total daily traffic and a.m./p.m. peaks) and the resultant total trips generated shall be provided. Trip generation shall be calculated for the maximum uses allowed under the existing and proposed zoning based on the latest data contained within the Institute of Transportation Engineers (ITE) Trip Generation Manual, or other applicable sources. If data is not available for the proposed land use, the City must approve estimated rates prior to acceptance. The calculation of design hour volumes used to determine study area impacts shall be based on:

- Peak hour trip generation rates as published in the ITE Trip Generation Summary or other applicable sources.
- Traffic volume counts for similar existing uses if no published rates are available.
- Additional sources from other jurisdictions, if acceptable to the Engineering Division.
- Use of reduction factors to account for passerby traffic may be considered upon approval of the Engineering Division. Internal trip reductions and modal split assumptions will require analytical support to demonstrate how the figures were derived and will require approval by the Engineering Division.

Trip Distribution

The estimates of percentage distribution of trips from the proposed development to destinations in the metro region shall be clearly stated in the report using the north, south, east and west compass points. Market studies and information concerning origin of trip attractions to the proposed development may be used to support these assumptions where available. A map showing the percentage of site traffic on each street shall be provided as part of the traffic study graphic material.

Trip Assignment

The direction of approach of site-generated traffic via the area's street system shall be presented in this section. The technical analysis steps, basic methods and assumptions used in this work shall be clearly stated and agreed to by the Engineering Division. The assumed trip distribution and assignment shall represent the most logically traveled routes for drivers accessing the proposed development. These routes can be determined by observation of travel patterns to existing land uses in the study area.

Existing & Project Traffic Volumes

Graphics shall be provided which show the following traffic impacts for private access points, public intersections, and public streets:

- A.M. peak-hour site traffic (in and out), including turning movements.
- P.M. peak-hour site traffic (in and out), including turning movements.
- A.M. peak-hour total traffic (in and out), including site-generated traffic. These volumes must include through and turning movement volumes for current conditions and separate set of numbers that also include 20-year projections or build-out, whichever is specified by the Engineering Division.
- P.M. peak-hour total traffic (in and out), including site-generated traffic. These volumes shall include through and turning movement volumes for current conditions and a separate set of numbers that also include 20-year projections or build-out, whichever is specified by the Engineering Division.

- Any other peak hour which may be critical to site traffic and the street system in the study area should be included in the graphics and show the same information as is provided for the A.M./P.M. peak hours.
- Actual counts of existing total daily traffic for the street system in the study area at the time the study is being prepared.
- Projected total daily traffic for the street system in the study area based on traffic from the proposed development and counts of existing daily traffic. The component of the existing daily traffic attributable to the existing uses shall be identified and the increase in total daily traffic from the proposed uses.
- Projected total daily traffic for the street system in the study area based on traffic from the proposed development, counts of existing daily traffic, traffic projections based on build-out of land use within the study area, or a 20-year projection, whichever is specified by the Engineering Division.

All raw traffic count data, including average daily volumes and peak-hour turning movements and analysis worksheets shall be provided in the appendices of the report. Computer techniques and the associated printouts may be used as part of the report. Volume projections for background traffic growth will be provided by the Engineering Division or alternatively, a method for determining these volumes will be recommended by the Engineering Division. All total daily traffic counts shall be actual machine counts and not based on factored peak-hour sampling. Latest available machine counts from the Colorado Department of Transportation, the City and other agencies may be acceptable if not more than two (2) years old.

Level of Service

Level of Service "C" shall be the design objective for all movements, and under no circumstances will less than Level of Service "D" be accepted for site and non-site traffic, including existing traffic at build-out of the study area. The design year will be approximately 20 years following construction and include volumes generated by build-out of the study area or a 20-year projection in background traffic, whichever is specified by the Engineering Division. The following interpretations of "Level of Service" have been provided:

- **Level of Service A.** A condition of free flow with low-traffic density where no vehicle waits longer than one (1) signal cycle.
- **Level of Service B.** A stable flow of traffic where only on a rare occasion do drivers wait through more than one (1) signal cycle.
- **Level of Service C.** Still in the zone of stable flow but intermittently, drivers must wait through more than one (1) signal cycle and back-ups may develop behind left-turning vehicles.
- **Level of Service D.** Approaching instability, drivers are restricted in their freedom to change lanes and delays for approaching vehicles may be substantial during peak hours.
- **Level of Service E.** Traffic volumes are near or at the capacity of the arterial and long queues of vehicles may create lengthy delays, especially for left-turning vehicles.
- **Level of Service F.** Congested condition of forced traffic flow where queued back-ups from locations downstream restrict or prevent movement of vehicles out of the approach creating a storage area during part or all of the peak hour.

Capacity Analysis

A capacity analysis shall be conducted for all public street intersections impacted by the proposed development and for all private property access points to streets adjacent to the proposed development and within the limits of the previously defined study area. The a.m., p.m., and any other possible peak period shall be tested to determine which peak hours need to be analyzed. Capacity calculations should also include an analysis for the 20-year projections or study area build-out conditions. The capacity analysis calculations should be based on the latest approved techniques as published in the latest update of TRB Special Report 209. All capacity analysis worksheets shall be included in the appendices of the report.

Traffic Signals

The need for new traffic signals shall be based on warrants contained in the Manual on Uniform Traffic Control Devices and any additional warrants established by the National Committee on Uniform Traffic Control Devices. In determining the location of a new signal, traffic progression is important. Generally, a spacing of one-half (1/2) mile for all signalized intersections should be maintained. This spacing is desirable to achieve good speed, capacity, and optimum signal progression. Pedestrian movements shall be considered in the evaluation and adequate pedestrian clearance provided in the signal cycle split assumptions.

To provide flexibility for existing conditions and ensure optimum two-way signal progression, an approved traffic engineering analysis shall be made to properly locate all proposed accesses that may require signalization. The section of roadway to be analyzed for signal progression will be determined by the City and will include all existing and possible future signalized intersections.

The progression pattern calculations shall use a cycle consistent with current signal-timing policies of the City. A desirable band width of 50 percent of the signal cycle shall be used where existing conditions allow. Where intersections have no signals presently but are expected to have signals, typically a 60 percent mainline, 40 percent cross-street cycle split should be assumed. Cycle split assumptions shall relate to volume assumptions in the capacity analysis of individual intersections, and where computerized progression analysis techniques are used, they shall be the type which utilize turning-movement volume data and pedestrian clearance times in the development of time/space diagrams. The green time allocated to the cross street shall be considered no less than the time which is required for a pedestrian to clear the main street using the Manual on Uniform Traffic Control Devices standards. Those intersections which would reduce the optimum band width if a traffic signal were installed may be required by the City to remain unsignalized and have turning movements limited by access design or median islands.

Traffic Calming & Traffic Accidents

Traffic accident data for affected street corridors may be required for the study. The study period will normally be three years. Such locations will be specified by the Engineering Division. Where this is necessary, estimates of increased or decreased accident potential shall be evaluated for the development, particularly if the proposed development might impact existing traffic safety problems in the study area and safety improvements recommended where necessary.

Noise Attenuation

If a residential development is planned adjacent to a freeway or arterial roadway, the need for noise attenuation measures may be required as part of the impact analysis. It is recommended that the need for noise attenuation measures be determined using the methods outlined in Colorado Department of Transportation Noise Analysis and Abatement Guidelines, Latest Edition.

Recommendations

In the event that analysis indicates unsatisfactory levels of service on study area roadways, a description of proposed improvements to remedy deficiencies shall be included. These proposals would include projects by the City or the

Colorado Department of Transportation for which funds have been appropriated and obligated. The assumptions regarding all existing and future roads in an analysis will require approval from the Engineering Division. In general, the recommendation section should include:

- Proposed Recommended Improvements
- This section must describe the location, nature and extent of proposed improvements to assure sufficient roadway capacity. A sketch of each improvement should be provided showing the length, width and other pertinent geometric features of the proposed improvements.
- Level of Service Capacity Analysis at Critical Points
- Another iteration of the operational analysis shall be described which demonstrates the anticipated level of service as a result of making these improvements. This Level of Service must be "D" or better.
- Traffic Volume Proportions
- Percentages based on the traffic impact analysis may be required by the City to determine the proportion of traffic using various public improvements (both existing and proposed) from several developments within the study area.

Conclusions

This last section of the report must be a clear, concise description of the study findings explained in a manner that a citizen could understand as the language in this section will be inserted into the Planning Commission and City Council agenda memorandums. At minimum, the summary will include information pertaining to existing site generated traffic, impacts and mitigation measures and when they will be implemented.

Revisions to Traffic Study

Revisions to the traffic study shall be provided as required by the Engineering Division. The need to require revisions will be based on the completeness of the traffic study, the thoroughness of the impact evaluation and the compatibility of the study with the proposed access and development plan.

Summary of Typical Study Contents

- Introduction
 1. Land Use, Site and Study Area Boundaries (provide map)
 2. Existing and Proposed Site Uses and Circulation (provide map)
 3. Existing and Proposed Uses in Vicinity of Site (provide map)
 4. Existing and Proposed Roadway and Intersections (provide map)
- Trip Generation and Design Hour Volumes (provide table)
- Trip Distribution (provide figure)
- Trip Assignment (provide figure)
- Existing and Projected Traffic Volumes (provide figure for each item):

1. A.M. Peak Hour Site Traffic (including turning movements)
 2. P.M. Peak Hour Site Traffic (including turning movements)
 3. A.M. Peak Hour Total Traffic (including site-generated traffic and projected traffic)
 4. P.M. Peak Hour Total Traffic (including site-generated traffic and projected traffic)
 5. Any Other Peak Hour Necessary for Complete Analysis
 6. Total Daily Existing Traffic for Street System in Study Area
 7. Total Daily Existing Traffic for Street System in Study Area and New Site Traffic
 8. Total Daily Existing Traffic for Street System in Study Area plus New Site Traffic and Projected Traffic from Build-Out of Study Area Land Uses
- Level of Service
 - Capacity Analysis (provide analysis sheets in appendices)
 - Traffic Signals (provide analysis sheets in appendices)
 - Traffic Accidents (optional) (provide collision diagrams and accident rates)
 - Noise Attenuation
 - Conclusions
 - Recommendations
 1. Proposed Recommended Improvements (provide sketches of improvements)
 2. Volume/Capacity Analysis at Critical Points (provide analysis sheets in appendices)
 - Traffic Volume Proportions

NOTE: Information required on figures may be combined provided that the information is clearly legible.

5.5.5 Reports

Submittal Format

All reports shall be bound in an 8 ½-inch x 11-inch folder and shall include the seal and signature of the Professional Engineer registered in the State of Colorado who is responsible for the report contents. In addition, all reports shall include the following statement:

"We acknowledge that the City of Northglenn's review of this study is only for general conformance with submittal requirements, current design criteria, and standard engineering principles and practices."

5.6 Pavement Design Report

All roadway construction in the City of Northglenn shall require a pavement design report. The report content shall be in accordance with these STANDARDS AND SPECIFICATIONS and shall include the following items:

- Prior to any roadway construction, the Responsible Party shall provide a pavement design report that recommends typical pavement structural sections based on the known site soil conditions. The report shall consist of the following:
 - 1. Vicinity map to locate the investigated area.
 - 2. Scaled drawings showing the location of borings.
 - 3. Scaled drawings showing the estimated extent of subgrade soil types and EDLA/ESAL for each street.
 - 4. Pavement design alternatives for each street on a scaled drawing.
 - 5. Tabular listing of sample designation, sample depth, Group Number, Liquid Limit, Plasticity Index, percent passing the No. 200 sieve, Group Index, Unified and AASHTO Classification, and soil description.
 - a. Proctor Compaction Curves.
 - b. Subgrade support testing of each soil type used in the design. (see 503.6.(c))
 - c. Pavement design computer printouts or nomographs properly drawn to show soil support, EDLA/ESAL, and structural number.
 - d. Design calculations. Include for all phases of project.
 - e. Design coefficient used for asphalt, base course, etc.
 - f. A discussion regarding potential subgrade soil problems including, but not limited to:
 - 6. Recommendations to alleviate or mitigate the impact of problems discussed above.

5.7 Pavement Evaluation Report

After installation of the concrete pavement or bituminous surface course except for the final two (2) inches on residential streets, the Developer may be required to furnish the Engineering Division with a copy of a report prepared by a Professional Engineer registered in the State of Colorado utilizing non-destructive deflection testing to assess and predict the performance of the pavement. This testing may be required if evidence exists that the pavement section may not meet the design specifications. The Professional Engineer shall have a history and knowledge in performing these tests. Qualifications of Professional Engineers shall be submitted to the Engineering Division for approval before the start of work.

The pavement evaluation shall be performed in accordance with good engineering practices. The report shall generally embody the following testing and pavement evaluation techniques:

- Pavement Surface Elevation
- Soil Borings in Areas of High Deflections
- Pavement Deflection Analysis
- Environmental Study (Frost Cycle, Drainage, etc.)

The report shall evaluate the existing condition of the base and binder course by performance of deflection tests at 100- foot spacing per traffic lane. Spacing will be staggered in each lane. The report shall determine whether the pavement section will meet a 20-year pavement life or greater.

If the pavement section is not projected to meet a life expectancy of 20 years or more, the report shall propose asphalt overlays in excess of the existing pavement section to bring the new pavement section to a 20-year life expectancy. The Engineering Division will evaluate the results of the report and inform the developer of the acceptable solution mentioned in the report.

5.8 Pavement Design & Technical Criteria

5.8.1 General

Recommended design methodologies for asphalt follow the Colorado Department of Transportation's "Pavement Design Manual", latest edition (the "Manual").

For all City land development approvals that involve a Public Improvements Agreement for roadway construction, the applicant shall provide a subgrade investigation and pavement design report that recommends a typical pavement structural section based on the known site soil conditions and the approved traffic study or in accordance with the criteria set forth in these STANDARDS AND SPECIFICATIONS. This pavement design serves as a justification of the roadway structural requirements.

5.8.2 Subgrade Investigation & Pavement Design Report

The report shall be prepared by or under the supervision of and signed and sealed by a Professional Engineer registered in the State of Colorado and shall include the following information:

- Vicinity map to locate the investigated area.
- Scaled drawings showing the location of borings. Scaled drawings showing the estimated extent of subgrade soil types and ESAL for each street.
- Pavement design alternatives for each street on a scaled drawing.
- Tabular listing of sample designation, sample depth, group number, liquid limit, plasticity index, percent passing the No. 200 sieve, AASHTO classification, group index, and soil description.
- R-value test results of each soil type used in the design.
- Pavement design nomographs properly drawn to show soil support -- ESAL - SN. A computer printout may be used if the DARWin[™] program is used.
- Design calculations.

- A discussion regarding potential subgrade soil problems including, but not limited to:
 1. Swell or settlement-prone soil.
 2. Frost-susceptible soils.
 3. Ground water.
 4. Drainage considerations (surface and subsurface).
 5. Cold-weather construction (if appropriate).
 6. Other factors or properties which could affect the design or performance of the pavement system.

Recommendations to alleviate or mitigate the problems discussed in above.

5.8.3 Field Investigation

The geotechnical investigation shall consist of borings or other suitable method of sampling subgrade soils to a depth of at least five (5) feet below proposed subgrade elevation, with a 10-foot boring every third hole, at spacings of no more than 250 feet unless otherwise accepted by the Development Engineering Manager. Samples shall be taken after grading is completed and the subgrade is rough cut.

5.8.4 Classification Testing

Each subgrade sample shall be tested to determine liquid limit, plastic limit, plasticity index and the percentage passing the U.S. Standard No. 200 sieve. Samples of sands and gravels may require gradation analysis for classification determination. These data shall be determined using the following methods:

- Liquid Limit - AASHTO T 89
- Plastic Limit - AASHTO T 90
- Percent Passing No.200 - AASHTO T 11
- Gradation - AASHTO T 27

The results of these tests shall be used to calculate the AASHTO Classification and Group Index using AASHTO M 145.

If the Plasticity Index (PI) of the subgrade is more than 15 or the R-value of the soil is less than 10, then the subgrade shall be stabilized with one of the methods outlined in the "Manual".

5.8.5 Subgrade Support Testing

Individual subgrade samples shall be tested to determine the subgrade support value using Hveem Stabilimeter (R-value), or California Bearing Ratio (CBR) and Unconfined Compressive Strength (Qu) testing, or direct measurement of resilient modulus of soil AASHTO T-307. These values shall be used in the design of pavement sections in accordance with the procedures outlined below. Tests shall be conducted in accordance with this procedure.

R-Value Tests - Hveem Stabilimeter tests shall be conducted in accordance with AASHTO T 190. The design R-value shall be at 300 pounds per square inch (psi) exudation pressure. The reported data shall consist of:

- Dry density and moisture content for each sample.
- Expansion pressure for each sample.
- Exudation Pressure - corrected R-value curve showing the 300-psi design R- value.

CBR Tests: California Bearing Ratio Tests shall be conducted in accordance with AASHTO T193 with the following modifications:

- Note 4 of AASHTO T193 shall not apply. A three (3) point CBR evaluation is required.
- The compaction method used for the CBR test shall be determined by the soil classification.
- Surcharge shall be calculated using a unit weight of 140 pounds per cubic foot for HMA and 135 pounds per cubic foot for ABC.
- The design CBR value shall be determined from the CBR dry density curve and shall be the CBR value at 95 percent compaction.
- In addition to the values requested in AASHTO T193 Stress Penetration curves for each sample, a CBR dry density curve and Proctor compaction test results shall be reported.

5.8.6 Minimum Pavement Section

This paragraph provides the minimum acceptable pavement sections for public roadways in the City of Northglenn. These pavement thicknesses may be used for preliminary planning purposes. Final pavement designs must be based on actual subgrade support test results. Table 5.2 lists these minimum thicknesses for each roadway classification.

Table 5.2: Minimum Pavement Thickness

Composite Section			Full Depth	Portland Cement
Classification	Asphalt (inches)	Aggregate Base Course (inches)	Asphalt (inches)	Concrete (inches)
Cul-de-sac	--	--	6.0	6.0
Local	4.0	8.0	6.0	6.0
Major Collector	4.0	8.0	8.0	7.0
Arterial	6.0	8.0	10.0	9.0

⁽¹⁾Concrete streets are only allowed with specific written approval of the Engineering Division.

⁽²⁾ "Full Depth Asphalt" is required on all "Public Streets". Composite sections will only be allowed when specifically approved by the Engineering Division.

⁽³⁾All cul-de-sacs shall be the minimum full depth shown or the full depth determined by the subgrade support tests, whichever is greater.

5.9 Pavement Design Procedure

5.9.1 Flexible Pavements

The following procedure should be used in determining the Structural Number (SN) of the pavement being designed:

- Determine roadway classification and corresponding EDLA/ESAL.
- Determine the Serviceability Index (SI) of the roadway classification.
- Determine the reliability (R) of the roadway classification.
- Approved proper nomographs.
- Determine the required structural number using AASHTO pavement design software or nomographs from AASHTO or CDOT along with soil support test results and EDLA/ESAL values previously determined. If used, copies of the nomograph determinations must be included with the design submittal:

Once the Structural Number (SN) has been determined, the design thicknesses of the pavement structure can be determined by the general equation:

$$SN = a(1)D(1) + a(2)D(2) + a(3)D(3) + \dots$$

Where A(1), Aa(2), Aa(3), Aa(n) = strength coefficients D(1),D(2),D(3),D(n) = thickness of pavement component sections. The strength coefficients for various components of the pavement structure.

- The component thickness selected must meet two (2) conditions:
 1. Total thickness selected cannot be less than the minimum specified in Table 500-1 for the roadway classification.
 2. The base course thickness selected cannot exceed two and one-half (2.5) times the asphalt thickness selected.
- Pavement section calculations shall be rounded up to the next thickness one-half (1/2) inch increment.
- The standard deviation for design of asphalt pavements shall be forty-four-hundredths (0.44).
- The design must reference any mitigation measures required when the subgrade contains swelling soils. Design reports recommending alternative methods or materials to address swelling soils (i.e., base course, lime, cement, etc.) must present the measures to be used to ensure adequate drainage of such layers and to maintain separation of the layers from the swelling soils. Swell tests shall be conducted for samples with probable expansion (volume change estimate) greater than two (2) percent based on actual tests. Surcharge pressure shall be 150 pounds per square foot, or as specified by the Development Engineering Manager.

5.9.2 Rigid Pavement

Rigid pavements are those that possess a high bending resistance and distribute loads over a large area of foundation soil. Examples include Portland cement concrete pavement or Portland cement concrete surfaced with asphalt. Rigid pavement shall only be utilized as specifically authorized by the Development Engineering Manager.

The design of rigid pavements is a function of support characteristics of the subgrade soil (R-value, CBR, or resilient modulus), traffic (EDLA/ESAL), and the strength of the concrete (working stress). In comparison to the strength of the concrete slab, the structural contributions of underlying layers to the capacity of the pavement are relatively insignificant. Therefore, the use of thick bases or subgrades under concrete pavement to achieve greater structural capacity is uneconomical and is not recommended.

Use the following procedure to obtain required thickness:

- Determine roadway classification and corresponding EDLA/ESAL.
- Determine design Serviceability Index (SI) of the roadway.
- The working stress of the concrete (Ft) used in the design shall be 75 percent of that provided by third-point beam loading, which shall have a minimum laboratory 28-day strength of 600 pounds per square inch based on actual tests of materials to be used.
- The reliability factor for design of all concrete pavements shall be 90 percent.
- The standard deviation for design of concrete pavements shall be between three-tenths (0.30) and four-tenths (0.40).
- Determine the structural numbers using AASHTO pavement design software. Nomographs of the AASHTO or CDOT parameters may be used instead. If used, copies of the nomograph determinations must be included with the design submittal.
- Using EDLA/ESAL and working stress data, locate point on the pivot line; connect this point to the R-value or CBR value on the soil support scale to determine slab thickness.
- Use slab thickness. (rounded upward to the nearest one-half (1/2) inch) or the minimum thickness from.
- For swelling soils (swell potential greater than two (2) percent, under 200 pounds per square foot surcharge pressure) concrete paving shall not be permitted without subgrade treatment.
- Pavement joint detail plans. With rigid pavement designs, the construction plans shall include a joint pattern layout for each street, alley, or intersection. All joints and joint filling in rigid pavements shall be designed and detailed in accordance with the current CDOT M&S Standards.

Chapter 6. EARTHWORK & EROSION CONTROL

6.1 Introduction

This chapter contains minimum criteria to be met on all earthwork and erosion control design in the City, both by private land developers and by the City through their Capital Projects Program. As a planning element, a (Geotechnical) Soils Investigation Report shall be completed for all site grading, utility, or pavement projects. Refer to **Chapter 5- Design Reports Requirements** for the requirements of the Geotechnical and Pavement Design Reports.

6.2 Soils Investigations

6.2.1 General

General Requirements

Three categories of testing and reports are required for all projects requiring right-of-way grading, utilities, and paving; geotechnical report, final pavement design report, and extra testing (e.g., imported fill).

Geotechnical Report

This report evaluates the characteristics of the soils and the general issues of groundwater, soil stability, and swell potential. If groundwater is found within certain parameters, a subsurface water investigation is required. A geotechnical report is required for street, utilities and related improvements within the Right of Way, public easements, or slope easements. This report is required as part of the preliminary plat submittal (refer to **Chapter 5- Design Report Requirements**).

Final Pavement Design Report

This report is required for all projects with roadway improvements. The soil investigation associated with this report will occur after grading for roadways and utilities is complete. This report must be submitted and approved prior to any nonstructural concrete or paving installation (refer to **Chapter 5 - Design Report Requirements**).

Extra Testing

If fill material is required for the project, this material shall also be tested before placement.

Supervision by Engineer

All sampling and testing of soils shall be performed under the direct supervision of a Professional Engineer who must sign and stamp the report.

6.3 Earthwork & Grading

6.3.1 Design

Prior to the issuance of Right of Way permits and/or grading permits, the Designer shall complete the following plans:

- Grading Plans with one-foot (1') contours for topographic information. The plans shall provide existing topographical information as well as designed changes to the topographic information. All plans should show contours at least one hundred feet (100') beyond limits of the project.
- Drainage Improvements shall be designed to address any rainfall and drainage across the project.
- Geotechnical Report. Refer to **Chapter 5- Design Report Requirements** for the requirements of this report.

- Erosion Control Design. Erosion control shall be designed for the area that is being proposed for excavation, grading, cuts, fills, clearing and grubbing.
- Stormwater Management Plan (SWMP) Submittal meeting the requirements of Colorado Department of Public Health and Environment. Refer to www.northglenn.org/stormwater or www.colorado.gov/pacific/cdphe/news/water-quality-permits, find Construction sector.
- All design elements for grading shall follow the requirements of this chapter as well as the requirements of Mile High Flood District (MHFD) Standards.

6.3.2 Design Requirements

- All earthwork operations shall be executed in a manner which will minimize dust, noise, excessive accumulation of debris, danger to the public and interference with other construction.
- Positive drainage and adequate erosion control shall be provided at all times during the earthwork operations.
- Earthwork operations shall be executed to provide compaction to a minimum 85-percent Standard Proctor density at + three percent (3%) of optimum moisture in areas to be eventually turfed or planted. Compaction to minimum 95 percent Standard Proctor density at + two percent (2%) of optimum moisture under all walks, trails, streets, structures, and other site improvements.
- Testing, if required by the City to demonstrate compliance with this specification, shall be performed per AASHTO T-180 by a Professional Engineer registered in the State of Colorado and practicing in the field of soils mechanics. All costs for such testing shall be paid by the Developer/Contractor. Refer to the applicable section in these STANDARDS AND SPECIFICATIONS for compaction requirements within the public Right of Way.
- Upon completion of earthwork operations, the Developer/Contractor shall leave the site and soil clean to allow for proper installation of irrigation, plantings, and related site improvements.
- Completed grades shall be smoothly and uniformly sloped, properly compacted and shall provide drainage away from site improvements. All banks or slopes constructed shall be maintained in a stable condition by approved methods to prevent slips, washouts, or erosion.
- No area to be seeded or sodded shall be steeper than a 4:1 maximum slope (4 horizontal: 1 vertical), nor flatter than a 2-percent minimum slope. Final grades shall conform to the final drainage study and grading plans.

6.4 Erosion & Sediment Control Plans

6.4.1 Review and Approval

A person may not clear or grade land without first preparing an erosion and sediment control plan which has been approved by the City prior to the issuance of any required Grading Permit.

The Applicant shall submit an erosion and sediment control plan and any supporting computations to the City for review and approval. The erosion and sediment control plan shall contain sufficient information, drawings and notes to describe how soil erosion and off-site sedimentation will be minimized. The City shall review the plan to determine compliance with these STANDARDS AND SPECIFICATIONS, Mile High Flood District Storm Drainage Criteria Manual, Volumes 1 through 3 and the Municipal Code prior to approval. The plan shall serve as a basis for all subsequent grading and stabilization.

The City may impose such conditions thereto as may be deemed necessary to ensure compliance with the provisions of these STANDARDS AND SPECIFICATIONS, Mile High Flood District Storm Drainage Criteria Manual, Volumes 1 through 3 and the Municipal Code for the preservation of public health and safety.

Approved plans may remain valid for one year from the date of acceptance unless renewed by the City. Approved plans will become an exhibit to the City's Grading Permit.

6.4.2 Modifications to Approved Erosion and Sediment Control Plans

When inspection of the site indicates the approved erosion and sediment control plan needs modification, the modification shall be made in compliance with the erosion and sediment control criteria contained in these STANDARDS AND SPECIFICATIONS, the Mile High Flood District Storm Drainage Criteria Manual, Volumes 1 through 3 and Municipal Code.

The permittee shall submit requests for major modifications to approved erosion and sediment control plans, such as the addition or deletion of a sediment basin, to the City to be processed appropriately. This processing includes modifications due to plan inadequacies at controlling erosion and sediment as revealed through inspection.

The City may approve minor modifications to approved erosion and sediment control plans in the field if conditions so merit.

6.4.3 Grading & Erosion Control Notes

The following minimum grading and erosion control notes shall be stated on, as well as incorporated into the grading and erosion control plan:

Erosion Control Notes

All temporary erosion control facilities and all permanent facilities intended to control erosion of any earth disturbance operation shall be installed before any earth disturbance operations take place.

Any earth disturbance shall be conducted in such manner so as to effectively reduce accelerated soil erosion and resulting sedimentation and should not exceed the erosion expected to occur for the site in its totally undeveloped state.

All persons engaged in earth disturbances shall design, implement, and maintain acceptable soil erosion and sedimentation control measures, in conformance with the erosion control technical standards adopted by the City.

All earth disturbances shall be designed, constructed, and completed in such a manner so that the exposed area of any disturbed land shall be limited to the shortest possible period of time.

Sediment caused by accelerated soil erosion shall be removed from runoff water before it leaves the site of the earth disturbance.

Any temporary or permanent facility designed and constructed for the conveyance of water around, through or from the earth disturbance area shall be designed to limit the water flow to a non-erosive velocity.

Temporary soil erosion control facilities shall be removed, and earth disturbance areas graded and stabilized with permanent soil erosion control measures pursuant to standards and specifications prescribed in accordance with the provisions of the "Erosion and Sediment Control for Construction Activities" and in accordance with the permanent erosion control features shown on the soil stabilization plan approved by the City.

Permanent soil erosion control measures for all slopes, channels, ditches, or any disturbed land area shall be completed within fourteen (14) calendar days after final grading or the earth disturbance has been completed. When it is not possible to permanently stabilize a disturbed area after an earth disturbance has been completed or where significant earth disturbance activity ceases, temporary soil erosion control measures shall be implemented within fourteen (14) calendar days. All temporary soil erosion control measures shall be maintained until permanent soil erosion measures are implemented.

Grading Permits and Construction Observation

Before construction begins, the Applicant shall apply for a Grading Permit to the City of Northglenn. A permit may be issued if a grading plan and an erosion control plan have been previously submitted and accepted. A grading permit is required when the Developer/Contractor is performing grading on one of more acres.

The Engineering Division shall monitor all overlot grading and other earth disturbance activities for compliance with the Grading Permit. If the construction activities are not in compliance with the intent of the Erosion Control Plan, the Responsible Party shall be issued a stop-work order. Work will not be allowed to continue until the site is brought into compliance with the intent of the Erosion Control Plan.

Modification of Approved Plans

All proposed modifications of the accepted grading plan must be submitted along with all supporting materials to the Engineering Division. No work in connection with the proposed modifications shall be permitted without prior approval of the Engineering Division, approval for which may be issued if the Applicant can demonstrate that the modifications will provide soil erosion controls equivalent to or better than the originally approved soil disturbance plans.

Maintenance Requirements

Persons carrying out soil erosion and sediment control measures under this section, and all subsequent owners of property concerning which such measures have been taken, shall maintain all permanent erosion control measures, retaining wall, structures, plantings, and other protective devices. Should the Applicant or any subsequent property owners fail to adequately maintain the permanent erosion control facilities, retaining walls, structures, plantings, and other protective devices; the City reserves the authority, after properly notifying the owner of needed maintenance and the owner failing to respond to the City's demand for such maintenance, to enter affected property, provide needed maintenance and to charge the owner for the work performed by the City or its contractors.

Standard Erosion Control Details

Erosion control measures shall comply with the Standard Drawings included in these STANDARDS AND SPECIFICATIONS, however these may be revised or updated as necessary in compliance with the latest requirements of Mile High Flood District (MHFD) as applicable.

For projects having the potential to cause water pollution, the Storm Water Management Plan (SWMP) must be available on site and at all times and must be implemented year-round throughout the duration of the construction project.

Storm Water Management Plan (SWMP). The Designer should refer to the CDPHE SWMP development guidance materials.

Dust control measures shall be implemented at all times during the construction period until no longer required. Contractor shall pay for the removal of all silt from the storm drain systems and the inspection thereof.

6.5 Erosion Control

The primary goal of all erosion control systems is to prevent unacceptable erosion and maintain water quality at acceptable levels. This shall be accomplished by analyzing pertinent environmental factors and applying technical procedures which result in a workable plan.

There are two major elements in developing an erosion and sedimentation control plan. The first is an investigation and analysis of the natural characteristics of a site (such as soil type, steepness of slopes and available vegetation) that will help the Developer/Contractor anticipate where erosion problems might occur. Detailed information on soils, vegetation, topography, geologic and hydrologic conditions shall be obtained for the site. The second element is use of effective control measures. Attention shall be given to identify and evaluate problems that may cause serious erosion during and after construction. Runoff from the site, as well as runoff from the watershed above, shall be controlled and discharged safely. Measures shall be taken to prevent erosion and sediment deposition on downstream properties.

6.5.1 Limitations

No person shall clear or grade land without implementing soil erosion and sediment controls in accordance with the requirements of these STANDARDS AND SPECIFICATIONS, Mile High Flood District publication known as the Urban Storm Drainage Criteria Manual, Volumes 1 through 3 and Municipal Code.

Chapter 7. SANITARY SEWER SYSTEM

7.1 Introduction

All sanitary sewer systems shall comply with the requirements of these STANDARDS AND SPECIFICATIONS and may include special criteria established by the Engineering Division for overall hydraulics of the sanitary sewer system. Special criteria shall be outlined at a Pre-Application (Developer)/Pre-Design (City Projects) meeting.

The use of sanitary sewers within the City of Northglenn shall be in accordance with applicable sections in **Chapter 7 – Sanitary Sewer Systems** of the Municipal Code.

7.2 Design Criteria - Planning

7.2.1 Scope

It is the intent of this "design criteria" section to provide sufficient detailed information to enable the Designer for the Owner/Developer to correctly and efficiently design the overall sanitary sewer system for a particular project. If there is a question or a concern regarding the design of any portion of the sanitary sewer system that is not adequately answered within this chapter, the Owner/Developer or their representative shall contact the Engineering Division to address all issues resolved prior to design.

CDPHE Oversight and Approval. Outfall sewers, pumping stations, interceptors and appurtenances are included under the definition of "domestic wastewater works" in the State Water Quality Control Act. Section 25-8-702 of the State Water Quality Control Act states: "No person shall commence the construction of any domestic wastewater treatment works or the enlargement of the capacity of an existing domestic wastewater treatment works, unless the site location and the design for the construction or expansion have been approved by the division (Colorado Department of Public Health and Environment, CDPHE)." Section 25-8-103 (5) of the State Water Quality Control Act states: "Domestic wastewater treatment works means a system or facility for treating, neutralizing, stabilizing, or disposing of domestic wastewater which system or facility has a designed capacity to receive more than two thousand gallons of domestic wastewater per day." Therefore, all plans falling under this criterion shall be submitted to the CDPHE for approval prior to construction of any domestic wastewater treatment works, including wastewater treatment plants, individual sewage disposal systems, lift (pumping) stations and certain interceptor sewers with a capacity of 2,000 gallons per day or greater, as well as certain facilities that produce reclaimed domestic wastewater.

General

The design process for sanitary sewer projects includes the submittal of a utility study (Refer to **Chapter 5 – Design Report Requirements**) and construction drawings for review and approval by the Engineering Division. Refer to CDPHE for sewage flow factor requirements. City sewage flow factor is 2.9 persons per dwelling unit at 151 gal/person/day.

The flows used to design the sanitary sewer system for a particular development or project vary depending on the type of project. There are three general categories of development/projects for which flow rates are given: residential development, commercial development and industrial development. Once the specific type of development is determined, the peak flows are calculated based on average demand, peak factor and infiltration/inflow amounts. The criteria for all sanitary sewer system for analyses is based on the current AWWA Standards.

7.2.2 Hydraulic Design/Downsizing of Sewer Lines

General

- **Design.** Sanitary sewer shall be designed to carry the discharge calculated in accordance with the Northglenn Collection System Modeling Report and to transport suspended material such that deposits in the sewer are precluded.

- **Minimum Pipe Size.** The minimum diameter for sanitary sewer mains shall be 8-inches. At peak flow in sanitary sewer main must not exceed 80% of pipe capacity or it shall be re-sized to carry the appropriate peak flow.
- **Oversizing.** Oversizing of mains may be required by the Engineering Division, and costs of such oversizing shall be borne by the City; however, if such oversizing is required to meet the needs of the Developer, the full cost thereof shall be borne by the Developer. The Public Works Engineering Division reserves the right to size mains to provide service for future needs.
- **Minimum Service Line Size.** The minimum diameter for sanitary sewer service lines shall be 4 inches.

Sanitary Sewer Mains

For minimum and maximum allowable slopes for sanitary sewer mains. Refer to CDPHE for sewer slope for pipes up to 21". All pipes over 21" will require separate design calculations in the Utility Report and Engineering Division review.

The sewer must be designed at a slope great enough to produce a flow velocity of two feet (2') per second at the peak design flow using the Manning equation and $n = 0.015$ but not less than the minimum slope given above. Maximum flow 8 feet per second.

Hydraulic design of pressure sanitary sewers shall be in accordance with these standard specifications.

Sanitary Sewer Service Lines

Table 7.1 shows the minimum and maximum allowable slopes for sanitary sewer service lines:

Table 7.1: Service Line Size and Slope

Diameter (Inches)	Minimum Slope (Foot/Foot)	Maximum Slope (Foot/Foot)
4	0.0208	0.0800
6	0.0104	0.0600

7.2.3 System Layout

Location

All mains shall be installed in dedicated Right of Ways or public easements. Under no circumstances should sanitary sewer mains be installed parallel to and directly below any concrete such as sidewalks, curbs or gutters. Lines shall normally be located five feet south or east of street centerline. Sanitary sewer mains shall be straight between manholes, both in horizontal and vertical alignment.

Minimum Cover

Sewer mains will ordinarily have a minimum of eight feet of cover to finished ground surface. Where this will provide less than nine feet of elevation difference between the finished lot grade at building line and the top of the sewer main, it will be indicated on the plans that the lot is served by a "shallow sewer" and appropriate elevation information will be given.

Termination

Sewer mains will be extended at least ten feet uphill from the lowest lot corner of the uppermost lot to be served adjacent to the sewer main. Sewer mains will terminate in a manhole.

Horizontal Clearance

Sanitary sewer mains shall be laid a minimum of ten feet horizontally from any existing or proposed utility.

Steel Casing

When the sanitary sewer main passes under a highway, railroad or drainage or irrigation ditch, there shall be a minimum of 3-1/2 feet of cover and steel casing shall be installed in accordance with **Standard Drawing W-17**. The steel casing shall extend the entire width of the Right of Way or easement of the crossing structure or as directed otherwise by the City Engineering Division. In certain circumstances, the City Engineering Division may require grouting or 'bricking' closed the end of the pipes.

For casings under irrigation ditches, the Designer shall contact the ditch company and coordinate with them on their design requirements.

Minimum Vertical Clearances

The minimum vertical clearance for utility crossings is two feet (2').

7.2.4 Easements

Utility easements shall be a minimum of twenty feet (20') for one utility, thirty feet (30') for two utilities and forty feet (40') for three utilities.

7.2.5 Future Connections

Manholes shall have pipes stubbed out which are sized to accommodate flows from the upstream basin whenever a future extension of the sanitary sewer main is anticipated. The main line stub-out shall be capped and sealed.

7.2.6 Services**Service Lines**

Each structure shall be served by a separate service line. Each service line shall have a cleanout. The sewer cleanout shall be located between the curb and sidewalk when the sidewalk is detached or in the sidewalk if not.

Horizontal Separation

Sanitary sewer service lines shall be located a minimum of ten feet away from all water services (measured horizontally).

Perpendicular Access

All service lines shall be constructed perpendicular to the property line of the property they are going to serve and not less than five feet from the side property line.

Location of Service Line

Typical installations should locate the sanitary sewer service line five feet downstream of the centerline of the lot. An 'S' shall be stamped on all new curbs for the location of each new service being installed.

Manhole Connections

Six-inch (6") service lines and larger shall require connection to the main with a manhole. Any service line tying into a main line larger than eight inches (8") shall also be enclosed within a manhole. Pressure line must be connected to a manhole prior to entering the City's sanitary sewer line.

Stub Outs for Future Connections

The City shall not be responsible for locating sewer service lateral stub-outs for future connections.

7.2.7 Taps

All sanitary sewer service connections to the sanitary sewer main shall be made using "wye" fittings. The City Engineering Division requires "Concrete encasement of the Eye" refer to **Standard Drawing SS-6**.

7.2.8 Unlawful Connections

It shall be unlawful to discharge roof drainage, foundation drainage, sump pumps, surface drainage or any other non-acceptable waste streams to the sanitary sewer which would violate any of the provisions of the Municipal Code.

7.2.9 Appurtenance

Manholes

The maximum spacing between manholes shall be 400 feet. Manholes shall not be located in areas which are subject to flooding from surface runoff. Manholes shall be located in areas which allow direct access by maintenance vehicles when it is not feasible to locate the manhole in the public street. If manholes are located outside of the Right of Way, they must be in an easement as described in Section 7.2.4.

If the possibility of surface runoff cannot be avoided, an internal watertight insert shall be installed to prevent inflow. All manholes located outside dedicated street Right of Ways shall be designed and constructed with locking-type cover and the manhole ring shall be bolted to the manhole cone and steel marker posts and shall be at eighteen inches (18") above the adjacent grade.

At the termination of a force main, outside drop manholes or other locations at which hydrogen sulfide gases (H₂S) is deemed to be a problem, a chemical and or gas resistant manhole lining will be required. The City requires Sewpercoat Protector 401 lining or approved equal.

Underdrains

Where underdrains are to be constructed under sewer mains, separate clean-outs shall be provided next to each manhole in accordance with **Standard Drawing SS-11**. Further, all underdrain service lines originating from within lots shall meet these requirements including size, marking tape and sock.

Sizing. The Designer is responsible for the sizing as per recommendations in the Utility and Geotechnical reports (Refer to **Chapter 5- Design Report Requirements**).

7.3 Materials & Facilities Requirements

7.3.1 Excavation & Trenching

Excavation, trenching and backfilling shall be done in accordance with **Chapter 14- Trenching, Backfilling and Compacting - Utilities** of these STANDARDS AND SPECIFICATIONS.

7.3.2 Bedding

Bedding shall conform and be installed in accordance with **Chapter 14- Trenching, Backfilling and Compacting – Utilities** of these STANDARDS AND SPECIFICATIONS.

7.3.3 Pipeline Installation

General

The Engineering Division shall be notified at least 48 hours in advance of any pipe installation. No pipes shall be backfilled until they have been inspected by the Engineering Division. Alignment and grade of the pipe and the location of fittings and manholes shall be staked under the supervision of a professional surveyor registered in the State of Colorado.

Proper implements, tools and facilities shall be provided and used by the contractor for the safe and convenient execution of the work. All pipe fittings and manhole sections shall be carefully lowered into the trench by means of a derrick, ropes or other suitable tools or equipment to prevent damage to sanitary sewer line material. Under no circumstances shall sanitary sewer line materials be dropped or dumped into the trench.

All pipe fittings and pre-cast manhole sections shall be carefully examined for cracks and other defects immediately before installation. The groove in the bells of the pipe shall be full and continuous or the pipe will be rejected.

Defective pipe or fittings shall be removed from the job site within 24 hours of notification by the Engineering Division. All foreign matter or dirt shall be removed from the interior and ends of the pipe before they are lowered into position in the trench and prior to connection.

Every precaution shall be taken to prevent foreign material and trench water from entering the pipe and fittings.

During construction, the contractor shall provide and maintain adequate equipment to properly remove and dispose of all water entering the trench and any other part of the work.

Pipe

Pipe shall be laid from downstream to upstream with spigot ends pointing downstream. All pipe shall be placed true to line and grade and carefully centered and with a smooth invert at the joint. The joint shall be made in a workmanlike manner and shall be watertight. Immediately before joining two lengths of pipe, the inside of the bell and the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure that the correct type of gasket is used. The Contractor shall follow the pipe manufacturer's instructions for gasket lubrications and other joint assembly instructions. The spigot end of the pipe shall be placed in the bell with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint. The pipe shall then be properly set and brought to correct line and grade. The pipe shall then be secured in place by installation of bedding material and backfill, in accordance with **Chapter 14 - Trenching, Backfilling and Compacting – Utilities** and the **Standard Drawing SS – 4**.

At times when installation is not in progress, the open ends of the pipe shall be closed with a watertight plug. Cutting of pipe for inserting closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining, leaving a smooth end at right angles to the axis of the pipe. Pipe ends shall be smooth and beveled with a file or other tools according to the pipe manufacturer's recommendations.

Extra care should be used in handling PVC pipe during cold weather due to the reduced flexibility and impact resistance as temperatures approach and drop below freezing. PVC pipe to be stored outside and exposed to sunlight for more than 30 days shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover

the pipe. Air circulation shall be provided under the covering. Any over-exposed pipe, as determined by the City, will not be permitted for installation.

No pipe or appurtenant structure shall be installed upon a foundation in which frost has penetrated or at any time when the City deems there is a danger of ice formation or frost penetrations at the bottom of the excavation. No pipe or appurtenant structure shall be installed unless backfilling can be completed before the formation of ice and frost.

7.3.4 Manhole Requirements

Cast-in-Place Base

Table 7.2: Cast-in-Place Manhole Details

Bases	Manhole bases shall be constructed per ASTM C-478 and C-858 with Class B concrete, placed on undisturbed ground and in conformance with the Standard Drawing SS-1 in Appendix G.2 Concrete bases shall extend at least eight inches below the invert of the pipe and shall be benched to at least two inches over the top of the pipe. The manhole floor between the sewer pipe and the outer portions of the bench shall be flush with the top edges at the pipe spring line and shall slope upward at least two inches per foot. No pipe shall be designed or constructed through the manhole. Connections from the pipe to manhole shall be constructed with boot connectors. The base shall have a 0.1' drop across manhole base.
Change in Flow	Changes in direction of flow through the manhole shall be made with a smooth curved channel having as large a radius as possible. The change in size of channels shall be made gradually and evenly and shall be formed directly in the concrete.
Finish	The floor of the manhole outside of the channel shall be finished to a brushed surface.
Base Reinforcement	Reinforcement will be required in all manhole bases. Precast base and invert must be used in all cases except when approved by the City Engineering Division. Manhole deeper than 15 feet may require additional reinforcement. Reinforcement shall be designed and provided on construction plans for approval prior to construction.

Precast Base/Inverts

- **Pre-Cast Bases.** Precast bases will be allowed by the Engineering Division and shall be in conformance with this section. There is a 0.1' drop across the manhole base.
- **Subbase.** The ground surface below the precast concrete base shall be excavated six inches below the elevation of the bottom of the base and backfilled with three quarter inch gravel. The gravel shall be carefully leveled and smoothed to give uniform support to the precast base over its entire area. The precast base shall be set at the proper location to center the manhole over the sewer main.

Precast Barrel

- **Setting of Manhole Sections.** Precast manhole sections shall not be placed on the foundation until it has reached sufficient strength to provide support without damage.

- **Joint.** The joint between the manhole base and the barrel section shall be made with a flexible butyl resin joint sealing compound. Each succeeding precast section shall be joined in a similar manner and smoothly finished, inside and out.
- **Intermediate Platform Requirements.** In the event that the distance between the manhole invert and the ring and cover exceeds seventeen feet (17'), a precast concrete platform shall be installed. The platform shall conform with Section 7.5.5 and **Standard Drawing SS-3**.

Manhole Grouting Treatment

Table 7.3: Manhole Grouting

Horizontal Joints	The horizontal joints between precast manhole sections shall be plastered and troweled smooth, inside, and out, with cement mortar.
Mortar Thickness	The mortar shall be not less than five eighths inch in thickness over the joint and shall extend at least four inches on either side of the joint.
Water Stop Gasket	All smooth surface pipes, such as PVC shall have a manhole water-stop gasket, to be furnished by the contractor, firmly attached to the pipe prior to grouting into the manhole.

Adjustment Rings

- **Precast Adjustment Rings.** Precast concrete adjustment rings shall be used on top of the cone to support and adjust the manhole frame to the required final grade.
- **Maximum Depth of Rings.** The maximum depth of the adjustment rings shall be six inches and the maximum depth from top of cone to final grade shall be twelve inches. The top elevation of the manhole shall be adjusted to match final street grade.

Cleanouts

All sanitary sewer services are required to provide a Cleanout. See **Standard Drawing SS – 6 or SS - 11**.

Manholes Off-Pavement

- **Manholes Outside of Pavement.** If manholes are located in open fields, they shall be left at least eighteen inches above grade and a locking ring and cover shall be installed.
- **Location in Fields.** In cultivated areas, manholes shall be properly marked by a steel post painted green on the top six inches and located five feet from the centerline of the manhole cover.

7.3.5 Connections to Existing Manholes

Sewer pipe connections to existing manholes where there is no existing pipe stubbed out shall be made in such a manner that the finished work will conform as nearly as practicable to the requirements specified for new manhole construction. The Contractor shall break out as small an opening in the existing manhole as necessary to insert the new sewer pipe. The existing concrete foundation bench shall be chipped to the cross-section of the new pipe in order to form a smooth continuous invert similar to what would be formed in a new concrete base. Where practical, the downstream invert shall be plugged during construction to prevent storm and non-sewage flow from entering the

system. The Contractor shall pump out and clean the manhole before removing the plug. Cement mortar shall be used to smoothly finish the new invert and to seal the new line, both inside and outside, so the junction is watertight.

7.3.6 Underdrains

General

- **Need for Underdrain.** Where excessive ground water is encountered, the Engineering Division will require construction of a piped underdrain, to reduce infiltration. Underdrains shall be daylighted to the nearest suitable point as shown on the approved construction drawings.
- **Cut-Off Walls.** Cut-off walls may also be required to minimize the movement of the groundwater through utility trenches.
- **Engineered Design.** Underdrain main construction shall be done in accordance with engineered construction plans for the work prepared under the direction of a registered professional engineer and accepted by the Engineering Division.
- **Report Requirements.** Subsurface investigations to determine soil properties and provide underdrain design recommendations are prerequisite to the underdrain system. A written proposal on the underdrain system must be presented to the City of Northglenn as part of the Utility Report required in **Chapter 5- Design Report Requirements**. This report must be accepted and approved before the Public Improvements Agreement is approved.

System Layout

- **Location.** Underdrain shall be placed in its own trench approximately 1-1.5 feet below sanitary sewer main.
- **Cleanouts.** All underdrain cleanouts should be located in either a storm sewer vault or in its own valve box. Underdrain cleanouts will not be permitted in sanitary sewer manholes.

Materials

- **Requirements.** All underdrains shall be constructed in perforated and/or non-perforated ASTM D 3034 SDR-35 PVC pipe or ASTM D3034, with a tracer wire attached for locating purposes.
- **Size.** A minimum of 6-inch PVC pipe shall be used for all underdrain mains and services.
- **Filter Fabric.** Underdrains shall be lined in filter fabric prior to installation only if perforated.

Mapping

As-built mapping and address plats should be provided to the Engineering Division prior to date of acceptance. All maps must provide adequate details of the underdrain prior to being accepted by the Engineering Division. GPS coordinates shall be shown for all manholes, inlets, and outlet pipes as well as any special features.

Inspections

- **Engineering Division Inspection.** The Engineering Division shall inspect underdrain mains prior to backfill. If the Contractor covers the pipe prior to inspection, the Engineering Division will require the contractor to re-expose the pipe for the required inspection.
- **Location of Clean Outs.** Underdrain cleanouts must be located outside of sanitary sewer manholes. See **Standard Drawing SS - 8**.

- **Daylighting of Underdrain.** Underdrain daylightings shall be placed to avoid being covered by dirt. This daylighting location shall be designed and provided on the Final Construction Drawings.

Bedding

- **Depth of Bedding.** Granular bedding material shall be installed a minimum of 12 inches above the top of the pipe and 12 inches below the invert of the pipe. (Granular bedding material will be the equivalent of squeegee.)
- Squeegee Sand

Table 7.4: Squeegee Sand Grading

Sieve Size	Total Percent Passing by Weight
3/8- inch	100
No. 200	0 - 5

- **Backfill Depth Limits.** Backfill must be placed in lifts not exceeding 6 inches.

Backfill

All trenching, backfilling and compaction of underdrain shall be done in accordance with **Chapter 14 – Backfill, Trenching and Compacting – Utilities** of these STANDARDS AND SPECIFICATIONS.

7.3.7 Pressure Sewers

All requirements of **Chapter 8 - Water System** of these STANDARDS AND SPECIFICATIONS shall apply to the installation of pressure sanitary sewer lines. All pressure sanitary sewers shall be installed using PVC AWWA C-900 or AWWA C-905.

A green plastic identification strip, a minimum of a six-inch wide, continuously labeled "Caution Sewer Line Below" shall be installed directly above the pressure sewer, the full length of the sewer, and shall be buried midway between the top of the pipe and the finished ground surface elevation.

7.3.8 Sanitary Sewer Service Line Construction

Conformance

All sanitary sewer service lines which connect to the City of Northglenn sanitary sewer system shall comply with these STANDARDS AND SPECIFICATIONS.

Appurtenances

The contractor shall place wyes, stubs and risers where required by the approved construction plans.

Table 7.5: Sanitary Sewer Appurtenances

Risers	Riser connections shall be installed where the elevation of the top of the branch is more than twelve feet below the approved finished grade. Riser connections will ordinarily reach to a grade ten feet below the finished ground surface.
Water-tight Plugs	Water-tight plugs shall be installed in each branch pipe or stub. As-built measurements shall be made by the contractor or his representative to reference the wye or riser connection to the nearest manhole before backfill. Said measurements shall be carefully and accurately made and recorded and shall be shown on the Record Drawings applicable portions of ASTM D-2321 (latest revision) and to the pipe manufacturer's installation instructions.
Laying of Pipes	The grooves shall be cleaned free of all foreign materials prior to assembling the joint. The pipe shall be laid with the spigot end pointing in the direction of the flow.
Dry Trenches	Trenches shall be kept free of water during laying and jointing. Lines longer than fifty feet shall be laid with a laser, or other means approved by the Engineering Division.
Clean Outs	Clean-outs are required at a minimum interval of 100 feet or at all bends or changes in grade. The area around a clean-out shall be graded so water runs away from the clean-out. No clean-outs, other than those installed as part of the sewer main underdrain system, shall be installed in publicly owned Right of Ways or easements.
Service Stub-Ins	Service stub-ins shall be extended at least ten (10) feet into the property and be plugged with a compression stop.
Backfilling	Backfilling shall be in accordance with Chapter 14- Trenching, Backfilling and Compacting - Utilities of these STANDARDS AND SPECIFICATIONS.
Risers	Riser connections shall be installed where the elevation of the top of the branch is more than twelve feet below the approved finished grade. Riser connections will ordinarily reach to a grade ten feet below the finished ground surface.

Tapping Existing Sanitary Sewers

Where tees have not been installed in the sewer main, the main shall be tapped by machine drilling a hole sized to fit the saddle for the service line. The drilling machine and method of drilling and the saddle shall be approved by the Engineering Division. The saddle shall be sealed when attached to the main and held in place with metal straps or other approved methods. The saddle and sewer main shall be encased in concrete flowfill.

7.4 Tests

7.4.1 General

All sanitary sewer mains and appurtenances shall be cleaned and tested after backfill operations have been completed and compaction test results have been submitted to and approved by the Engineering Division. All required testing must be completed and reviewed prior to acceptance. Should the Engineering Division find that the completed line or any portion thereof fails any of the specified tests, the Engineering Division will not accept the new sewer line until such

time as the sewer line meets the test specifications. Once the sewer line is completed and before a "Release for Service" letter is issued, the contractor shall perform an air test and video inspection of the completed line. The use of alternate testing methods may be allowed or required in addition to those stated herein and as determined necessary by the Engineering Division. Alternate testing methods include water infiltration test, deflection test and additional video inspection.

The Contractor shall furnish all labor, materials, tools and equipment necessary to clean the pipe and appurtenances, make the tests and perform all work incidental thereto. Any damages to the pipeline caused by cleaning or testing operations shall be repaired or replaced by the contractor at his expense.

7.4.2 Air Tests

The contractor shall perform these tests with suitable equipment specifically designed for air testing sewers. The pipe or sections of concrete pipe to be tested, may be wetted before the air test. The line shall be plugged at each manhole with pneumatic balls. All service plugs shall be secured in place to prevent displacement during testing operations.

Low pressure air shall be introduced into the plugged lines until the internal air pressure reaches 4.0 psi plus 0.4 psi per foot of water table above the pipe invert, if any. At least two minutes shall be allowed for the air temperatures to stabilize before readings are taken and the timing started.

The portion being tested shall pass if it does not lose air at a rate to cause the pressure to drop from 3.5 to 3.0 psi (plus any adjustments for water table pressure as mentioned previously) in less time than listed in Table 7.6:

Table 7.6: Air Test Specs

Pipe Diameter (Inches)	Minimum Allowable Time for Pressure Drop from 3.5 to 3.0 psi (Minutes)
4	3.0
6	3.0
8	4.0
10	5.0
12	6.0
15	7.0
18	9.0
21	10.5
24	12.0

If the installation fails this test, the testing equipment may be used to determine the location of the pipe leak. All failing tests shall be paid by the Contractor/Developer.

7.4.3 Deflection Test

The maximum vertical deflection for PVC pipe shall not exceed manufacture's recommendations. The Engineering Division may require the contractor to perform deflection tests of the pipe before acceptance. Optional devices for testing include calibrated television, photography, properly sized go-no-go mandrel, sewer ball or deflectometer. The method used shall be approved by the Engineering Division. To ensure accurate testing, the line shall be thoroughly cleaned prior to testing. Testing shall be done no sooner than 30 days after the pipe has been backfilled.

The contractor shall schedule the test with the City 48 hours prior to the test and the City shall be present during the test and shall verify the accuracy of the equipment used. The City may require the contractor to perform another deflection test prior to the end of the warranty period.

7.4.4 Pressure Test for Pressure Sewers

After the pipe has been laid, including fittings, thrust blocks, and backfill in accordance with the specifications, it shall be subjected to a hydrostatic pressure of not less than 150 P.S.I. for one hour. The allowable leakage shall not exceed the following formula:

$$L = \frac{SD \sqrt{P}}{148,000}$$

Where, L = Testing allowance (makeup water), in gallons per hour

S = Length of pipe tested, in feet

D = Nominal diameter of pipe, in inches

P = Average test pressure during the hydrostatic test, in pounds per square in gauge

Each valved section or the entire line if there are no valves, shall be slowly filled with water and the specified test pressure, measured at the highest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges and all necessary apparatus shall be furnished by the contractor. Gauges and measuring devices shall be approved by the City and the necessary taps made as required by the contractor. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made at the highest elevations of the test section and plugged with brass plugs once the pipeline has passed the test.

Any cracked or defective pipes, fittings, or valves discovered in the pressure test shall be removed and replaced by the contractor with sound material. The test shall be repeated until the pipeline passes the pressure test and is accepted by the City.

7.4.5 Manhole Leakage Test

Manholes shall be tested for leakage separately from the pipe when required. The sewer pipe in the manhole shall be sealed with watertight plugs. If the ground water table is below the invert, the manhole shall be filled with water to a depth five feet above the invert. The test level shall be clearly marked. The maximum leakage allowance shall be 0.00947 gallons per foot diameter per foot of depth per 24 hours. If the water level in the manhole drops during this 24-

hour period, the level shall be raised to the test level mark prior to the start of the test. All vent holes in the lid shall be plugged and the lid shall be installed prior to start of the test. The test shall last a minimum of 24 hours. Once the test begins, the manhole lid shall only be removed in the presence of the ENGINEER. Exfiltration will be determined by measuring the amount of water required to raise the water level back to the marked level at the end of the test period.

The manhole shall be considered to pass the water exfiltration test if the measured exfiltration is less than or equal to the allowable leakage specified in paragraph 1 above.

If a manhole fails the water exfiltration test, the manhole shall be repaired with a non-shrinkable grout or other material approved by the ENGINEER. The water exfiltration test shall then be repeated until a satisfactory test is obtained.

All observed leaks shall be corrected even if exfiltration is within the allowable limits. All temporary plugs shall be removed after each test.

If the ground water table is above the invert of the manhole, then the manhole shall be filled to a level at least three feet above the ground water table or to the top of the uppermost precast manhole section, whichever is less, but not less than five feet above the invert. After soaking for one hour, the manhole shall be filled to the original level. It shall then be tested for two hours. The allowable drop in the water level shall be one-quarter inch. No manhole shall be accepted that has any visible infiltration when empty. Any manhole whose test is unsatisfactory shall be repaired at the contractor's expense and retested until satisfactory results are obtained.

7.4.6 Video Inspection

The Contractor will perform video inspections unless otherwise specified by the City of all new sewer lines and all defects that have been repaired prior to acceptance. Upon completion of the video inspection, the Contractor shall provide a thumb drive or other form of an electronic file containing the inspection prior to the Owner releasing the retainage. In order to be considered for inspection, the improvements shall have been completed, accessible and cleaned sufficiently to allow for detailed inspection.

Cleaning Prior To Inspections

Sewer cleaning shall be by high-pressure jet cleaning to remove foreign materials from lines. The jet cleaning machine shall be capable of removing stones, grit, grease, sludge, and other debris from the sanitary lines by the flushing action of high-pressure water. Dumping of large volumes of water from hydrants or tankers is expressly prohibited.

The jet cleaning machine must be capable of providing a continuous flow of water at a minimum of 40 GPM and 2000 PSI. At a minimum, the cleaner shall use a 90% interior pipe diameter proofer skid at all times. Cleaning shall begin at the upper end of the system and proceed downstream to the outfall. The hose should be brought back at a proper yet steady speed for appropriate and satisfactory cleaning. If necessary, repeat the process to remove all debris. All debris shall be captured and prevented from entering the downstream portion of the existing collection system.

Sewers found to be improperly cleaned shall be cleaned and re-inspected at the contractor's expense.

7.5 Materials

7.5.1 General

Only those pipeline materials described in this section are approved for sanitary sewer installations. Any other material proposed as an equal shall be approved by the City prior to construction. All pipe materials to be incorporated in the construction of sanitary sewers shall conform to the requirements specified herein or as modified elsewhere in these STANDARDS AND SPECIFICATIONS. All materials furnished shall be new and undamaged. Everything necessary to complete all installations shall be furnished and installed whether shown on the accepted drawings or not and all

installations shall be completed and fully operational. Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Developer of the responsibility for furnishing materials meeting the requirements of these STANDARDS AND SPECIFICATIONS.

All materials delivered to the job site shall be adequately housed and protected to ensure the preservation of their quality and fitness for the work.

7.5.2 Defects

The presence of any of the following defects in an individual pipe or in a shipment of pipe, may constitute sufficient cause for rejection of the pipe. Rejected materials shall be removed from the work site within 24 hours unless otherwise permitted by the City.

- Pipe length varying more than two inches from the specified length. Pipe shall not be ordered in random lengths.
- Pipe having a deviation from straight which exceeds the following:
 - $(\text{Length of Pipe in Feet}) / (32) = \text{Maximum Deviation in Inches}$
- Porous areas on either the inside or the outside surface of a concrete pipe having an area of more than five square inches and a depth of more than one-half inch.
- Pipe which has been patched or repaired without City approval.
- Exposure of the reinforcement.
- Pipe damaged during shipment or construction.
- Any deficiencies noted in applicable ASTM Specifications.

7.5.3 Certification

A manufacturer's certification that material was manufactured and tested in accordance with applicable ASTM designations, together with a report of all test results, will be required by the City at substantial completion of the work.

7.5.4 Pipe

Polyvinyl Chloride Pipe (PVC) – Gravity

All gravity pipe materials and fittings shall meet the minimum requirements of ASTM D-3034, latest revision or ASTM F-679. Pipe shall be subjected to drop-impact tests in accordance with ASTM D-2444. The pipe shall have bell and spigot joints with gasketed joint per ASTM D-3212. The spigot end shall be marked so the installer and the inspector can determine when the pipe is properly inserted into the bell. The maximum pipe length shall be 20 feet.

Table 7.7: Minimum Pipe Wall Thickness for Gravity PVC Pipe

Pipe Diameter (Inches)	Wall Thickness (Inches)
4	0.125
6	0.180
8	0.240
10	0.300
12	0.360
15	0.437
18	0.499

All fittings and accessories shall be as manufactured and furnished by the pipe supplier and have bell and/or spigot configurations compatible with that of the pipe.

Pipe stiffness for all pipe sizes shall be tested in accordance with ASTM D-2412. Joint tightness shall be tested in accordance with ASTM D-2855.

Polyvinyl Chloride Pipe (PVC) – Pressure

All pressure pipe materials and fittings shall meet the minimum requirements of AWWA C-900 (latest revision) or AWWA C-905 (latest revision). Pipe shall be subjected to sustained pressure tests in accordance with ASTM D-1598. The pipe, couplings and fittings shall meet the requirements of ASTM D-1784. Gaskets and lubricants must be compatible with the pipe as well as in combination. The spigot end shall be marked so the installer and the inspector can determine when the pipe is properly inserted into the bell. The maximum pipe length shall be twenty feet.

Table 7.8: Minimum Pipe Wall Thickness for Pressure PVC Pipe

Pipe Diameter (Inches)	Wall Thickness DR18 (Inches)	Wall Thickness DR14 (Inches)
4	0.267	0.343
6	0.383	0.493
8	0.503	0.646
10	0.617	0.793

12	0.733	0.943
16	0.967	-
18	1.083	-

All fittings and accessories shall be as manufactured and furnished by the pipe supplier and have bell and/or spigot configurations compatible with that of the pipe.

PVC pipe and all fittings shall conform to the manufacturer's specifications.

7.5.5 Manholes

Table 7.9: General Manhole Design Requirements

Requirements	Manholes, reducing sections, ladder rungs and traffic lids shall be precast and conform to ASTM Standard Designation C-478.
Traffic Loading	All traffic lids shall be designed for AASHTO H-20 traffic loading.
Steps/Rungs	No rungs or steps are to be built into sanitary manholes.
Reducing Sections	Concrete reducing sections shall not be used. The top cone is not a reducing section.
Extension Collars	Concrete extension collars shall be used to bring the manhole ring and cover up to approved street or ground surface elevation.
Cast-Iron Locking Lid	All manholes not within the Right of Way shall have cast-iron locking lids.
Type of Concrete	Concrete used in the manufacturing or construction of manholes shall be a minimum of Class B concrete as per CDOT Standard Specifications in accordance with Chapter 15– Street Construction Standards of these STANDARDS AND SPECIFICATIONS.

Manhole Rings & Covers

All cast iron manhole rings and covers and other iron castings shall conform to the requirements of AASHTO M105/ASTM A48. Ductile Iron castings shall conform to the requirements of ASTM A536. All castings shall conform to Federal Specification, Commercial Item Description A-A-60005, for shape and dimension required. Castings shall be free from sand, blowholes, shrinkage, cracks, and other cold shuts and be well cleaned by shot blasting. Runners, risers, fins and other cast-on pieces shall be removed from the castings and ground smooth. Bearing surfaces between manhole rings and covers shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact.

Manhole frame or ring dimensions shall be 24" diameter, 8" tall or as otherwise approved.

Fittings shall be hot dipped, factory applied, water base, asphalt paint to form a firm and tenacious coating. Aluminum covers may be used for meter vaults where approved and must have a recessed cut out for a transponder. Aluminum rings may not be used.

Acceptable product is East Jordan Iron Works #2405A, Product #240561 (sanitary vault only) or approved equal.

Manhole Base Slabs

- **Constructed.** Pre-cast manhole bases are preferred by the City. In special circumstances, poured bases will be permitted.
- **H-20 Loading.** The slab shall be designed to uniformly support AASHTO H-20 traffic loading and any earth loading.
- **Minimum Thickness.** The minimum slab thickness shall be eight inches below bottom of the pipe and 2-inches above the top of the pipe.
- **Reinforcement.** The minimum reinforcement required in all base slab shall conform to the ***Standard Drawing SS - 1.***

Joint Material

Joint material used to set barrel sections shall be a flexible butyl resin joint sealing compound meeting Federal Specifications SS-S-00210(210-A) and AASHTO M 198-B.

Mortar

Mortar used within Manholes must follow the following:

Table 7.10: Mortar Guidelines

Mixture	Mortar used in repair of precast sections shall be composed of one-part Portland Cement and not more than three nor less than two parts of fine aggregate. Hydrated lime or masonry cement shall not be used.
Portland Cement	Portland cement shall meet the requirements of ASTM C-150, Type II. Fine aggregate shall consist of well-graded natural sand having clean, hard, durable, uncoated grains, free from organic matter, soft or flaky fragments or other deleterious substances.
Aggregate	The fine aggregate shall be thoroughly washed and shall be uniformly graded from coarse to fine with a minimum of 95 percent passing a No. 4 sieve and a maximum of seven percent passing a No. 100 sieve.

7.6 Industrial Pre-Treatment Devices

7.6.1 General

The section pertains to interceptor devices only. All pretreatment devices must be approved in writing through the City's Industrial Pretreatment Program.

This section pertains to interceptor devices only. All pretreatment devices must be approved in writing through the City's Industrial Pretreatment Program. The requirements established in the municipal code shall apply to facilities subject to the Fats, Oils and Grease (FOG) Sector Control Program established by the City. These facilities shall install and maintain a grease interceptor as directed by the City Engineering Division.

Sanitary Sewer Pre-Treatment Sewer-Monitoring Facility

Any new building to be constructed in an industrially-zoned area with a floor space greater than five thousand square feet or with a water meter size greater than three-quarter inch or if otherwise required by the City Engineering Division shall install a sewer-monitoring facility in accordance with the Standard Drawings prior to final building inspection approval. The monitoring facility shall be situated outside of the building on the user's premises. If the industrial user's service line ties into an existing City manhole and such manhole allows for safe sampling and isolation of the industrial user's discharge, the City Engineering Office may allow said manhole to serve as the industrial user's monitoring facility. Building with multiple tenants will be required to have multiple sewer-monitoring facilities.

Hydromechanical vs Gravity (Preference – Hydromechanical)

The requirements contained in this document are applicable to all commercial food service establishments, including those that are undergoing:

- New construction
- Interior remodeling to accommodate expansion or operational modifications.
- Changes of ownership/occupancy
- Facilities which may be experiencing difficulty in achieving compliance with maintenance and/or wastewater discharge limitations

Existing facilities with a gravity grease interceptor currently in operation must operate and maintain a grease interceptor at the standards of the City. Inspection by the City will identify if a facility's grease interceptor is correctly sized and operating efficiently. Under circumstances that the City deems the gravity grease interceptor poses a risk to wastewater back-ups the City may require upgrades to a hydromechanical grease interceptor.

All new grease interceptors shall be hydromechanical grease interceptors unless written exception is provided by the City.

7.6.2 Grease Interceptors

For Non-Domestic Facilities

All non-domestic facilities that prepare, serve, or otherwise make any type of food or beverages available for consumption are required to install and maintain a grease interceptor. An individual grease interceptor shall be provided for each building, lot or unit that requires an interceptor. Domestic waste is prohibited from entering the grease interceptor; thus, no toilets, urinals, and similar fixtures shall be connected to a building's grease interceptor. All domestic waste must be directed into the building's sewer and waste system. In addition, food and food waste shall not directly enter the grease interceptor.

Sizing of Hydromechanical

Hydromechanical grease interceptors (HGI) shall conform to the following requirements. The FOG Sector Control Program – Hydromechanical Grease Interceptor Design Form must be completed and stamped by a licensed Professional Engineer, or otherwise approved by the City of Northglenn Public Works.

HGIs must be certified to ASME A112.14.3, CSA B481, or PDI G101. They may be installed indoors or outdoors and shall have the minimum flow rate in gallons per minute (gpm) based on the kitchen fixtures connected and the minimum grease storage capacity based on a minimum service frequency of 90 days. The minimum flow rate and the minimum grease storage capacity can be determined through a two-step process.

They must be installed in an easily accessible location with access to the Engineering Office during the hours of 7 am to 5 pm and maintain a 3-foot clearance zone around to provide adequate space for inspection, cleaning, and removal of intercepted grease. Access to pre-treatment facilities shall always remain unobstructed. The removal of large objects such as boxes, crates, cans, etc. or the need for a ladder to inspect a wastewater pre-treatment facility shall constitute a violation. Refer to specific manufacturer requirements for details on compaction requirements and bedding type and depth.

STEP 1: SIZE BY FLOW RATE

Calculate the minimum required flow rate for the following three types of common kitchen fixtures: drainage fixtures, faucet fixtures, and cleaning fixtures. (See **Appendix F** for FOG Sector Control Program's Hydromechanical Grease Interceptor Design Form)

Drainage fixtures are filled and completely drained at the end of their use and includes the 3-compartment sink and cooking equipment like tilt skillets, braising pans, rotisserie ovens, and wok ranges. Flow is calculated using the Manning Formula which accounts for sink pipe drain size, pipe material and pipe slope to determine the maximum flow rate from fixture. Most drainage fixtures connect to a single drainpipe; if the fixture connected to a separate drainpipe, list as multiple fixtures.

$$Flow\ Rate\ (gpm) = 669 \times A \times R^{2/3} \times S^{1/3} \div n$$

$$\text{Where, } A = 0.7254 \times [Pipe\ Diameter\ (in.) \div 12]^2$$

$$R = 0.251 \times Pipe\ Diameter\ (in.)$$

$$S = Pipe\ Slope$$

$$n = roughness\ coefficient$$

Note: Manning's roughness coefficient, n, depends on the pipe material and age of the drainage pipe. Additionally, an estimate can be made for the minimum slope based on pipe size if slope is unknown.

Table 7.11: Manning's Roughness Coefficient

Roughness, n	PVC	Copper
Minimum (new)	0.008	0.010
Normal (used)	0.009	0.011
Maximum (old)	0.010	0.012

Table 7.12: Minimum Slope

Drainage Pipe Diameter	Minimum Slope
2 ½ inches or smaller	0.0208
3 to 6 inches	0.0104
8 inches or larger	0.0052

Also, it is assumed that 87.5% of the horizontal drainage pipe is wettable due to flow caused by gravity alone. (Contact City if sewage ejector pumps are used)

Faucet fixtures are not filled, but instead drain at their faucet's flow rate and includes sinks for food preparation, pre-rinse, equipment cleaning and waste food disposal units. If floor drains are present, their combined flow equals the fixture(s) supplying the spray. Sinks with two faucets count as two fixtures. Ignore hand-wash-only fixtures for sizing.

The International Plumbing Code requires most faucets discharge a maximum 2.2 gpm at 60 psi and service/mop sinks should discharge a minimum 3 gpm at 8 psi.

Cleaning fixtures have specific peak discharge rates that exceed faucet flow but are less than the maximum rate the drainpipe permits and includes dishwashers, clothes washers used for cleaning of food services-associated linens, and automatic food cleaning systems. A facility must provide a list with the manufacturer and model of all fixtures that specifies the flow rate.

The total minimum flow rate is calculated by summing the calculated flow rate from drainage fixtures, the flow rate from faucets discharge, and the flow rate of cleaning fixtures provided by the manufacturer.

Thus, HGI Flow Rate = DFQ + FFQ + CFQ = Minimum flow rate.

Note: DFQ (Drainage Fixture Flow), FFQ (Faucet Fixture Flow) and CFQ (Cleaning Fixture Flow)

STEP 2: SIZING BY GREASE PRODUCTION

Once the minimum flow rate has been established in Step 1, calculate the minimum grease storage capacity for the HGI required for the desired pump-out frequency as follows:

Required Grease Capacity = Grease Factor × Meals or Customers per day × Days between pumpout

Where, the grease factor is determined using the Table 7.13.

Table 7.13: Grease Factor

Type	Menu	Grease Factor ->	Without Fryer Without Flatware	Without Fryer with Flatware	With Fryer Without Flatware	With Fryer with Flatware
			A	B	C	D
1	Bakery		0.035	0.0455	0.035	0.0455
2	Bar and Grille		0.005	0.0065	0.025	0.0325
3	Barbeque		0.035	0.0455	0.035	0.0455
4	Breakfast Bar - Hotel		0.005	0.0065	0.025	0.0325
5	Buffet		0.035	0.0455	0.058	0.0754
6	Burger and fries, fast food		0.035	0.0455	0.035	0.0455
7	Cafeteria		0.025	0.0325	0.035	0.0455
8	Caterer		0.005	0.0065	0.025	0.0325
9	Chinese		0.035	0.0455	0.058	0.0754
10	Coffee Shop		0.025	0.0325	0.035	0.0455
11	Convenience Store		0.005	0.0065	0.025	0.0325
12	Deep Fried Chicken/Seafood		0.035	0.0455	0.058	0.0754
13	Deli		0.005	0.0065	0.025	0.0325
14	Family Restaurant		0.035	0.0455	0.035	0.0455
15	Frozen Yogurt		0.005	0.0065	0.025	0.0325
16	Greek		0.025	0.0325	0.035	0.0455
17	Grocery Bakery		0.025	0.0325	0.035	0.0455

		Without Fryer Without Flatware	Without Fryer with Flatware	With Fryer Without Flatware	With Fryer with Flatware
Type	Menu Grease Factor ->	A	B	C	D
18	Grocery Deli	0.025	0.0325	0.035	0.0455
19	Grocery Meat Department	0.025	0.0325	0.025	0.0325
20	Ice Cream	0.025	0.0325	0.035	0.0455
21	Indian	0.025	0.0325	0.035	0.0455
22	Italian	0.035	0.0455	0.035	0.0455
23	Mexican, Fast Food	0.035	0.0455	0.035	0.0455
24	Mexican, Full Fare	0.035	0.0455	0.058	0.0754
25	Pizza	0.025	0.0325	0.035	0.0455
26	Religious Institution	0.005	0.0065	0.025	0.0325
27	Sandwich Shop	0.005	0.0065	0.025	0.0325
28	Snack Bar	0.005	0.0065	0.025	0.0325
29	Steak and Seafood	0.035	0.0455	0.058	0.0754

Grease interceptors certified to meet the minimum requirement of ASME A112.14.3, CSA B481, and/or PDI G101, shall have the flow rates and minimum grease storage capacities as listed.

Table 7.14: Grease Storage

HGI Flow Rate	Minimum Grease Storage Capacity* (lbs.)
20	40
25	50
35	70

50	100
75	150
100	200

*Minimum grease capacity as required by ASME A112.14.3, CSA B481 and/or PDI G101

Sizing of Gravity Grease Interceptors

Gravity grease interceptors are to be sized based on the expected flow rate of three categories of kitchen fixtures (similar to HGI) in gallons per minute with criteria of hydraulic residence time of 30 minutes and a 25% FOG and solids storage factor. The design flow rate is one-third the maximum flow rate because of the bulk hydraulic compensation of short-term peak flow events.

$$Volume = [Maximum\ Flow\ R(gpm)] \times 30\ min \times 1.25\ Storage\ Factor \div 3$$

Where maximum flow rate is calculated by summing the calculated flow rate from drainage fixtures, the flow rate from faucets discharge, and the flow rate of cleaning fixtures provided by the manufacturer.

Thus, HGI Flow Rate = DFQ + FFQ + CFQ = Minimum flow rate. (For calculation details of DFQ, FFQ, and CFQ see section, Sizing of Hydromechanical)

7.6.3 Sand & Oil Interceptors

For Automotive Facilities

Non-domestic dischargers where work or service is performed includes automotive service, machine shops, parking garages, automotive care centers, auto body shops, car washes or any other facility that generate sand, petroleum oil, grease, or other petroleum products, grit, gravel, or other aggregate that may discharge into the wastewater collection system. Access to wastewater collection system is often via floor drains located inside shop areas that are not limited to non-polluting wastewater sources.

At repair garages, car washing facilities with engine or undercarriage cleaning ability, all oil-bearing, grease-bearing, and flammable waste shall be discharged to an hydromechanical grease interceptor before emptying in the building drainage system or other point of disposal.

Sizing

Where automobiles are serviced, greased, repaired, or washed or where gasoline is dispensed, an interceptor shall be installed having a minimum capacity of 45 gallons for the first one-hundred square feet of area to be drained, plus 7.5 gallons for each additional one-hundred square feet of area to be drained.

7.6.4 Best Management Practices

Best management practices (BMP) benefit facilities by preventing grease discharges and keeping interceptor maintenance cost low.

All food preparation facilities are required to follow kitchen BMP, including, but not limits to the following:

- Regularly train all employees on fats, oil, and grease control and management.

- Prevent grease from entering all fixture units.
- Excess food waste and grease must be scraped off plates prior to washing.
- Food waste must be disposed of in the garbage.
- Drain screens must be installed on all drainage fixture units.
- Cooking grease must be collected and recycled.

It is the responsibility of the waste generator to ensure compliance with the City's discharge limitation. Hazardous waste, such as acids, strong cleaners, pesticides, herbicides, paint, solvent, or gasoline should be disposed properly.

7.6.5 Operation & Maintenance

Periodic operation and maintenance inspection are performed by the City to ensure compliance. It shall be the responsibility of those engaged in the operation of the business activity to maintain the associated wastewater pre-treatment facilities in efficient functioning order.

Grease interceptors shall be pumped and cleaned of the accumulated matter as often as necessary to ensure maximum efficiency and to prevent non-compliance with applicable discharge. Must occur at a minimum of once per 90 days for Food Service Establishments and once per year for Automotive Facilities.

A hydromechanical grease interceptor is deemed to require service when settled solids and FOG exceed manufacturers' recommended depth. A gravity grease interceptor is deemed to require service when settled solids and FOG exceed 25% maximum depth.

The Engineering Division may require a business to maintain a specific grease interceptor pumping and cleaning interval based on observed problems or non-compliance related to grease production, accumulation, and wastewater discharges.

Grease interceptor pumping, cleaning, and hauling service companies must be hired to perform work for non-domestic grease producers in the City of Northglenn. If a facility produces more than 55 gallons of waste to dispose, an accredited and licensed grease transporter must be hired to remove the waste grease and dispose of it according to Colorado state law. The transport and disposal of waste grease is regulated under Colorado's solid waste regulation (6 CCR 1007-2, Section 18). The Division's website, www.colorado.gov/cdphe/wastegrease, has a list of registered waste grease transporter who can accept the waste.

Maintenance and pumping records must be kept onsite for a minimum of three years. The Engineering Division reserves the right to require a business to submit maintenance and pumping records to the Engineering Division within a week of the event.

Partial cleaning of grease interceptors is not allowed.

Enzymes, solvents, and emulsifiers are not permitted as these will only change the form of grease allowing it to be carried out of the grease interceptor with the wastewater and deposited in the collection system. Biological treatment systems must be pre-approved by the Engineering Division. These systems will not alleviate the necessity for inspection and proper maintenance.

7.6.6 Inspection & Construction

All permitting, construction, and inspection activities must be completed in accordance with the City Plumbing Code. Additionally, the following specifications must be incorporated into grease interceptor construction and inspection.

- In facilities where dishwashing machines are installed and water discharge temperature may exceed 150 °F, a tempering valve must be installed prior to the grease interceptor.
- All grease bearing waste streams, such as two-compartment sinks, three-compartment sinks, pot/pan sinks, dishwashers, mop sinks and floor drains should be routed through an appropriate grease interceptor.
- All hydromechanical grease interceptors shall be certified to ASME A112.14.3, CSA B481 or PDI G101. If the interceptor does not follow one of these standards, then an effluent sampling well must be implemented. Sampling wells will have an access cover and a drop from inlet to outlet pipe.

Design Form Documents/Worksheets

See **Appendix F**.

7.7 Lift Stations Specifications

7.7.1 General

Gravity Flow

The Engineering Division acknowledges the use of lift stations on their sanitary sewer system; however, there are limited occurrences where a portion of the Engineering Division cannot be served by gravity that the Engineering Division will consider the construction of a sewage lift station.

CDPHE Requirements

The lift station must satisfy all of the requirements of the Colorado Department of Public Health and the Environment (CDPHE), 208 agencies and in accordance with the Engineering Division requirements. The requirements set forth in this section are minimum requirements and additional requirements may be applied.

CDHPE Application

The Engineering Division will require that the Developer's Designer and/or Contractor prepare the "Application for Site Approval" for the submittal to the Colorado Department of Health and a set of Record drawings of the sewage lift station in accordance with these Standards and Specifications. The Owner/Designer will be responsible to acquire approval through the applicable agencies and must keep the Engineering Division involved in the process.

Operation & Maintenance Manuals

Upon completion of the lift station construction, the Contractor shall also provide the Engineering Division with four copies of an "Operation and Maintenance Manual" for the lift station. All lift stations must have all approvals from the Engineering Division and other agencies before construction will be permitted.

Duplex Station

New lift stations will be duplex station, where each of the two pumps will be capable of meeting 110% of the station design flow. Built out flow based on full development and zoning must be considered as design flow.

Hardware Specification

All hardware exposed metal surfaces to sewage or are outside must be 316 stainless steel.

Submersible Pumps

Submersible pumps shall pass a minimum 2 inches diameter solids. All new lift stations for all new dry/wet stations are not accepted.

Maximum Detention Time

Lift Stations maximum detention time in the wet well must not exceed 30 minutes. In some cases, larger pumps station may be required, which shall be constructed with three or more pumps.

Discharge

All lift stations shall discharge to a manhole prior to gravity flowing to a sewer main.

Approval of Lift Stations

All lift stations have unique sites and/or characteristics requiring review and approval on a case by case basis.

Chapter 8. WATER SYSTEM

8.1 Introduction

All water distribution systems constructed within the City of Northglenn shall comply with the requirements of these STANDARDS AND SPECIFICATIONS and may include special criteria established by the City for overall hydraulics of the water utility system. Special criteria shall be outlined at pre-application meetings, as determined necessary by the Engineering Division.

In the case of water mains larger than 12 inches, the Designer shall submit construction specifications to the Engineering Division for review and acceptance prior to the Engineering Division's review of the construction drawings.

8.1.1 Interruption of Service

The Engineering Division will operate all existing valves, hydrants, blow-offs and curb stops. NO VALVE OR OTHER CONTROL DEVICE ON THE EXISTING PUBLIC SYSTEM WILL BE OPERATED FOR ANY PURPOSE BY ANYONE OTHER THAN THE CITY WITHOUT PRIOR WRITTEN AUTHORIZATION. Twenty-four hours prior to the interruption of service, the Contractor shall notify all users whose service will be interrupted in order for them to make provisions for necessary water storage. For water mains servicing commercial areas (i.e., restaurants) 48 hours prior notice shall be given and work affecting the shutdown shall only be performed between the hours of 1:00 a.m. and 5:00 a.m. No line in service will be shut down for more than a four-hour period at one time. Prior approval by the Engineering Division is required for all shutdowns.

8.1.2 Water Breaks

If notification prior to shutdown is impossible, the Contractor shall notify all users within one hour after the shutdown. Since prior notification was not possible, it will be the responsibility of the Contractor to supply potable water to the users affected. The Developer/Contractor shall also contact the Engineering Division and Fire District in reference to this emergency shutdown within one hour. All fire line valves are owned and operated by the Fire District.

8.1.3 Meter Set Installation Reinspection Fee

Water tap fees provide for inspection of the meter set only. Where additional inspections are made necessary by incomplete or faulty work, no fee shall be charged for the first two inspections; however, a fee will be charged for the third inspection and each subsequent inspection. This fee shall be charged to the holder of the permit and paid to the City before any additional inspections will be made.

8.2 Design Criteria

8.2.1 Scope

It is the intent of this "design criteria" section to provide sufficient detailed information to enable the Designer to correctly and efficiently design the overall water system for a particular project or development. The Engineering Division recommends that the Designer plan a pre-application/pre-design meeting to review and answer concerning design questions.

8.2.2 Design Flow

The flows used to design the water system for a particular Project vary depending on the type of land use associated with the Project. There are two general categories for which flow rates are given: residential Project and commercial/industrial Project. Once the specific type of development is determined, the peak flows are calculated based on average demand, peak day, and peak hour factors. With each type of development, there is also a unique fire

flow that shall be considered when designing the system. The Fire District shall provide the required fire flows to be used in the analysis.

The following is a list of the criteria to be used in the preparation of all water system analyses:

Table 8.1: Water System Analyses Criteria

	Residential	Commercial/Industrial
Assumptions	2.9 people/unit for all single-family residential units ⁽¹⁾ 1.8 people/unit for all multi-family units, including apartments	For planning purposes only use 1,000 gallons per day per acre for average demand.
Average Demand	151 gallons/capita/day ⁽²⁾	300 gallons/day/1,000 square foot floor area (gross) ⁽³⁾
Peak Day Factor	2.5 ⁽²⁾	2.5 ⁽²⁾
Peak Hour Factor	4.0 ⁽²⁾	4.0 ⁽²⁾

⁽¹⁾ From "1988 Population and Household Estimates," or latest edition published by the Denver Regional Council of Governments with revisions by the City of Northglenn Planning Department.

⁽²⁾ From "Evaluation of Potable Water Storage Distribution and Pumping System", 1998.

⁽³⁾ From "Water Supply and Sewerage Fifth Edition," E.W. Steel and Terence J. McGhee

Table 8.2: Fire Flow

Fire Flow to be determined by the Fire District		
Fire Flow Analysis	Analyze system to the greater value:	
	Max Day plus Fire Flow	Peak Hour
Minimum Residential Pressure plus Fire Flow	20 psi ⁽⁴⁾	

⁽⁴⁾ Exceeds the minimum requirements of the latest adopted International Building Code.

8.2.3 Hydraulic Design

State of the art engineering practices and techniques shall be used when analyzing and designing the hydraulics of the proposed water system. The Engineering Division shall review any proposed modeling software to determine if it is acceptable.

8.2.4 Operating Pressures Within the Distribution System

Static pressure within the distribution system shall be a minimum of 40 pounds per square inch during the maximum hour demand and a maximum of 125 pounds per square inch static pressure at the main. The maximum pressure

fluctuation at any location in the distribution system between maximum hour demand and minimum hour demand shall not exceed 30 pounds per square inch.

8.2.5 Pressure Regulating Stations

Pressure reducing valve (PRV) installations are used to control pressure between distribution zones. For main extensions, the Designer should determine the need for a pressure regulating valve installation based on existing zones and the existing distribution system. Plans shall be submitted as part of the utility study indicating size, type, and location of the PRV installation. All calculations shall be submitted to the Engineering Division for review with the Utility Study. A PRV will be required if directed by the Engineering Division.

8.2.6 Sizing of Mains

Distribution Mains

All mains shall be sized large enough to provide for domestic, irrigation and fire protection flows to the area serviced. The maximum acceptable head loss for six, eight and twelve-inch mains is two feet per thousand feet of main. The minimum diameter for water mains in residential areas, including cul-de-sacs, shall be 6 inches. All schools, shopping centers, business parks, industrial parks and high-density residential areas shall be looped with mains at least 8 inches in diameter. All waterlines shall be looped and not be built as dead-end lines, except when the lines extend into cul-de-sacs serving not more than 12 single-family residential units.

For development projects, oversizing of mains may be required by the City, and the recovery of the costs of such over sizing shall be in accordance with the Municipal Code.

Transmission Mains

All transmission mains shall be sized in compliance with the City's "Northglenn Treated Water System Modeling Evaluation", latest edition.

8.2.7 System Layout – Design

Pipe Within Right of Way or Easements

All mains shall be installed in dedicated Right-of-Ways or public easements. Water main installation in easements between single-family residential lots will only be allowed for the purpose of looping a water main at the end of a cul-de-sac. Waterlines shall not be installed adjacent to and directly below any concrete such as sidewalks, curbs or gutters. Water lines shall typically be located 5 feet north or west of street centerline or 5 feet north or west of a curbed median.

Minimum Cover

All mains shall be installed in dedicated Right-of-Ways or public easements. Water main installation in easements between single-family residential lots will only be allowed for the purpose of looping a water main at the end of a cul-de-sac. Waterlines shall not be installed adjacent to and directly below any concrete such as sidewalks, curbs or gutters. Water lines shall typically be located 5 feet north or west of street centerline or 5 feet north or west of a curbed median.

Horizontal & Vertical Spacing

Water mains shall be laid a minimum of ten feet horizontally from any existing or proposed utility, per Colorado Department of Public Health and Environment "Design Criteria for Potable Water Systems" (latest revision).

- **Exception.** In re-development areas or physically constrained areas, the Engineering Division may allow a water main may be laid closer than ten feet to a parallel sewer main if it is laid in a separate trench and if the

elevation of the invert of the water main is at least 24 inches above the crown of the sewer main. In addition, PVC C-900 is used for the sewer main.

- **Extend Along Frontage.** Water mains shall be designed such that they extend the entire frontage of the property to be served or as approved by the Engineering Division.
- Under no circumstances shall the vertical clearance between any lines involving a waterline, sanitary sewer line or storm sewer be less than 24 inches.

Casing Requirements

When the water main passes under a highway, railroad or waterway, there shall be a minimum of five feet of cover and a steel casing shall be installed in accordance with the Standard Drawings. The steel casing shall extend the entire width of the Right of Way or easement of the crossing structure or as otherwise approved by the Engineering Division. In all cases, valves shall be located such that the water main at such crossings can be completely isolated without interruption of any services.

Main Crossing Scenarios

Table 8.3: Main Crossing Scenarios

Water Main crossing over Sanitary Sewer Main	When there is less than 24 inches of vertical clearance between the water main and the sanitary sewer, the sanitary sewer shall be encased in concrete a minimum of ten feet on each side of the centerline of the crossing or polyvinyl chloride pressure pipe in accordance with American Water Works Association C900 Class 235 may be used.
Water Main crossing over Storm Sewer Main	When there is less than 24 inches of vertical clearance between the water main and the storm sewer, each joint of the storm sewer within ten feet of the centerline of the crossing shall be encased in concrete. Crossing details shall be approved by the Engineering Division.
Sanitary Sewer Main crossing over Water Main	The sanitary sewer line should not be designed over a waterline. In all cases, regardless of vertical clearance, the sanitary sewer shall be encased in concrete a minimum of ten feet on each side of the centerline of the crossing or polyvinyl chloride pressure pipe in accordance with American Water Works Association C900 may be used.
Storm Sewer Main crossing over Water Main	In all cases, regardless of vertical clearance, the joints of the storm sewer shall be encased in concrete a minimum of ten feet on each side of the centerline of the crossing.

8.2.8 Easements

All mains shall be in an easement which has a width of at least two times the depth to the pipe invert. The minimum easement shall be 20 feet in width for one utility, 30 feet in width for two utilities, and 40 feet in width for three utilities. Site specific circumstances may dictate the need for wider easements.

The main shall be located a minimum of 10 feet from and parallel to the edge of the easement. All City required easements shall be for the exclusive use of the City of Northglenn.

Meters and Fire Hydrants

Meters and fire hydrants not installed within the Right of Way will require an easement dedication ten feet wide and extending three feet behind the meter or fire hydrant. If the meter or fire hydrant easement is longer than ten feet, then the width of the easement shall be a minimum of 20 feet. The fire hydrant shall be centered in such easements.

Limits of Use in Easements

No landscaping (except grass and private irrigation systems) nor permanent structures (mailboxes, sheds, buildings, etc.) shall be placed in the easement.

The easement agreement, provided by the City, shall state that any temporary structures (including paving and fencing) placed in the easement shall be removed and replaced by the owner of the land when requested by the City so that maintenance can be performed. The owner of the land shall agree to hold the City of Northglenn harmless for any replacement of structures removed from the easement.

The following statement shall appear on all official development plans and all final plats.

“All public water, storm sewer and sanitary sewer mains and appurtenances located in public Right of Way shall be maintained by the City of Northglenn Public Works Department. All public water, storm sewer, sanitary sewer mains and appurtenances under private drives are located in utility easements. City is responsible for maintenance of these water, storm, and sanitary sewer facilities. City is not responsible for repair or replacement of private drive, curb and gutter or landscaping damaged during utility repair or maintenance.”

8.2.9 Future Connections

Dead End Line

A blow-off, as shown in the ***Standard Drawing, W-22***, is required at the end of any water main which terminates and is anticipated to be extended in the future. When a future main extension is anticipated, the main shall be valved so that only one valve will have to be closed when the main is extended. The Engineering Division prefers a hydrant for flushing of dead-end line.

Valve Restraint

The valve shall be restrained so when the one valve is closed and the line to be extended is exposed, the valve will not blow off. Restraint shall be made by the use of a mechanical joint anchoring tee (swivel tee), cross, or by installing a minimum of two full lengths of pipe on the extension side of the valve.

No service taps shall be allowed on a main which can be extended in the future between the single valve to be closed and the dead end.

8.2.10 Services

One Service for each Structure

Each separated structure shall be served by a separate service line and meter. No pressure booster facility of any kind shall be allowed on any service line between the public main and the meter. All service line pressure booster facilities shall be privately owned and maintained.

Horizontal Spacing

Water service lines shall be located a minimum of 10 feet away from all sewer services (measured horizontally). All service lines shall be constructed perpendicular to the front property line of the property they are going to serve and not more than 5 feet from the side of a front property line.

Same Size Services

All service lines and meters connected to these will be the same size.

Issuance of Water Taps

Water taps cannot be issued prior to a building permit and/or tap entitlement approval.

Size of Service Lines

All service lines 3/4-inch through 2-inch shall be copper and shall be installed continuous without joints between the corporation stop at the water main and the meter or curb stop.

Minimum Cover

Services shall have a minimum of 5 feet of cover and be laid as shown on the ***Standard Drawing W-24***.

Service Connections

Service connections (3-inch, 4-inch, 6-inch, or 8-inch) to new lines shall be made with mechanical joint anchoring tees (swivel tees) or reducing mechanical joint anchoring tees (swivel tees) if installed at the time of main line construction. Connections shall be reviewed and accepted by the City.

Sizing

Table 8.4: Pipe Sizing Suppliers

Meter Size	Supplier
1 ½" meter on 2" line	1 pair Ford A67 adaptors
1" meter on 2" line	1 pair Ford A47 adaptors
1" meter on 1 ½" line	1 pair Ford A46 adaptors
5/8" x ¾" meter on 1" line	1 pair Ford A24 adaptors
Other sizes	Contact Public Works Department

Size changes shall be accomplished by providing a full-sized meter vault and setting for the line size installed and using industry standard adapters to install a reduced size meter in the full-size line.

8.2.11 Transmission Mains

All water mains 16 inches and larger in diameter shall be classified as "transmission mains."

Air and Vacuum Release Valves

All transmission mains shall have air and vacuum release valves installed at all high points on the line, and on each side of butterfly valves as shown on ***Standard Drawing W-18***.

Blow-Off Assemblies

All transmission mains shall have blow-off assemblies installed at all low points on the line, constructed as shown in ***Standard Drawing W-19***.

Limits of taps on Transmission Lines

No service line taps nor any taps less than six inches in diameter shall be made to transmission mains. Exceptions to this will be for air and vacuum release valves only.

Valves on Transmission Lines

Valves on transmission mains shall be placed no more than 1,200 feet apart. Where there are connections to transmission mains, all connecting mains shall be valved at the connection. If the connection main is 16 inches or greater in diameter, there shall be a minimum of two valves at a tee connection and three valves at a cross connection.

8.2.12 Unlawful Connections

No installation of potable water supply piping or part thereof shall be made in such a manner that it will be possible for used, unclean, polluted or contaminated water, mixtures or substances to enter any portion of such piping from any tank, receptacle, equipment or plumbing fixture by reason of back siphonage, suction, back pressure or any other cause, either during normal use and operation or when any such tank receptacle, equipment or plumbing fixture is flooded or subject to pressure in excess of the main line operating pressure. No person shall make a connection or allow one to exist between pipes or conduits carrying domestic water supplied by the City and any pipes, conduits or fixtures containing or carrying water, chemicals, liquids, gases, or any other substances from any other source.

8.2.13 Appurtenances

Valves

- **Residential Valves Locations.** Residential distribution systems shall be valved to ensure that no more than 600 feet of main or 18 residential units and 1 fire hydrant will be out of service in the event of a single water main break. Valve placement shall be such that there are at least two valves at every tee and three valves at every cross.
- **Valves on 12" plus Lines.** Valves larger than 12 inches shall be butterfly valves. Main line valves shall be located at a point on the main which is intersected by an extension of the side property line of lots in the subdivision.
- **Locations Not Permitted.** Under no circumstances shall a valve be located in concrete areas such as sidewalks, crosspans, aprons or gutters. Valves are permitted to be located in concrete pavements or asphalt.
- **Valve Locations for Water Lines in Easements.** Valves located on water mains in easements shall be located at the connecting tee, cross, or elbow.
- **Location of Butterfly Valve Operators.** Butterfly valve operators shall be located on the north or east side of the water main.
- **Concrete Collar.** Any valve located in a greenbelt area shall have a 6-inch-wide by 6-inch-thick concrete collar around the valve box.

Fire Hydrants

- **Maximum Spacing.** The maximum distance, as measured along the centerline of the street, between fire hydrants shall be 500 feet in residential areas and 300 feet in business and other high-value areas.

- **Dead End Line.** One fire hydrant will be allowed on dead-end line provided that the line is an 8" line. The number and location of fire hydrants in a given area shall be approved by the Fire District.
- **Location of Hydrants at Intersections.** When hydrants are to be installed at locations other than street intersections, they shall be located on the extension of property side lot lines. In no case shall a hydrant be located closer than 5 feet to obstructions, driveways, etc.
- **Location within the Right of Way.** The fire hydrant shall be located within the Right of Way or easement and on the same side of the street as the water main. Fences, landscaping, etc., shall in no way hinder the operation of the fire hydrant. In addition, clear distances to the fire hydrant shall be no less than 60 inches of these STANDARDS AND SPECIFICATIONS.
- **Lateral Lines.** The fire hydrant lateral lines shall be set at 90 degrees to mains. The fire hydrant lateral line shall be no more than 70 feet in length from the main. No horizontal bends or offsets shall be used in fire hydrant lateral lines. Under no circumstances shall any tap be made on a fire hydrant lateral line.

Thrust Blocks

- **Uses for Thrust Blocks.** All bends, tees, plugs, dead-ends, wet taps (in certain cases), hydrants and blow-offs shall be designed and constructed with restrained fittings and concrete thrust blocks. See **Standard Drawings W-3 to W-5**.
- **Unknown Soil Strength.** If the soil-bearing strength is unknown, the soil-bearing capacity used in design shall be 2,000 pounds/square foot for waterlines 12" and smaller.
- **Thrust Block Design on Waterlines larger than 12".** Waterlines larger than 12" must be designed by a Designer and submitted with construction plans for approval.

Meters

- **Same Size Taps and Meters.** All water taps, service lines and meters connected to the meter will normally be the same size.
- **No Public Water Meters in Buildings.** Public water meter installations inside any buildings are prohibited. Meters shall be located within publicly owned Right-of-Way or easements. If an existing meter in a building and a permit is requested, the Engineering Division shall require the meter to be moved.
- **City Owned Meters.** All water meters connected to the City of Northglenn's utility system shall be the property of the City. Under no circumstances shall anyone other than City personnel remove or install a water meter once the pit or vault has been inspected and approved. No connections shall be made in the meter pit other than those related to the meter and bypass.
- **Sprinkler System Connection.** Sprinkler system connections shall be made downstream from the meter and a minimum of five feet from the meter pit or vault.
- **Unusual Conditions.** For any installation where special or unusual conditions might exist, additional design and review shall be required prior to Engineering Division acceptance.
- **Master Meter System.** Every "Master Metered" system to which fire hydrants or fire protection lines will be connected shall have a UL or FM approved "Fire Service Protection Water Meter" in accordance with AWWA C703.

- **Sizing.** The Designer shall develop the form from AWWA for water line sizing and present it at the Pre-Application/Pre-Design meeting and provide the information in the Utility Report (Refer to **Chapter 5 – Design Report Requirements**).
- **Additional Requirements for meters over 2 inches in size.** For any water meter installation over 2 inches in size, detailed drawings of the proposed installation shall be submitted to the City for review and acceptance prior to construction.
- **No Wiring in Water Meter Pits.** There shall be no electrical wiring allowed in any water meter pit or vault.
- **Installation of Meter Pits.** All meter locations shall be accurately shown on the construction plans for specific review and approval. The City requires that all meter pits and vaults be specifically inspected and approved prior to substantial Completion of the work.

Fire Protection Service Line

- **Valve Locations.** Valves on newly constructed fire lines shall be located on the tee at the main line.
- **Private Ownership.** The owner shall maintain all private fire lines beginning at and including this valve.
- **Backflow Prevention Device.** All fire sprinkler taps shall be installed with an approved backflow prevention device as defined by the Municipal Code and a flow switch which will indicate when water has flowed through the line.
- **Separate Taps.** A property requiring a domestic service line and a fire protection service line will have separate taps for each.

Valve Vaults

- **24” and Larger Valves Installed in a Vault.** All valves larger than 24 inches shall be installed in a vault in accordance with the detail drawings in **Appendix G.6**.
- **H-20 Loading Requirements.** All valve vaults shall be capable of withstanding AASHTO H-20 highway loading. The vault shall also have lift hooks in the roof for valve removal inside the vault.
- **Design of Vaults.** Vaults shall be made waterproof after construction by use of sealants, epoxies or other approved methods. All vaults shall be designed with wall sleeves and link seal and be capable of handling thrusts caused by removing valves. All vent pipes for vaults shall be installed in conformance with the detail drawings in **Appendix G.6**.

Manholes

Manholes shall be installed on all pressure regulating valves, permanent blow-off installations, and air release valves. See **Standard Drawing W-18**.

Backflow Prevention Assemblies

To prevent backflow contamination of the City of Northglenn’s potable water mains, a backflow prevention assembly shall be installed where any condition might exist that could result in a higher pressure downstream of the water meter than exists in the main line that could allow backflow or back-siphonage of polluted or contaminated water or other substances from the water user’s system.

The City shall have the right to access Backflow Prevention Assemblies for all City of Northglenn residences, businesses, or industries. All non-single family residential shall test assembly and submit testing report to the Engineering Division.

- **Location of the Backflow Prevention Assembly.** The assembly shall be placed downstream of the water meter and installed per Colorado Department of Public Health and Environment guidelines to allow for proper operation and easy access for annual testing and maintenance.
- **Type of Assembly.** Criteria listed in State guidelines will be used to determine the type of assembly required for each installation based on the potential hazards of the intended use. Some typical applications requiring backflow prevention include hospitals, medical and dental clinics, car washes, dry cleaners, mortuaries, manufacturing processes using chemicals, locations with lawn irrigation systems, buildings with fire protection systems, buildings greater than 40 feet high and locations with a service line larger than 4 inches in diameter.

8.3 Construction Specifications

8.3.1 Excavation, Trenching & Backfilling

Excavation, trenching and backfilling shall be performed in accordance with **Chapter 14 – Trenching, Backfilling, and Compacting – Utilities** of these STANDARDS AND SPECIFICATIONS and comply with Industry Safety Standards.

8.3.2 Bedding

Bedding shall conform and be installed in accordance with **Chapter 14 - Trenching, Backfilling and Compacting - Utilities** of these STANDARDS AND SPECIFICATIONS.

8.3.3 Pipeline Installation

General

- **City Required Inspections.** The City shall be notified at least 48 hours in advance of any pipe installation. No pipes shall be backfilled until they have been inspected by the City.
- **Construction Staking for Alignment and Grading.** Alignment and grade of the pipe and the location of fittings, valves and hydrants shall be staked under the supervision of a professional surveyor registered in the State of Colorado at the cost of the Designer and/or Developer.
- **Correct Materials and Equipment.** Proper implements, tools and facilities shall be provided and used by the contractor for the safe and convenient execution of the work. All pipe fittings, valves and hydrants shall be carefully lowered into the trench by means of a derrick, ropes or other suitable tools or equipment to prevent damage to water main materials and protective coatings and linings. Chains or cables shall not be used for handling pipe with protective coatings. Under no circumstances shall water main materials be dropped or dumped into the trench.
- **No Defective Pipe or Fittings.** All pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. The groove in the bells of the pipe shall be full and continuous or the pipe will be rejected. Defective pipe or fittings shall be removed from the job site within 24 hours of notification by the City. All foreign matter or dirt shall be removed from the interior and ends of pipe and accessories before they are lowered into position in the trench and prior to connection.
- **Clean Work Environment.** Every precaution shall be taken to prevent foreign material and trench water from entering the pipe and fittings. During construction, the contractor shall provide and maintain adequate equipment to properly remove and dispose of all water entering the trench and any other part of the work.

- **Pipe Joint Installation.** Immediately before joining two lengths of pipe, the inside of the bell and the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure that the correct type of gasket is used. This work shall be completed in accordance with manufacturer's instructions. The spigot end of the pipe shall be placed in the bell with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint. The pipe shall then be properly set and brought to correct line and grade. After installation of the polyethylene protective wrap, if required, the pipe shall be secured in place by installation of bedding material and backfill, in accordance with **Chapter 14 – Trenching, Backfilling, and Compacting - Utilities**. See **Standard Drawing W – 1**.
- **Deflection of Pipe.** Deflection from a straight line or grade, as required by horizontal or vertical alignments or offsets, shall not exceed the maximum allowable limits set by the manufacturer's specifications. If the alignment requires deflection in excess of the allowable deflection per joint, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limits set forth and in accordance with the Manufacturer's recommendation.
- **Polyethylene Film Wrap.** All ductile iron pipe fittings and appurtenances shall be protected with minimum 8 mil polyethylene film wrap. Miscellaneous steel or other ferrous pipe for temporary blow-offs, etc., shall be similarly protected. Methods for applying the wrap shall conform to the **Standard Drawing W - 6**.
- **Protection of Pipe during Work Stoppages.** At times when installation is not in progress, the open ends of the pipe shall be closed with a watertight plug. Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining, leaving a smooth end at right angles to the axis of the pipe. Pipe ends shall be smooth and beveled with a file or other tools according to the pipe manufacturer's recommendations.
- **Cold Weather Pipe.** Extra care should be used in handling PVC pipe during cold weather due to the reduced flexibility and impact resistance as temperatures approach and drop below freezing. PVC pipe to be stored outside and exposed to sunlight for more than 30 days shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover the pipe. Air circulation shall be provided under the covering. Any over-exposed pipe, as determined by the City, will not be permitted for installation.
- **Location Tape.** During the backfilling of all waterline trenches, a continuous 2-inch-wide metallic-coated tape labeled "Waterline Buried Below" shall be placed in the trench backfill 2 feet above and directly over the pipe.
- **Tracer Wire.** Additionally, all waterline installations shall include the installation of a single, 12-gauge, insulated copper tracing wire taped to the top of the pipe. The tracing wire shall be one piece and installed in a continuous run between valves. Each end of the tracing wire shall be brought to the surface in an anode box next to the fire hydrant or as applicable in the valve box containing the riser pipe. See **Standard Drawing W – 7**. The tracer wire shall be tested by the City for continuity prior to acceptance.

Fittings

Pipes shall be connected to valves and fittings by mechanical joints unless specified differently in the approved drawings. For approved slip-on joints, the joint shall be assembled with a ratchet jack or other approved method in a manner that does not cause any damage to the pipe. Both the spigot and bell must be thoroughly clean and free from tar or other coatings and rust.

For mechanical joint pipe, the last 8 inches of the outside of the spigot end of the pipe and the inside of the bell of all fittings and gate valves shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating) and other

foreign matter from the joint and then a thin film of gasket lubricant shall be applied. The cast iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the bell of the fitting. Gasket lubricant shall be applied to the rubber gasket and placed on the spigot end of the pipe with the thick edge towards the gland.

After the spigot end of the pipe is placed into the bell and fully inserted the gasket shall be pressed into place within the bell so it is even around the entire joint. After the gland is positioned behind the gasket, the contractor shall install all bolts and nuts and tighten them with a torque wrench. Nuts spaced 180 degrees apart shall be tightened alternately to produce equal pressure on all parts of the gland.

Jointing shall be done, unless specifically excepted above, in accordance with AWWA Specification C-111 for a mechanical joint for ductile iron pressure pipe and fittings.

8.3.4 Valve & Valve Box Installations

In addition to the jointing requirements mentioned of these STANDARDS AND SPECIFICATIONS, the additional requirements of this section shall apply. Valves and valve boxes shall be installed where shown on the approved drawings and as directed by the City.

- **Elevation of Valve Box Covers.** Valve boxes shall be firmly supported, centered, and plumbed over the wrench nut of the valve with the box cover at or minus 1/4-inch within the surface of the finished pavement or at such other elevation as may be directed by the City.
- **Extensions.** Extensions to within 4 feet of the finished grade shall be provided for valves installed with more than 5 feet of cover. All extensions shall be pinned to the valve operating nut. Earth fill shall be carefully tamped around each valve box to a minimum distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet. Valves shall have the interiors cleaned of all foreign matter before and after installation. Screw in extension to right height.

Gear cases shall be tightened, and the valve shall be inspected in opened and closed positions to ensure that all parts are in working condition prior to installation. The cases shall be supported by bricks or other means to prevent any shock or stress being transmitted to the valve.

8.3.5 Thrust Blocks

Setting Thrust Blocks

The contractor shall excavate as required to ensure that the thrust blocks are placed against undisturbed soil and shall form the sides of the thrust block to provide the size and shape required. When it is impossible, because of over excavation or other causes, to pour a thrust block against undisturbed earth, harness rods shall be used to anchor the fittings to the main in addition to the thrust block and as required by the City. After the concrete has been placed and has set, the contractor shall remove all forming materials prior to backfilling around the thrust block. Concrete for the thrust blocks shall comply with provisions set forth in **Chapter 15– Street Construction Standards** of these STANDARDS AND SPECIFICATIONS

Bond Breakers

The blocking shall be placed so that the pipe and fitting joints will be accessible for repair. A bond breaker shall be placed between the fittings and the thrust block.

Backfill & Tamping

Backfill may be placed over the thrust blocks once the surface has set sufficiently to resist the weight of the backfill. However, no tamping or compacting shall be allowed above the thrust block for a minimum of 24 hours after

placement. Concrete must set a minimum of 48 hours prior to the initial filling of the line. Ensure that the ground under thrust block location is compacted.

8.3.6 Connection to Existing Mains

At locations where connections to existing water mains are to be installed, the contractor shall locate the existing mains, both vertically and horizontally and shall verify their exact size in advance of the time scheduled for making the connections. The contractor shall notify and schedule the connection with the City.

Prior to connecting to existing water mains, the contractor shall have all labor, materials, and equipment ready to connect the fitting to the existing main to keep the shut-off time to a minimum. As soon as possible after making the connections, the contractor shall flush the connection to prevent any contamination of the existing facilities. The contractor shall take every precaution necessary to prevent dirt or debris from entering the main.

8.3.7 Fire Hydrant Installation

Immediately before installation of a hydrant, the following operations shall be performed.

Inspected & Cleaned

The hydrant shall be thoroughly inspected for any defects or damage. The hydrant interior shall be thoroughly cleaned before completed.

Ensure Operation

The hydrant shall be opened and closed as many times as necessary to determine that all parts are in proper working order, valves are seating properly, and the drain valve is operating freely.

Setting Requirements

Hydrants shall be set so that a minimum of 5 feet of cover is provided for the lateral line and the nozzles are a minimum of 18 inches above finished grade. Each hydrant shall be set on a concrete foundation at least 18 inches by 18-inches and 6 inches thick. Each hydrant shall be blocked against the end of the trench with a concrete thrust block. If the trench is unstable then the hydrant shall be mechanically restrained from the tee at the main to the hydrant in addition to the thrust block.

Washed Rock

Each hydrant shall have drain holes with a minimum 18-inch-thick layer of 1-1/2-inch (minimum) washed rock beneath them. A sheet of 8-mil polyethylene shall be placed over the washed rock to prevent dirt from filling the rock.

Connection to Main

All hydrants shall stand plumb and shall be connected to the street main by a minimum 6-inch DIP lateral line.

Maximum Base Adjustment

The fire hydrant base shall be adjusted to not more than 3 inches nor less than 2 inches above the approved finished grade.

Maximum Height of Extensions

The maximum allowable height of extensions on hydrants is 12 inches. No hydrant lateral shall be installed any deeper than 6 feet from the top of the approved finished grade.

Bollards

Depending upon hydrant location, the use of bollards may be required for protection, as specified by the City.

Hydrant Gate Valves

Hydrant gate valves shall have a restrained connection directly to the tee at the main.

Ground Water

In areas where the hydrant bottom is installed below ground water, the drain shall be plugged, and the hydrant marked with a metal tag to indicate the requirements to pump the hydrant after use. See **Standard Drawing W - 2** for construction requirements.

8.3.8 Taps

The size of tap and the tapping method for a given type and size of waterline shall be as follows:

Table 8.5: Required Service Tab Sizes Based on the Diameter & Type of Pipe

Size of Pipe	Ductile Iron				PVC			
(inches)	¾"	1"	1-1/2"	2"	¾"	1"	1-1/2"	2"
3"	NO	NO	NO	NO	NO	NO	NO	NO
4"	S	S	NO	NO	S	S	NO	NO
6"	DT	S/DT	S	S	DT	S/DT	S	S
8"	DT	DT	S	S	DT	DT	S	S
12"	DT	DT	S	S	DT	DT	S	S
16"	--	--	--	--	--	--	--	--
20"	--	--	--	--	--	--	--	--

S - Tapping saddle required. All saddles shall have the AWWA taper on its threads.

DT - Direct tap permitted.

NO - No tap permitted with or without a saddle. A tee connection may be permitted if specifically authorized by the City.

S/DT - Either a tapping saddle or a direct tap may be permitted depending on the situation.

Saddles

All existing AC waterlines shall be tapped using a saddle.

Tap Angle

All taps into the water main shall be at an angle of not more than 45 degrees from the horizontal, and corporation stops shall be installed.

Release for Service

Taps shall not be made on a water main until the City has performed and the main has passed the pressure tests and clear water tests and a "Release for Service" letter has been issued by the City. Care shall be taken to properly install water service lines so that a minimum of 12 inches of slack is in the service line at the main to protect against pull out. Tapping mains may require digging out bedding material and cutting or removing part of the corrosion protective wrapping. After the taps are made, the wrap shall be repaired or replaced by the contractor to protect both the service line and the main.

Separation

Service taps shall have a minimum separation of 24 inches and be no closer than 24 inches to a main line joint.

Service Taps

All service taps shall be performed by the Contractor. All necessary materials for said taps, including corporations stops, cooper line, meter pits, copper setters, curb stops, etc., shall be supplied by the Contractor. Said materials shall conform to these Standards and Specifications. The City will inspect each tap prior to backfilling.

Taps on Mainline

Taps to mains shall be accomplished with the mainline valves either side of the tap in the closed position.

Temperature Limitations

Taps to PVC mains shall only be made when the air temperature is 32°F or higher.

8.3.9 Meter Installation

No connections shall be made in the meter pit other than those related to the meter and bypass. Sprinkler system connections shall be made no closer than five (5) feet from the meter pit or vault on the downstream side of the meter.

The City will provide all meters after connection fees are paid. Contractor is responsible for the installation of all meter appurtenances. Meter will be set only at the time of approval of all other work done by the Contractor.

3/4 Inch and 1 Inch Meter Installations

- **Meter Location.** The meter shall be located a minimum of 1 foot behind the sidewalk. Where no sidewalk exists, the meter shall be placed a maximum of 6 feet behind the back edge of the curb. In all cases, the meter shall be installed within Right of Ways or public easements. No meters shall be set in streets, sidewalks, driveway alignments or concrete areas without prior approval of the Engineering Division.
- **Horizontal Grade.** The dome or meter lid shall be level and 2 inches above the approved final grade. The copper setter shall be a minimum of 10 inches below the inner cover. A variance of more than 4 inches (vertically) in installing the copper setter will not be accepted.
- **Meter Pits.** Meter pits shall be constructed of modified hi-density polyethylene and a steel cover.

- **Grade Adjustment.** The size shall be as specified in the detail drawing in **Appendix G.6**. Grade adjustment shall be made using concrete rings. The trench floor under the concrete rings shall be compacted earth. The concrete pit shall not bear on the service pipe.
- **Final Inspection Timing.** Final inspections of the meter pit will be made at the time the meter is actually set. The building permit applicant is responsible for any required adjustments to the copper setter or meter lid at that time.
- See **Standard Drawing W – 8** for specific requirements.

1 1/2 Inch and 2 Inch Meter Installations

The entry hole through the roof of the vault shall be centered over the water meter. Vaults shall be sealed at all joints and made watertight. Meter vault lids shall be a maximum of 2 inches above the approved final grade. See **Standard Drawing W – 9** for specific requirements.

3 Inch and Larger Meter Installations

The entry hole through the roof of the vault shall be centered over the water meter. Vaults shall be sealed at all joints and made watertight. Meter vault lids shall be a maximum of 2 inches above the approved final grade. See **Standard Drawing W – 10**.

Piping shall be ductile iron, flanged-joint design only. Insulators shall be provided between connections of dissimilar metals.

8.3.10 Tests

General

- **Disinfect and Test Lines.** The Contractor shall disinfect and test all mains and fire lines regardless of existing conditions. This may include repairing existing facilities that must be included in the test and are not capable of holding test pressures.
- **Cure on Thrust Blocks.** All thrust blocks or other bracing facilities shall be in place at least 48 hours before the initial filling of the line for disinfecting and testing.
- **Inspection Requirements.** All tests will be conducted in the presence of the City.

Filling and Venting Lines

- **Operation of Valves.** All existing valves will be operated by the City for this testing procedure. The line shall be slowly filled with water and all air expelled from the pipe. Care shall be taken so that all available hydrants (including hydrant gate valves), air valves and other vents are open during the filling of the line.
- **Filling Rate.** The rate of filling the line shall not exceed the venting capacity of the vent.
- **Temporary Taps.** Where hydrants or other vents are not available in the line, the contractor shall make whatever taps are required for venting purposes. Once the construction is complete, the taps shall be removed and the main repaired by the use of a stainless-steel repair clamp.

Pressure Test

After the pipe and appurtenances have been laid, the line has been backfilled, and all field-place concrete has cured, each valved section, unless otherwise directed by the CITY, shall be subjected to a hydrostatic pressure of not less than

150 PSI. However, in all cases the test pressure shall be 50 percent over existing main pressure in the test area. The test duration shall be a minimum of one hour.

Water added to maintain the pressure shall be per AWWA C-600. Allowable leakage shall be calculated according to the following formulas:

Ductile Iron Pipe:

$$L = \frac{SD\sqrt{P}}{148,000}$$

Polyvinyl Chlorine Pipe:

$$L = \frac{ND\sqrt{P}}{7,400}$$

L = Testing Allowance (makeup water), in gallons per hour

S = Length of pipe tested, in feet

D = Nominal Diameter of pipe, in inches

P = Average test pressure during the hydrostatic test, in pounds per square inch (gauge)

When testing against existing closed valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size may be allowed at the discretion of the City.

Each valved section of pipe shall be slowly filled with water and the specified test pressure (measured at the lowest point of elevation) shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges and all necessary apparatus and labor shall be furnished by the contractor. Gauges and measuring devices shall be approved by the City. Before applying the specified test pressure all air shall be expelled from the pipe. Any cracked or defective pipes, fittings, valves, or hydrants discovered in the pressure test shall be removed and replaced by the contractor with sound material including any existing pipe or appurtenances that are leaking and were included in the test section. After all visible leaks have been repaired, the pressure test shall be conducted again. Should testing show a leakage rate in excess of the rates above, the pipeline shall not be accepted. The pipeline shall be repaired, re-chlorinated to meet the criteria and retested as described in this section until it meets the test requirements and is accepted by the City.

Disinfection

The contractor will be required to chlorinate every new water main installed. The chlorine must remain in the main for a contact period of not less than 24 hours. The chlorine count must be at least 50 parts per million (PPM) after 24-hours to pass. If the PPM are not a minimum of 50, the contractor shall re-chlorinate the water main. This procedure will continue until the minimum requirements of this section are met.

Flushing the Main

The entire line shall be flushed after the specified contact time, and after passing the disinfection test. Such flushing shall continue until the water is clear and meets the chlorine content of the existing line. The entire line, including hydrant leads, branch lines and dead-end mains shall be flushed. The discharge of flushed water shall be accomplished such that no erosion will occur and with no harm to fish, animals, or plants. Procedures for discharge will be subject to the review of the City.

Bacteriological & Turbidity Test

Water from all new mains must successfully pass a bacteriological and turbidity test in accordance with the requirements of the City before the main is placed in service. A minimum 24 hours is required to receive bacteriological test results and may take as long as 72 hours. No bacteriological tests will be taken on Fridays or Weekends. When unsatisfactory results are obtained from bacteriological tests, the City may direct the contractor to re-chlorinate the main. When re-chlorination is deemed necessary, it will be done by the contractor, at his expense, under the City's supervision. After re-chlorination, the bacteriological test shall be performed again, and the procedure repeated until the test passes.

Testing must be scheduled with the Engineering Division at least one week in advance.

8.4 Materials

8.4.1 General

Only polyvinyl chloride PVC is approved for water main installations. All materials furnished shall be new and undamaged. (Lines 16 inches in diameter and larger may at the discretion of the City, be ductile iron pipe.)

Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Developer of the responsibility for furnishing materials meeting the requirements of these STANDARDS AND SPECIFICATIONS. The City reserves the right to direct or deny the use of certain types of materials in specific circumstances. All materials delivered to the job site shall be adequately housed and protected to ensure the preservation of their quality for the work. The presence of any defects in any materials may constitute sufficient cause for rejection of the pipe or appurtenances. Rejected materials shall be removed from the work site unless otherwise permitted by the City.

All references cited in these STANDARDS AND SPECIFICATIONS as the Denver Water Board Specifications shall meet the latest edition of the Engineering Standards of the Board of Water Commissioners of Denver, Colorado.

8.4.2 Pipe

Ductile Iron Pipe (DIP)

- **Class.** All ductile iron pipe shall be manufactured in accordance with AWWA Standard C-151. Pipe furnished under this specification shall conform to the following thickness classes: Special Class 50 (6")
- **Joint Type.** The joint type shall be "push-on, single-gasket" type conforming with applicable requirements of AWWA Standard C-111. Joint types other than "push-on, single-gasket" are acceptable only if specifically approved by the City in writing.
- **Length.** Pipe shall have normal laying length of either 18 feet or 20 feet. Random lengths shall not be acceptable.
- **Iron.** Iron used in the manufacture of pipe shall have 60/42/10 physicals in accordance with AWWA C-151.
- **Cement Mortar Linings.** Pipe shall have standard thickness cement mortar linings in accordance with AWWA Standard C-104.
- **Pipe Marking.** The weight, class or nominal thickness, and casting period shall be shown on each pipe. The manufacturer's mark, the year in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.

Polyvinyl Chloride Pipe (PVC)

- **PVC Pipe.** All PVC pipe shall meet the requirements of AWWA Specification C-900 (for 4" - 12" pipe) or C-905 (for 14" - 48" pipe), and shall be Class 305 (DR 14 for 4" - 12" pipe), or Class 235 (DR 18 for 14" - 24" pipe), or Class 165 (DR 25 30" and larger).
- **Rubber Ring.** All pipe shall be suitable for use as a pressure conduit. Provisions must be made for expansion and contraction at each joint with a rubber ring. The bell shall consist of an integral wall section with a solid cross-section rubber ring which meets the requirements of AWWA Specification C-900 and C-905.
- **Lengths.** Standard laying lengths shall be twenty feet (20') for all sizes. Random lengths shall not be acceptable.
- **Manufacturer Information.** Each length of pipe shall bear the date manufactured, type, grade, length, manufacturer's name, and NSF seal of approval.
- **Pipe Joints.** Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint or using machined couplings of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint.
- **Solvent Cement Joints.** Solvent cement joints are strictly prohibited.
- **Certified Statement.** The manufacturer shall furnish a certified statement that all of the specified tests and inspections have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the City upon request.

Fittings

All fittings shall be manufactured in accordance with the following AWWA Standards:

- C-104, "Cement Mortar Lining for Cast-Iron and Ductile Iron Pipe and Fittings for Water"
- C-111, "Rubber Gasket Joints for Cast-Iron and Ductile Iron Pressure for Pipe and Fittings" The following are additional requirements or exceptions to the standards mentioned above:

All fittings shall be furnished with a cement mortar lining of standard thickness as defined in the referenced specifications and given a seal coat of bituminous material. All fittings shall be furnished with mechanical joint or flanged ends conforming to the referenced specifications and in addition, the tee-head mechanical joint bolts and hexagon nuts shall be fabricated from a high strength, low alloy steel known in the industry as "Cor-Ten" or approved equal. Mechanical joint anchoring fittings (swivel) as approved by the City, in writing, may also be used.

Fittings shall have pressure ratings of 250 PSI for pipes larger than 24" diameter and 350 PSI for pipes that are 24" diameter and smaller and shall conform to the dimensions and weights shown in the tables of the referenced specifications. All fittings shall be made from gray iron or ductile iron. The manufacturer shall prepare a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the City upon request.

8.4.3 Valves

General

All valves shall open left (counterclockwise). All valves shall have a 2-inch-square operating nut. The extension stem shall be mechanically connected to the operating nut. All valves shall have a mechanical joint end and shall be delivered complete with bolts, glands, and rubber gaskets.

End connections shall be furnished with all necessary joint materials and shall have full opening flow way of equal diameter to the nominal size of the connecting pipe.

Gate Valves

Gate valves shall be iron body, resilient-seated, gate valves with non-rising bronze stems with design, construction and pressure rating conforming to AWWA Specifications C-509 or C515, with modifications specified herein. Stem seals shall be double "O" ring seals designed so that the seal above the stem collar can be replaced with the valve under pressure and in full open position.

All ferrous internal and external surfaces of the valves shall be coated to a minimum thickness of four mils. The coating shall be a two-part thermosetting epoxy suitable for field overcoating and for touch-up with the same coating material without special surface preparation. The supplier shall furnish detailed performance tests of adhesion, hardness and abrasion resistance of the furnished coatings when requested by the City. The coating shall have a successful record of performance in valves, pipe, or other fittings for a minimum of ten years. The resilient seat gate valves shall have external break-off capabilities for over-torquing and positive stop to prevent over compression.

All bolts and nuts used in conjunction with valves shall be stainless steel, "Cor-Ten" or approved equal. All gate valves shall be installed with a valve box meeting the material specifications of these STANDARDS AND SPECIFICATIONS.

Butterfly Valves

All butterfly valves shall be installed in a vault in accordance with **Standard Drawing W - 11**. All valves having a nominal diameter greater than 12 inches shall be geared butterfly valves designed for direct burial and shall conform to AWWA Specification C-504, Class 150-B. Valves shall be tight closing rubber seat type with rubber seats which are bonded to the valve body. No metal-to-metal sealing surfaces will be permitted. Valves shall be bubble tight at 150.

PSI-rated pressure with flow in either direction. Valve discs shall rotate 90 degrees from the full open position to the shut-tight position. Valve bearings shall be sleeve-type corrosion-resistant and self-lubricating with the load not to exceed 2,500 PSI. All surfaces of the valve shall be clean, dry, and free from grease before painting. All surfaces, exterior and interior, shall be evenly coated with asphalt varnish in accordance with Federal Specification TT-V-51a or Joint Army-Navy Specification JAN-P-450. The coating shall have a successful record of performance in valves for a minimum of ten years.

Valve Boxes

- **Manufacturer.** Valve box parts for 3" and larger valves shall be Tyler type, series 6860 or approved equal conforming with ASTM A48 Class 20A and made of gray cast-iron, buffalo-type with No. 160 large, oval base.
- **Adjustment for shaft.** A 5-1/4-inch screw-type shaft shall be adjustable from 45 inches to 60 inches.
- **Vertical Adjustment.** Valve boxes shall be considered integral units and shall have at least 6 inches adjustment above and below the specified depth of cover over the pipe.
- **Valve Box Lids.** Valve box lids shall be marked with the word "WATER" and shall have a lip or flange extending into the valve box shaft.

- **Slip-type Boxes.** No slip-type boxes will be allowed. The valve box shall be of a design which will not transmit shock or stress to the valve.

8.4.4 Fire Hydrants

Hydrants will be Mueller Model Super Centurion 250 or City approved equal with the following options:

- Bronze to bronze seating.
- Oil cup reservoir.
- Bronze "safety sleeve" stem coupling.
- Bronze operating nut.
- Epoxy-coated upper and lower washer assembly.
- **Sizing.** Hydrants shall have a 5-1/4-inch main opening with a 6-inch mechanical joint end. Each hydrant shall be equipped with one 4-1/2-inch pumper nozzle and two 2-1/2-inch hose nozzles with national standard threads.
- **Open.** Fire hydrants shall open right (clockwise).
- **Depth and Flange Height.** Fire hydrants shall be installed so that the traffic flange is at or within 2 inches above finished grade. Fire hydrants shall be designed for 5-foot pipe bury.
- **Finish.** Hydrants shall be thoroughly cleaned and then painted with a prime coat followed by one shop coat of federal safety yellow, #916 or approved equal. Care shall be taken when handling hydrants to protect the paint. Whenever the paint is chipped or scratched, the contractor shall repaint the hydrant. A traffic break-away feature shall be incorporated into the barrel of the hydrant at the ground line.
- **Operating Nut.** The operating nut shall be National Standard pentagon measuring 1-1/2 inches from point to opposite flat. Nozzle covers shall have the same size and shape nut as the operating nut and shall be attached by chain to the hydrant body. Any product that must be modified to meet these STANDARDS AND SPECIFICATIONS shall be accompanied by a certification signed by a company officer that states that these changes have been incorporated into the product furnished and in addition, the hydrant shall be tagged by the manufacturer to assure that all the above options were included.

8.4.5 Blow-Offs

- **Material.** Blow-offs shall be fabricated from 2-inch brass pipe with a 2-inch stop and waste on the connecting pipe.
- **Valve.** The valve shall be iron-bodied bronze mounted with a 2-inch square operating nut complete with valve box.
- **Riser Pipe.** The freeze-proof riser pipe shall be provided with drain pit and well-greased plug. The discharge pipe shall terminate above the vault to prevent a backflow situation.
- **Large Mains.** The standard required blow-off for 16-inch and larger mains shall be a 6-inch or larger pipe with a gate valve meeting the material requirements of these STANDARDS AND SPECIFICATION and a manhole meeting the material requirements of these STANDARDS AND SPECIFICATIONS. See **Standard Drawing W-22**.

8.4.6 Manholes

General

- **Material Standards.** Manholes, reducing sections, ladder rungs and traffic lids shall be precast and conform to ASTM Standard Designation C-478.
- **Lid Loading.** All traffic lids shall be designed for AASHTO H-20 traffic loading.
- **Ladder Rungs.** All ladder rungs or manhole steps shall be cast into the manhole barrel when the manhole barrel is poured.
- **Prohibited Sections.** Concentric reducing sections shall not be used.
- **Extension Collars.** Concrete extension collars shall be used to adjust the manhole ring and cover to approved street or ground surface elevation.
- **Locking Lids.** All manholes not within the Right of Way shall have locking lids. All valves in manholes shall be operable from above ground.
- **Concrete.** Concrete used in the manufacturing or construction of manholes shall be a minimum of 4,000 psi concrete in accordance with **Chapter 15 – Street Construction Standards** of these STANDARDS AND SPECIFICATIONS.

Requirements

All cast iron manhole rings and covers and other iron castings shall conform to the requirements of AASHTO M105/ASTM A48 Class 35B. Ductile Iron castings shall conform to the requirements of ASTM A536. All castings shall conform to Federal Specification RR-F-621E, for shape and dimension required. Castings shall be free from sand, blowholes, shrinkage, cracks, and other cold shuts and be well cleaned by shot blasting. Runners, risers, fins and other cast-on pieces shall be removed from the castings and ground smooth. Bearing surfaces between manhole rings and covers shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact.

- **Size.** Manhole frame or ring dimensions shall be 24" diameter for manholes and 36" diameter for valve vaults, 8" tall or as otherwise approved.
- **Weight.** Cast iron ring and covers shall have a combined weight of not less than 365 pounds.
- **Fittings.** Fittings shall be hot dipped, factory applied, water base, asphalt paint to form a firm and tenacious coating.
- Acceptable product is East Jordan Iron Works #2405A, Product #240568 (water vault only) or approved equal.

Manhole Base Slabs and Base Beams

When required, manhole base beams shall be precast, reinforced concrete.

- **Base Beam Size.** The beams shall be 12 inches wide by 9 inches deep by 8 feet long.
- **Reinforcement.** The reinforcement shall consist of three No. 5 bars longitudinally and No. 4 bars at 12-inch centers transversely.

- **Manhole Base Slabs.** Manhole base slabs may be poured in place or precast. The slab shall be designed to uniformly support AASHTO H-20 traffic loading and any earth loading. The minimum slab thickness shall be 8 inches. The minimum reinforcement in the base slab shall conform to the ***Standard Drawing ST - 1***.

Joint Material

Joint material used to set barrel sections shall be a flexible butyl resin joint sealing compound meeting Federal specifications SS-S-00210(210-A) and AASHTO M 198-B.

Mortar

- **Mortar Design.** Mortar used in repair of precast sections and for grouting joints shall be composed of one-part Portland cement and not more than three nor less than two parts of fine aggregate.
- **Unacceptable Materials.** Hydrated lime or masonry cement shall not be used.
- **Portland Cement.** Portland cement shall meet the requirements of ASTM C-250, Type II.
- **Aggregate.** Fine aggregate shall consist of well-graded natural sand having clean, hard, durable, uncoated grains, free from organic matter, soft or flaky fragments or other deleterious substances. The fine aggregate shall be thoroughly washed and shall be uniformly graded from coarse to fine with a minimum of 95 percent passing a No. 4 sieve and a maximum of 7 percent passing a No. 100 sieve.

8.4.7 Vaults

- **Vaults with Electricity.** All vaults requiring electricity shall have 110/120 volt, watertight outlets and light fixtures. All outlets shall be GFI and conform to National Electrical Code.
- **Light Switch Location.** The light switch shall also be connected to the ventilation fan and be located such that it can be operated without entering the vault. Vaults shall also be equipped with a sump pump, ventilation fan, sump hole and dehumidifier meeting the following specifications, when required by the City.
- **Sump Pumps.** Sump pumps shall be bronze mounted with built-in automatic float controls with a 1/3-horsepower motor designed to operate on 115 volts. A union shall be installed in the discharge line between the pump and the check valve to aid in the removal of the pump for repair or replacement.
- **Ventilation Fans.** Ventilation fans shall be Dayton Model Number 2C889 or City approved equal with a 9-inch wheel. The discharge of the vent fan shall be totally enclosed and attached to the opening of the exhaust vent pipe.
- **De-Humidifiers.** De-humidifiers shall be EBCO Model 00-200-1 or approved equal rated at 13 pints per 24 hours and designed to run on 115 volts. Concrete floors shall have 12-inch diameter by 18-inch-deep sump holes in the opposite corner from the manhole opening.

The Engineer shall submit construction drawings along with design calculations, which include the electric layout of the vault, to the City for written approval prior to the installation.

8.4.8 Vent Pipes

Above-ground vent pipe shall be 4-inch nominal diameter galvanized steel pipe, Grade 40, which conforms to ASTM Standard Designation A-53. The vent screen shall be a 3/4-inch, No. 9-11 flattened, expanded galvanized metal screen. Below-ground vent pipes shall be 6-inch diameter, Scheduled 40 PVC with glued joints. A PVC glued joint by standard

pipe thread female adapter shall be used to connect the steel pipe to the PVC pipe at ground level. The vent pipe shall be prime coated and painted Fox Valley Systems “Electric Blue” with a louvered top.

8.4.9 Service Connections

Pipe

Acceptable materials for a service line are seamless copper tube or ductile iron pipe. All service pipes shall conform to one of the following specifications. Plastic pipe is not an acceptable service pipe material.

- Seamless copper tube designated as "Type K" (soft) in the industry shall be used for service lines 3/4-inch through 2 inches.
- PVC C-900 pipe conforming to these STANDARDS AND SPECIFICATIONS shall be used for 3-inch service lines and all service lines larger than 4 inches.

Saddles

For all taps requiring saddles, the saddles shall be CC thread in accordance with AWWA C-800, epoxy coated body with stainless steel double straps. Saddles for PVC pipe shall be full-support, wide-bearing type.

Curb Stops

Curb stops shall be **Mueller Company Mark II Oriseal, Jones, Ford ball valves McDonald ball valves** or approved equal. 1-1/2 inch and 2-inch curb stops shall have compression fittings.

Curb Stop Boxes shall be **Tyler, 6870 series**, 5-foot (5') extension, size 145R with 4 1/4" shaft and bolt down lid.

Tapping Sleeve and Valve

ALL TAPPING SLEEVES shall be approved by the Public Works Department on a “case by case” basis. General Guidelines include:

- Cast or Ductile Iron
 - Full body Mechanical Joint (MJ) cast or Ductile Iron Tapping Sleeves
 - Acceptable models include Mueller H-615, Waterous Series 1004 or 2800, US Pipe T-9, Tyler/Union Compact (up to 12")
- PVC or AC
 - Fabricated Stainless Steel with Stainless flange.
 - A flange insulator kit between the valve and tee is required.
 - Stainless Steel bolts on the tapping sleeve side.
 - Triangular sidebar style only. No repair clamp style will be allowed.
 - Rated for 250 PSI minimum (4"-12")
 - 200 PSI for larger sizes.

- Acceptable models include JCM 432 or 452, Romac SST III or STS 400, Mueller H-304, Smith Blair 665, Ford FTSS
- Tapping Valves
 - Re-sealant seat, cast iron body, fully bronze mounted with non-rising stem and materials shall be in conformance with the Safe Drinking Water Act and shall be certified as suitable for contact with drinking water by an accredited certification organization in accordance with ANSI/NSF Standard 61. Tapping valve materials not specifically specified in this section shall meet the requirements of AWWA C509.

Corporation Stops

All corporation stops and threaded brass fittings shall be in accordance with ASTM-B62-63 (common trade name 85-5-5-5). All threads shall conform to AWWA C-800-66.

Acceptable corporation stops are:

Table 8.6: Acceptable Corporation Stops

3/4"	1"	1-1/2"	2"
Ford: F-1000-3-G	Ford: F-1000-4-G	Ford: FB-1000-6-G	Ford: FB-1000-7-G
McDonald: 4701BQ	McDonald: 4701BQ	McDonald: 4701BQ	McDonald: 4701BQ
Mueller: H-15008	Mueller: H-15008	Mueller: H-15013	Mueller: H-15013
Jones: J3401SG	Jones: J3401SG	Jones: J1937SG	Jones: J1937SG
McDonald - Q series compression end	Mueller – 110 compression end	Ford – Quick Joint compression end	

Stop & Waste

Stop and wastes for use in blow off assemblies shall be either Mueller Company Mark II ORISEAL H-10284 with A#B-20299 2-inch square nut adapter or FORD B11 777SW with a QT67 2-inch square nut adapter.

Compression Couplings

Compression couplings where allowed shall be either:

Table 8.7: Compression Couplings

Compression Couplings
Mueller: H-15403
Ford: C44
McDonald: 4758-Q
Jones: J2609SG

8.4.10 Encasement

Concrete

All concrete shall be a minimum of Class B and shall conform to City standards for Portland cement concrete work as specified in **Chapter 14 – Trenching, Backfilling and Compacting – Utilities** of these STANDARDS AND SPECIFICATIONS. All concrete encasements shall be a minimum of 6 inches thick from outside of pipe to outside of encasement.

Polyethylene Wrap

- **Manufacturer.** Polyethylene encasement material shall be a minimum of 8 mils thick and shall be Scotchrap No. 50 (polyvinyl) or approved equal.
- **Standard.** All polyethylene encasement material shall be manufactured in accordance with ANSI/AWWA Standard C-105/A21.5. The raw materials used to manufacture polyethylene film shall be Type I, Class A, Grade E-1 in accordance with ASTM Standard Designations D-1250.

8.4.11 Meters

General

All water meters shall be Badger or City approved equal. Approval of the meter by size, type and brand shall be obtained from the City prior to purchasing the meter. All meters shall be pre-tested by the Public Works Department prior to installing the meter in the meter setting to assure compliance with current “Remote Read” systems in use by the City.

Magnetic Drive Displacement Type Water Meters

All magnetic drive displacement-type meters shall conform to AWWA C700 and C710.

Compound & Turbine Meters

Compound meters shall conform to AWWA 702, AWWA 701 for Turbine meters, and C703 for Fire service meters.

Meter Bypass Line

Bypass lines shall contain an independent control valve and shall contain no tees, plugs, or other outlets through which water could be withdrawn.

Meter Check Valves

- **Conformance.** Swing-check valves shall be manufactured in accordance with AWWA Standard C-508, "Swing-check Valves for Ordinary Waterworks Service".
- **Valves.** Valves shall be iron body and the disc shall be swing type.
- **Working Pressure.** The working pressure for all sizes shall be 150 psig.

Bolts and hex nuts used for attaching top cap to the body shall be the manufacturer's standard, fabricated from a low-alloy steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process in accordance with ASTM A 153 is not acceptable.

Check valves shall be furnished with flanged ends. The size and drilling shall be in accordance with ANSI B16.1 Class 125. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA C207. Ferrous surfaces except machined or bearing surfaces shall be prepared in accordance with SSPC-SP-10. These surfaces shall then be coated with liquid epoxy in two or more uniform coats or with fusion bonded epoxy, to a minimum dry film thickness of 12 mils in accordance with AWWA C550.

A copy of the Certification including compliance with NSF/ANSI 61 shall be provided to the City.

Valves for Use with 1-1/2 Inch and 2 Inch Meters

Ball valves 2 inches and smaller to be used with copper service pipe shall be brass with non-rising stems and solid wedge disc, manufactured in accordance with ASTM Specification B-62 and Federal Specification W.W.-V54 Class A 125 PSI W.S.P., 200 PSI, W.O.G.

All other gate valves shall conform to these STANDARDS AND SPECIFICATIONS.

Meter Yokes (Line Setters)

Meter yokes shall conform to the Denver Water Board Material Specifications. Copper setters 12" x 3/4" with locking nut, 3/4" conductor compression connection ends. See ***Standard Drawings W-8 to W-10***.

Acceptable Setters are:

Table 8.8: Acceptable Setters

3/4"	1"
Ford – VH83-09W-44- 33-G	Ford – VH84-12W-44- 44-G
McDonald – 31-309- WCTT33	McDonald – 31-312- WCTT44
Mueller – B-2474-6A	Mueller – B-2474-6A

Valve and Meter Supports

Meter supports shall be in conformance with ***Standard Drawing W-12***.

Meter Pits

- **Residential Meter Pit.** Residential meter pits shall be constructed of modified high-density polyethylene with a nominal wall thickness of (minimum) .50", shall have protected UV degradation with a low temperature brittleness which exceeds -76° F, a thermal transfer rate of .40, smooth walled (inside and out) and shall have a vertical crush rating which exceeds 20,000 pounds. The meter pit covers shall be airtight, shall have a cast iron, cap-type, top lid with a locking screw forged pentagon bolt. The body of the meter pit lid shall be aluminum.
- **Commercial Meter Pit.** Commercial meter pits shall be constructed of modified high-density polyethylene with a nominal wall thickness of (minimum) .50", shall have protected UV degradation with a low temperature brittleness which exceeds -76° F, a thermal transfer rate of .40, smooth walled (inside and out) and shall have a vertical crush rating which exceeds 20,000 pounds. The meter pit covers shall be airtight, shall have a cast iron, cap-type, top lid with a locking screw forged pentagon bolt. The body of the meter pit lid shall be aluminum.

8.4.12 Pressure Reducing Valve

- **Manufacturer.** All pressure reducing valves shall be Singer approved equal. The valve shall be designed to reduce a high upstream pressure to a constant downstream pressure by way of a pilot control system. The pilot system shall control the main valve which shall be single-seated, hydraulically-operated, diaphragm, globe-valve type. The valve seats shall be bronze except when subjected to sustained high velocities through the valve, the manufacturer recommends stainless steel seats. An indicator rod or flow tube shall be furnished as an integral part of the valve to show the position of the valve.
- **Standard.** The valve shall be cast-iron body. Flanges and covers shall conform to ASTM Standard Designation A-50. Bronze castings or parts of internal trim shall conform to ASTM Standard B-61. All valves shall be furnished with flanged ends and drilled in accordance with ANSI B-16.1 Class 125 specifications. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA Standard C-115.
- **Pilot Valve.** The pilot valve for controlling operation of the main valve shall be single-seated, diaphragm-operated, and spring-loaded type. The pilot valve shall be attached to the main valve with piping and isolation valves arranged for easy access in making adjustments and also for its removal from the main valve while the main valve is under pressure. The pilot control system shall be cast bronzed ASTM B-62 with 303 stainless steel trim.
- **Needle Valve.** The needle valve shall be all bronze and included with the main valve to control the speed of piston travel.

8.4.13 Combination Air Vacuum /Release Valves

Air vacuum release valves shall be in conformance with AWWA C512.

8.4.14 Restraining System

Harness Rods

Harness rods shall be mild steel, ASTM Standard Designation A-36. Hex nuts shall be ASTM Standard Designation A-307, Grade A or B, hexagon heavy series.

Mechanical Joint Restraint

Mechanical joint restraint can be accomplished by the use of a Megalug restraining system, Uniflange joint restraints or approved equal.

- **Glands.** Glands shall be manufactured of ductile iron conforming to ASTM A 536. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53, latest revision. Twist-off nuts, sized the same as the tee-head bolts, shall be used to ensure that the proper torque is applied to the bolts. In no case shall the twist-off bolts be torqued beyond 90 ft. lbs.
- **Joint Restraint Device.** The mechanical joint restraint device shall have a working pressure of at least 250 PSI, with a minimum safety factor of 2:1.

Concrete Reinforcement

All deformed reinforcing in concrete shall be steel bars and conform to ASTM Standards A-615, Grade 60 or ASTM Standard A-671, Grade 60 or welded wire steel fabric shall conform to ASTM Standard A-185.

Backflow Prevention Device

Backflow prevention devices shall conform to the requirements of AWWA C511.

Repair Clamps

Repair clamps shall be made of stainless-steel bands, lugs, nuts, and bolts. Gaskets shall be gridded virgin GPR compounded for water service and meeting the requirements of ASTM D 2000-90M 4AA607. Prior to construction, a submittal to the City is required showing repair clamp design and make for specific approval prior to installation.

Chapter 9. STORM DRAINAGE & OTHER CONCRETE FACILITIES

9.1 Planning

9.1.1 Introduction

The purpose of this chapter is to present the design criteria and regulations governing storm drainage and floodplains in the City of Northglenn. All planning and design must provide control of storm drainage regarding quantity and quality to protect the health, safety, welfare, and property of the citizens and the City of Northglenn.

9.1.2 Stormwater Drainage

The stormwater drainage system provides protection from nuisance minor flooding and timely removal of storm runoff. The system includes several structures and features, including:

- storm sewer pipes, inlets and manholes,
- open ditches, channels and swales,
- detention and retention facilities of various types,
- levees and embankments,
- permanent erosion control measures,
- water quality control measures.

The following references apply to design of all storm drainage facilities in the City of Northglenn. The criteria in this chapter are intended to supplement these references, which are to be considered a part of these STANDARDS AND SPECIFICATIONS and shall apply for all policies and technical criteria not included or modified herein.

- The Mile High Flood District (MHFD)'s "Urban Storm Drainage Criteria Manual" (USDCM), Volumes 1 through 3 and any amendments issued by the MHFD.
- The City of Northglenn's Municipal Separate Storm Sewer System (MS4) Permit.
- The City of Northglenn Municipal Code Chapter 12 "SUBDIVISION REGULATIONS".
- The City of Northglenn Municipal Code Chapter 16 "PUBLIC PROPERTIES, UTILITIES AND SERVICES".

9.1.3 Floodplains

These floodplain requirements are intended to "promote and protect the public health, welfare, and safety so that citizens and property owners can remain under the National Flood Insurance Program." The major concerns in floodplain regulations are as follows:

- Prevention of excessive erosion, flood heights, or flow velocities.
- Protection of any use within or adjacent to a floodplain from damage.
- Control or alteration of natural floodplains and channels.

- Prevention of barriers which would divert flood waters and increase flood hazards in other areas. Floodplain regulations and requirements are detailed in the following documents, incorporated into these STANDARDS AND SPECIFICATIONS by reference:
- The City of Northglenn Municipal Code Chapter 11 (City of Northglenn Zoning Ordinance), Article 52 (Regulations to Minimize Flood Losses).
- The Code of Colorado Regulations 2 CCR 408-1 (Rules and Regulations for Regulatory Floodplains in Colorado).
- The Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual (USDCM) Volume 1 (Management, Hydrology, and Hydraulics), Chapter 4 (Flood Risk Management).
- FEMA Regulations 59 and 60 Colorado code of regulations.

9.2 Design

9.2.1 Storm Design Criteria

All stormwater drainage, flood control and water quality calculations shall be completed for both a minor and a major storm event. The USDCM will be used to develop both the minor and major storms, with the following specific requirements:

- Minor storms shall be a 5-year return period. Roadside ditches and driveway culverts shall be designed using a 10-year return period.
- Major storms shall be a 100-year return period.
- Rainfall depths used for design storms shall be from the NOAA Atlas 14 Rainfall depths for Northglenn City Hall. This data is pre-loaded in the UDFCD design spreadsheets and can also be obtained from the NOAA Precipitation Frequency Data Server by inputting the Northglenn City Hall address (11701 Community Center Dr, Northglenn, CO 80233).
- Rational Method shall be used for runoff calculations for all drainage basins less than 90 acres. Runoff calculations for drainage basins greater than 90 acres must use the Colorado Unit Hydrograph Procedure (CUHP). Rational method may not be used for any basins larger than 90 acres.

9.2.2 Stormwater Drainage System

Use of Stormwater Drainage Facilities

The use of stormwater drainage facilities within the City of Northglenn shall be in accordance with the City of Northglenn Municipal Code, UDFCD guidelines, and all applicable state and federal laws.

Design Criteria

All subdivisions, re-subdivisions, planned unit development, private development and re-development, public improvements or any other proposed construction submitted for approval under the provisions of the Municipal Code shall include adequate storm drainage system analysis and appropriate drainage system plans in conformance with these STANDARDS AND SPECIFICATIONS. Special criteria shall be outlined at Pre-Application meetings and in the approved construction plans, as determined necessary by the City. Any deviation from these STANDARDS AND SPECIFICATIONS must be accepted in writing by the City, prior to acceptance of construction plans.

It is the intent of this "design criteria" section to provide enough detailed information to enable the Engineer for the Owner/Developer to correctly and efficiently design the overall stormwater drainage system for a particular development. If there is a question or a concern regarding the design of any portion of the stormwater drainage system that is not adequately answered within this chapter, the Owner/Developer or his representative shall contact the City to get all issues resolved prior to design.

System Layout

- All mains shall be installed in dedicated Rights of Way or public easements. Under no circumstances should stormwater drainage pipes be installed parallel to and directly below any concrete such as sidewalks, curbs or gutters.
- Stormwater drainage pipes shall be straight between manholes, both in horizontal and vertical alignment.
- Stormwater drainage pipes shall be laid a minimum of ten feet horizontally from any existing or proposed utility. See Section 9.2 of these STANDARDS AND SPECIFICATIONS for further horizontal and vertical clearance requirements and variances.

Inlet Capacity

Design of inlets shall provide enough inlet capacity to limit pavement spread at inlet locations to the maximum values shown in Table 9.1 and Table 9.2 below. Inlets at sag locations must meet the pavement spread requirements for minor storms with a 10-year return period.

Table 9.1: Minor Storm Allowable Pavement Spread

	Maximum Encroachment
Industrial and Local Residential	No curb overtopping, but flow may spread to crown of street (flow may spread to back of sidewalk).
Collectors	No curb overtopping and flow spread must leave at least one 10-foot lane free of water (5-feet on each side of the street crown or 10 feet on at least one side of median).
Arterials	No curb overtopping and flow spread must leave at least two 10-foot lanes free of water (10-feet each side of the street crown or median).

Table 9.2: Major Storm Allowable Pavement Spread

Classification	Maximum Encroachment
Industrial, Local Residential and Collectors	Building structures shall not be inundated at the ground line. The depth of water at street crown shall not exceed 6-inches.

Arterials	Building structures shall not be inundated at the ground line. To allow for emergency vehicles, the depth of water shall not exceed the street crown and 12-inches at the gutter flow line, whichever is more restrictive.
-----------	--

Surface Cross Flow

Cross street flow can occur in an urban drainage system under three conditions. One condition occurs when the runoff in a gutter spread across the street crown to the opposite gutter. The second is when cross-pans are used, typically at intersections. The third condition occurs when the flow in a Drainageway exceeds the capacity of a road culvert and subsequently overtops the crown of the street. Cross street flow is allowed only up to the limits shown below in Table 9.3. Cross pan gutters are not allowed in Collector or Arterial Streets.

Table 9.3: Limits of Cross Street Flow

Classification	Minor Storm Maximum Depth	Major Storm Maximum Depth
Industrial and Local Residential	6-inches of depth in cross pan; 4-inches or less cross flow depth at centerline with 6-inches of depth at gutter flow line.	12-inches of depth in cross pan; 10-inches or less cross flow depth at centerline with 12-inches of depth at gutter flow line.
Collectors	4-inches or less cross flow depth at centerline with 6-inches of depth at gutter flow line.	10-inches or less cross flow depth at centerline with 12-inches of depth at gutter flow line.
Arterials	Cross flow not allowed.	6-inches cross flow depth at centerline.

Pipe Capacity

All pipes shall be designed to accommodate the minor storm flows (5-year) with no surcharging of the pipes (hydraulic grade line below top of pipe). All storm drainage collection systems shall be designed such that the hydraulic grade line for major storm flows (100-year) maintains at least a 1-foot freeboard below the rim elevation of structures or the top of embankment on ditches and open channels.

Easements

Utility easements shall be attained in accordance with these STANDARDS AND SPECIFICATIONS.

Unlawful Discharges

It shall be unlawful for any person to discharge or cause to be discharged or spilled any substance other than naturally occurring stormwater runoff into the City's storm drainage system, other than those exceptions listed in the Municipal Code. This restriction applies to storm runoff from potential contamination sources such as outdoor fuel, fertilizer, chemical and other hazardous substance storage areas, garbage handling and dumpster pads, excessive fluid leaks from stored vehicles, and any other pollutant source that can be carried to the stormwater drainage system.

Unlawful Discharges

It shall be unlawful for any person to discharge or cause to be discharged or spilled any substance other than naturally occurring stormwater runoff into the City's storm drainage system, other than those exceptions listed in the Municipal Code. This restriction applies to storm runoff from potential contamination sources such as outdoor fuel, fertilizer, chemical and other hazardous substance storage areas, garbage handling and dumpster pads, excessive fluid leaks from stored vehicles, and any other pollutant source exposed to stormwater runoff that can be carried with runoff to the stormwater drainage system. This restriction also applies to unauthorized direct connections to any component of the stormwater drainage system such as roof drains and sump pumps.

The City does not permit Designers to directly connect roof drains and sump pumps to the storm drainage system. Designer is responsible for the dispersement of these flows within the historic flows permitted through these Standards and Specifications and Mile High Flood District.

9.2.3 Stormwater Detention & Water Quality

General

On-site detention and water quality treatment is required for all new development, expansion, and redevelopment. Required minimum detention volumes and maximum release rates shall be determined based on the criteria in the USDCM or as established by approved master plans.

Stormwater quantity management should strive to reduce or disconnect impervious areas as the first step in reducing runoff volumes prior to determining detention requirements per the USDCM, Volume 3, Chapter 1.

Detention may be provided by means of open space detention ponds, above ground or subsurface parking lot detention, rooftop detention incorporated with a “Green Roof” concept, and other emerging technologies and structures. Detention concepts should be discussed with City staff early in the planning stages, and all proposed detention concepts will be allowed on a case-by-case basis through the review and approval process of the drainage reports/letters. Designers are also required to add any required water quality capture volume (WQCV) to the flood detention volume. The WQCV itself shall be increased by 20% to account for sedimentation. Any proposed concept must have performance verified by third party testing such as the New Jersey Corporation for Advanced Technology (NJCAT), or equivalent testing, and must also meet Colorado Water Rights requirements of section 37-92-602(8), Colorado Revised Statutes (C.R.S.).

Detention ponds and water quality treatment measures should be designed as landscaped areas with multiple use provisions (recreation, aesthetic, wildlife needs, etc.). Within Urban Centers the detention ponds and water quality treatment measures should be designed to be architecturally compatible with the urban environment of the development. The landscape concepts, slope, and wall treatments should be identified on the landscape plan and site plan submitted to the City of Northglenn. All Designer are responsible to ensure that their design does not permit drainage other than rainfall to enter the storm drainage system. As an example, the Designer shall not put a dumpster near the storm drainage system inlets.

There are specific notification requirements that apply to all new or modified stormwater detention and infiltration facilities, including individual site facilities built by private parties as a development requirement. For any stormwater detention and infiltration facility constructed after August 5, 2015 and seeking protection from Water Rights claims under section 37-92-602(8), Colorado Revised Statutes (C.R.S.), the “entity that owns, operates, or has oversight for” shall, prior to operation of the facility, provide notice to all parties on the substitute water supply plan notification email list maintained by the State Engineer. This notice must include the following:

- The location

- The approximate surface area at design volume
- Data that demonstrate that the facility has been designed to comply with the release rates listed in section 37-92-602(8), Colorado Revised Statutes (C.R.S.).

Documentation of compliance must be provided in the Final Drainage Report document on forms provided by the City. City staff will then provide the required notification to the Colorado Stormwater Detention and Infiltration Facility Notification Portal.

Further information on this requirement can be obtained from the Colorado Department of Natural Resources, Division of Water Resources, Rainwater Collection & Storm drainage Management.

Design Requirements

- Design is in accordance with the USDCM, Volume 2.
- Emergency overflow and its flow path downstream shall be explicitly addressed in the design. The 100-year peak inflow shall be used as a minimum basis for designing emergency overflow structures.
- Detention facilities shall be designed to release or infiltrate at least 97% of all runoff from a rainfall event that is less than or equal to a 5-year storm within 72 hours after the end of the event.
- Detention facilities shall be designed to continuously release or infiltrate as quickly as practicable, but in all cases release or infiltrate at least 99% of the runoff within 120 hours after the end of events greater than a 5-year storm.
- Detention facilities shall be designed to operate passively and shall not subject the stormwater runoff to any active treatment process (e.g., coagulation, flocculation, disinfection, etc.).

Easements

All new developments and redevelopments must dedicate drainage access easements for their private detention ponds and Water Quality Control Measures (BMP's), including any "Green Roofs", and for maintenance access to drainage facilities. This easement is required to allow City personnel emergency access to the facilities and to allow for random inspections by city staff to determine compliance with maintenance requirements. A note must be added to the site plans or contextual site plans indicating who will be responsible for the maintenance of these facilities, i.e., the property owner, HOA or metro district. It is the underlying responsibility of the property owner to ensure the private detention and water quality Control Measures (BMP's) are maintained and they continue to serve the intended stormwater management function. For any public storm drainage systems or in special cases, the Engineering Division may require a utility easement that gives the City operation, maintenance and construction access.

Maintenance

Maintenance access must be provided to the top of the detention pond outlet structure and to Control Measure structures that may be located within the detention pond.

- Access routes shall be a minimum width of eight-feet with a two-foot recovery zone on each side of the access.
- Centerline radii less than 50-feet will require the access to be widened to accommodate the turning movement of maintenance vehicles, i.e., tandem axle dump trucks.
- In no case shall the centerline radii be less than 30-feet.

- The maximum grade shall be 10 percent.
- Where tributary areas are less than five acres in size the maximum longitudinal slope for maintenance access may be considered on a case by case basis for approval of up to 4:1 (horizontal: vertical).

Certifications

Refer to **Chapter 4- Public Infrastructure Acceptance Procedures & Warranty Requirements** for further requirements.

Construction Site Storm Drainage Management

Refer to **Chapter 13- Right-of-Way Grading & Erosion Control** for construction site storm drainage management requirements.

Post-Construction Water Quality Control Measures

The following Standards shall apply to all Post-Construction Control Measures per the most current version of the Phase II MS4 Permit.

- WQCV Standard
 1. Control Measures will provide treatment and/or infiltration of the WQCV.
 2. Control Measures will capture 100% of site runoff.
 3. The City of Northglenn, at its sole discretion, may exclude up to 20% of the proposed site, not to exceed 1 acre, if the City determines it is not practicable to capture runoff from some areas of the site. Applicant must adequately demonstrate, through design and the drainage report, the impracticability of capturing 100% of site runoff.
 4. The Control Measures design calculations will use a minimum drain time based on the specific pollutant removal mechanism and functionality of the measure.
- Pollutant Removal Standard
 1. Control Measures will be designed to treat minimum 80th percentile storm event.
 2. Control Measures will be designed to treat runoff to reduce event mean TSS to 30mg/L or less.
 3. Control Measures will capture 100% of site runoff.
 4. The City of Northglenn, at its sole discretion, may exclude up to 20% of the proposed site, not to exceed 1 acre, if the City determines it is not practicable to capture runoff from some areas of the site. Applicant must adequately demonstrate, through design and the drainage report, the impracticability of capturing 100% of site runoff.
- Runoff Reduction Standard
 1. Control Measures will provide Infiltration, evaporation, and/or evapotranspiration of 60% of WQCV runoff volume.

2. Control Measures can include "Green Infrastructure" as approved by the City of Northglenn. Requests to use "Green Infrastructure" measures must include performance data from field testing on measures installed and operating in "real world" conditions in addition to any lab testing data.
- Applicable Development Site Draining to a Regional WQCV Control Measure
 1. Applications to use Regional Control Measures must show the Regional Control Measures are designed to accept the drainage from the entire Site under consideration.
 2. Site may not discharge to a water of the state prior to discharge into a regional WQCV control measure.
 3. Any Regional WQCV must meet the requirements of item #1 above.
 - Applicable Development Site Draining to a Regional WQCV Facility
 1. Applications to use Regional facilities must show that the Regional facilities are designed to accept the drainage from the entire Site under consideration.
 2. Site may discharge to water of the state prior to discharging to regional facility provided:
 - a. A minimum of 20% of the total impervious surface area of the applicable site first drains to a Control Measure with an area of at least 2% of the total impervious surface area of the applicable site,
 - b. the Control Measure is adequately designed to treat 20% of the total impervious surface area of the applicable site,
 - c. the Control Measure is designed in accordance with a design manual identified or accepted by the City of Northglenn, and
 - d. the stream channel between the Site discharge point and the Regional WQCV Facility must be stabilized.
 1. Regional facilities must meet following requirements:
 - a. the Regional WQCV Facility must be implemented, functional, and maintained,
 - b. the Regional WQCV Facility must be designed and maintained for 100% of the WQCV for its entire drainage area,
 - c. the Regional WQCV Facility must have capacity to accommodate drainage from the Site,
 - d. the Regional WQCV Facility must be designed and built to comply with all the assumptions for the development activities within the Regional WQCV Facility's drainage area,
 - e. the minimum drain time is based on the specific pollutant removal mechanism and functionality of the measures,
 - f. the Site shall meet the City of Northglenn MS4 Permit for Control Measures,

- g. the Regional facility must be subject to City authority consistent with the City of Northglenn MS4 Permit, and
- h. the Regional facility must be designed and implemented with flood control or water quality as the primary use.
 - Recreational ponds and reservoirs are not considered regional facilities.
 - Water bodies listed by name in 5 CCR 1002-32 through 5 CCR 1002-38 are not considered Regional facilities.
- Constrained Redevelopment Sites Standard
 - 1. Criteria for consideration as a Constrained Site:
 - a. The Site prior to redevelopment is greater than 75% impervious,
 - b. the applicant provides sufficient documentation to prove it is not practicable to meet Standards 1, 2 or 3 above, and
 - c. the Drainage Report must include evaluation of site's ability to install Control Measure without reducing the surface area of the Site covered by structures.
 - 2. Standards – Site must meet 1 of the following:
 - a. Control Measure is designed to treat at least 50% of the WQCV for the Site
 - Captured area is at least 50% of site total impervious area, and
 - Minimum drain time based on specific pollutant removal mechanism and functionality of the Control Measure
 - b. Control Measures are designed to treat a minimum 80th percentile storm event
 - Control Measures are designed to treat runoff to reduce the event mean TSS to 30mg/L or less,
 - the Control Measures treat at least 50% of the total site including 50% of the total site impervious area, and
 - the TSS removal meets or exceeds the requirements for the entire Site by providing increased removal for the smaller area.
 - c. Control Measures provide Infiltration, evaporation, and/or evapotranspiration of at least 30% of the entire site WQCV runoff volume.

9.3 Construction Specifications

9.3.1 Excavation & Trenching

Excavation, trenching and backfilling shall be done in accordance with **Chapter 14– Trenching, Backfilling & Compacting – Utilities** of these STANDARDS AND SPECIFICATIONS.

9.3.2 Bedding

Bedding shall conform and be installed in accordance with **Chapter 14– Trenching, Backfilling & Compacting – Utilities** of these STANDARDS AND SPECIFICATIONS.

9.3.3 Pipeline Installation

General

The City shall be notified at least 48 hours in advance of any pipe installation. No stormwater drainage pipe shall be installed without prior City approval. No pipes shall be backfilled until they have been inspected by the City. Alignment and grade of the pipe and the location of fittings, manholes and inlets shall be staked under the supervision of a professional surveyor registered in the State of Colorado.

Proper implements, tools and facilities shall be provided and used by the contractor for the safe and convenient execution of the work. All pipe sections, pre-cast manholes and inlet sections, shall be carefully lowered into the trench by means of a derrick, ropes or other suitable tools or equipment to prevent damage to stormwater drainage line material. Under no circumstances shall stormwater drainage line materials be dropped or dumped into the trench.

All pipe fittings shall be carefully examined for cracks and other defects immediately before installation. The groove in the bells of the pipe shall be full and continuous or the pipe will be rejected. Defective pipe or fittings shall be removed from the job site within 24 hours of notification by the City. All foreign matter or dirt shall be removed from the interior and ends of the pipe before they are lowered into position in the trench and prior to connection.

Every precaution shall be taken to prevent foreign material and trench water from entering the pipe and fittings. During construction, the contractor shall provide and maintain adequate equipment to properly remove and dispose of all water entering the trench and any other part of the work.

Pipe

Pipe shall be laid from downstream to upstream with spigot ends pointing downstream. All pipe shall be placed true to line and grade and carefully centered and with a smooth invert at the joint. The joint shall be made in a workmanlike manner and shall be watertight. Immediately before joining two lengths of pipe, the inside of the bell and the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure that the correct type of gasket is used. A thin film of gasket lubricant shall be applied to the inside face of the gasket and the spigot end of the pipe. The spigot end of the pipe shall be placed in the bell with care to prevent the joint from contacting the ground.

The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint. The pipe shall then be properly set and brought to correct line and grade. All lifting holes shall be filled with cement mortar prior to backfilling. The pipe shall be secured in place by installation of bedding material and backfill, in accordance with **Chapter 9 – Storm Drainage & Other Concrete Facilities** and the detailed drawings in **Appendix G.3**.

At times when installation is not in progress, the open ends of the pipe shall be closed with a plug. Cutting of pipe for inserting closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining, leaving a smooth end at right angles to the axis of the pipe. Pipe ends shall be smooth and beveled with a file or other tools according to the pipe manufacturer's recommendations.

Extra care should be used in handling PVC pipe during cold weather due to the reduced flexibility and impact resistance as temperatures approach and drop below freezing. PVC pipe to be stored outside and exposed to sunlight for more than 30 days shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover the pipe. Air circulation shall be provided under the covering. Any over-exposed pipe, as determined by the City, will not be permitted for installation.

No pipe or appurtenant structure shall be installed upon a foundation in which frost has penetrated or at any time when the City deems there is a danger of ice formation or frost penetrations at the bottom of the excavation. No pipe or appurtenant structure shall be installed unless backfilling can be completed before the formation of ice and frost.

9.3.4 Manhole Construction

General

Manholes, including cast-in-place or precast bases, inverts, barrel sections, tops and adjusting rings, shall conform to and be installed in accordance with Standard Drawings of these STANDARDS AND SPECIFICATIONS.

Inlets

Inlets shall be constructed with Class B concrete, placed on undisturbed ground and in conformance with the detail drawings in **Appendix G.3**. The top portion of inlets shall be constructed concurrently with the adjacent curb and gutter to ensure proper alignment of grades.

Manhole/Inlet Grouting Treatment

The horizontal joints between precast manhole/Inlet sections shall be plastered and troweled smooth, inside and out, with cement mortar. The mortar shall be not less than five eighths inch (5/8") in thickness over the joint and shall extend at least four inches (4") on either side of the joint.

All pipes, including concrete, PVC and HDPE shall have a manhole water-stop gasket, to be furnished by the contractor, firmly attached to the pipe prior to grouting into the manhole. The opening in the manhole wall where a pipe enters or leaves shall be sealed and patched in a neat workmanlike manner, both inside and out with cement mortar. All lifting holes and other imperfections in the interior manhole/inlet wall shall be filled with cement mortar.

9.3.5 Connections to Existing Manholes

Stormwater drainage pipe connections to existing manholes where there is no existing pipe stubbed out shall be made in such a manner that the finished work will conform as nearly as practicable to the requirements specified for new manhole construction. The contractor shall break out as small an opening in the existing manhole as necessary to insert the new stormwater drainage pipe. The existing concrete foundation bench shall be shaped to the cross-section of the new pipe in order to form a smooth continuous invert similar to what would be formed in a new concrete base. The downstream invert shall be plugged during construction to prevent storm and non-sewage flow from entering the system. The contractor shall pump out and clean the manhole before removing the plug. Cement mortar shall be used to smoothly finish the new invert and to seal the new line, both inside and outside, so the junction is watertight.

9.3.6 Tests

General

All stormwater drainage mains and appurtenances shall be cleaned and tested after backfilling operations have been completed. All required testing must be completed and approved prior to acceptance. Should the City find that the completed line or any portion thereof fails any of the specified tests; the City will not accept the new stormwater drainage line until such time as the stormwater drainage line meets the test specifications. Once the stormwater drainage line is completed and before a "Release for Service" Final Acceptance letter is issued, the contractor shall perform a television inspection on the completed line.

The contractor shall furnish all labor, materials, tools, and equipment necessary to clean the pipe and appurtenances prior to the television inspection. Any damages to the pipeline caused by cleaning shall be repaired or replaced by the contractor at his expense.

TV Inspection

Refer to **Chapter 9 – Storm Drainage & Other Concrete Facilities** for TV Inspection and Cleaning requirements and procedures for stormwater drainage lines.

9.3.7 Material Specifications

General

Only those pipeline materials described in this section are approved for stormwater drainage installations. Any other material proposed as an equal shall be approved by the City prior to construction. All pipe materials to be incorporated in the construction of stormwater drainages shall conform to the requirements specified herein or as modified elsewhere in these STANDARDS AND SPECIFICATIONS. All materials furnished shall be new and undamaged. Everything necessary to complete all installations shall be furnished and installed whether shown on the approved drawings or not and all installations shall be completed and fully operational. Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Developer/Contractor of the responsibility for furnishing materials meeting the requirements of these STANDARDS AND SPECIFICATIONS.

All materials delivered to the job site shall be adequately housed and protected to ensure the preservation of their quality and fitness for the work.

Defects

Pipe shall be free of defects in accordance with these STANDARDS AND SPECIFICATIONS.

Certification

A manufacturer's certification that material was manufactured and tested in accordance with applicable ASTM designations, together with a report of all test results, may be required by the City prior to final acceptance of the work.

Polyvinyl Chloride Pipe (PVC) – Gravity

All gravity pipe materials and fittings shall meet the minimum requirements of ASTM D-3034, SDR-35, latest revision. Pipe shall be subjected to drop-impact tests in accordance with ASTM D-2444. The pipe shall have bell and spigot joints with gasketed joint. The spigot end shall be marked so the installer and the inspector can determine when the pipe is properly inserted into the bell. The maximum pipe length shall be twenty feet.

All fittings and accessories shall be as manufactured and furnished by the pipe supplier and have bell and/or spigot configurations compatible with that of the pipe.

Pipe stiffness for all pipe sizes shall be tested in accordance with ASTM D-2412. Joint tightness shall be tested in accordance with ASTM D-2855.

Reinforced Concrete Pipe (RCP)

Developer/Owner shall have soils testing and a summary letter prepared by a geotechnical firm to determine the suitability of using RCP prior to including it in the design. Soil testing results and the letter shall be submitted with the design. All Reinforced Concrete Pipe used in the construction of a stormwater drainage system within the right-of-way in the City of Northglenn shall conform to the following specifications:

- Pipe – ASTM C76 – Reinforced Concrete Culvert, Storm Drainage and Sewer Pipe for Class II, III, IV, and V.
- Joints – ASTM C443 – Joints for Circular Concrete Sewer and Culvert Pipe, using Rubber Gaskets.
- O-Ring/Profile Rubber Gaskets – AASHTO M198

- All RCP shall be constructed with Type II modified cement. The absorption of the pipe shall meet minimum ASTM C-76.
- All concrete pipe fittings, wyes, tees, and bends shall be cast as an integral part of the pipe to which they are attached and shall be the same pipe classification.
- The following shall be clearly marked on the exterior surface of all pipe with waterproof paint:
 - ASTM Specification.
 - Class and Size.
 - Date of Manufacture.
 - Name or Trademark of Manufacturer

High Density Polyethylene Pipe (HDPE)

- High Density Polyethylene (HDPE) Corrugated and Smooth Lined Pipe & Fittings shall be manufactured in accordance with requirements of ASTM F 2306, latest edition. Type S: This pipe shall have a full circular cross section, with an outer corrugated pipe wall and a smooth inner wall.
- High Density Polyethylene (HDPE) Corrugated and Smooth Lined Pipe shall be manufactured from virgin PE compounds which conform with the requirements ASTM D 3350.
- Minimum Pipe Stiffness shall be in compliance with ASTM F 2306 and tested in accordance with ASTM D 2412.
- Installation shall be in accordance with ASTM D 2321.

Manholes

Manholes, reducing sections, ladder rungs, base slabs, joint material, mortar, and traffic lids shall conform with these STANDARDS AND SPECIFICATIONS.

Chapter 10. CONCRETE SIDEWALKS & OTHER CONCRETE FACILITIES

10.1 General

This chapter sets forth the minimum criteria to be used in the design of all sidewalks, access ramps and other concrete facilities. Roadway typical sections including sidewalks and curb and gutter shall be as specified by these STANDARDS AND SPECIFICATIONS.

10.1.1 ADA Requirements

All pedestrian facilities shall be designed in accordance with American Disabilities Act (ADA) regulations and the requirements of these Standards; whichever is safer for pedestrians.

10.2 General Layout & Design Criteria

10.2.1 Sidewalks

Sidewalks on Both Sides of Streets

Sidewalks shall be designed and constructed on both sides of all roadways unless specifically deleted by action of City of Northglenn. Bikeways may be constructed on both sides of the streets as required by the standard sections or through the Unified Development Ordinance requirements.

Minimum Width

All sidewalks used in conjunction with vertical curb and gutter shall have a minimum width of five feet (5') and as shown on the standard street sections.

In-Fill Sidewalk, Curb, & Gutter

In all existing areas previously developed, sidewalks, curbs, and gutter may be required to match existing conditions or Standards, as determined by the Engineering Division.

Thickness

All detached sidewalks less than 8 feet in width and not within driveways shall be a minimum of 4-inches thick concrete. All detached sidewalks greater than eight feet (8') wide shall be a minimum of six inches (6") thick. All sidewalks within a driveway area shall be six inches (6") thick. Sidewalks shall be a minimum of eight inches (8") thick where crossed by commercial traffic.

Slope

- **Cross Slope.** Maximum cross slope for sidewalks shall be ¼ inch per foot (1:48).
- **Longitudinal Slope.** Longitudinal slope of attached sidewalks shall be consistent with the street slopes and ADA requirements.
- **ADA Requirements for Steeper Slopes.** Sidewalks detached from the curb, with greater than five percent (5%) longitudinal slopes, shall be constructed to meet ADA requirements.
- Preferred design cross slope 1.5 - 1.8%.

Horizontal & Vertical Curves

- **Horizontal Curves.** When designed with horizontal directional changes, they shall be adjusted with no less than a ten (10') foot radius curve.
- **Vertical Curves.** All sidewalks with vertical grade changes shall be designed with a vertical curve that smoothly transitions the vertical grade changes.

Vertical Clearance

Any sidewalk shall have a minimum vertical clearance of eight (8') feet.

Horizontal Clearance

All sidewalks shall have a minimum horizontal clearance of two (2') feet.

Sidewalks

All sidewalks shall be detached from the curb and gutter. Combination curb, gutter and walk are limited to local streets that have limited width and are specifically approved by the Engineering Division.

Joints

All curb and gutter or curbside shall have joints every 10 feet. When removing sections of curb and gutter or curbside, the entire section shall be removed and replaced. If the Contractor damages a portion of the adjacent stone, the Engineering Division will require the Contractor to replace the stone. For all sidewalks during construction or rehabilitation, the Contractor shall remove only from joint to joint.

10.2.2 Access Ramps

Locations

In accordance with [CRS 32-2-107(2)], access ramps shall be installed at all intersections and at certain mid-block crosswalks and other special situations for all new construction or reconstruction of curb and sidewalks, as follows:

- Access ramps shall be constructed in accordance with the Standard Drawings.
- All "T" intersections shall have a minimum of three access ramps in accordance with the Standard Drawings.
- Type of ramps directional or standard
 - Directional Ramp. Refer to Standard Drawings.
 - Standard Corner Ramp. Refer to Standard Drawings.
- Cul-de-sacs. Either an access ramp or a driveway that meets access ramp requirements shall be provided in all cul-de-sacs. If a public walkway or bikeway intersects the street, a ramp shall be provided to connect the walkway or bikeway to the street. The ramp must line up with the walkway.
- Access ramps may be shown at all curb returns or called out by a general note on the development plans but must be shown (located) on all "T" intersections. Whenever referencing an access ramp, call out the specific detail drawing to construct that ramp.
- Access ramps are to be poured monolithic with the abutting curb and gutter.

- The ramp portion shall be constructed with “Truncated Domes/Detectable Warning Devices” in accordance with the Standard Drawings in **Appendix G.4**. The truncated domes shall be cast iron.
- Inlets and other Drainage structures shall not be placed in line with access ramps. Location of access ramps shall take precedence over location of the drainage structure.

10.2.3 Curb Cuts

Drainage

Where curb cuts are allowed based on traffic considerations, concentrated storm water runoff must not be discharged across the sidewalk. These flows must be directed to a sidewalk chase section. If this is not possible due to grading restraints, radius returns and a crossspan shall be used.

Standard Design

Curb cuts and driveways shall be constructed in accordance with the Standard Drawings in **Appendix G.4**.

Residential Use

Curb cuts should not be used for commercial/industrial or high-volume residential driveways. In general, when the number of parking spaces serviced by the driveway exceeds ten (10), radius returns should be used.

Crossspans

Crossspans shall be constructed in accordance with the Standard Drawing in **Appendix G.4**. Crossspans are not permitted across collector or arterial roadways, nor are they allowed on roadways with storm sewer systems. Double crossspans may be used parallel to collectors or arterial roadways to convey storm runoff across residential roadways.

The use of double crossspans elsewhere or the use of any crossspan on roadways where the vertical grade exceeds four-and-one-half percent (4.5%) will be considered only after all alternatives have been exhausted.

Inlets

Inlets shall be located to intercept the curb flow at the point curb flow capacity is exceeded by storm runoff. Refer to **Chapter 9 – Storm Drainage & Other Concrete Facilities** and the Mile High Flood District Criteria Manual (Latest Edition) for curb capacity. Inlets shall also be installed to intercept cross-pavement flows at points of transition in superelevation. Due to the presence of ADA ramps, inlets shall not be allowed in the curb return but shall be located outside the tangent points of the curb returns. Gutter transition sections abutting inlets shall not be within the curb return.

Sidewalk Chases

Storm water from concentrated points of discharge shall not be allowed to flow over sidewalks but shall drain to the roadway or storm inlet by use of chase sections. Sidewalk chase sections shall not be located within a curb cut or driveway. Hydraulic design shall be in accordance with the Mile High Flood District Criteria Manual (Latest Edition). Sidewalk chase sections shall be constructed in accordance with the Standard Drawing in **Appendix G.4**.

Temporary Erosion Control

Temporary erosion control is required along and at the ends of all roadways that are not completed due to project phasing, subdivision boundaries, etc., in accordance with **Chapter 6 – Earthwork & Erosion Control** of these STANDARDS AND SPECIFICATIONS.

Construction Stakes

The Contractor's surveyor shall provide all stakes required for curbs, gutters, walks and structures and shall furnish all necessary information relating to lines and grades. The contractor shall be held responsible for the reasonable preservation of all such stakes. The Contractor shall not remove stakes until three (3) working days after placement of concrete unless approved by the Engineering Division.

Backfilling

When side forms are removed, the space adjoining the concrete shall be backfilled in a timely manner with suitable material properly compacted and brought flush with the surface of the concrete and adjoining ground surface. In embankments, the backfill shall be level with the top of the concrete for at least two feet (2') and then sloped to the property line. Maximum slope shall be four to one (4:1). Where detached walks occur, the space between the curb and walk shall be backfilled on a straight line from the top of walk to the top of curb.

Connections with Existing Concrete Curb, Gutter, & Drives

Where new construction abuts existing, the work shall be accomplished so that no abrupt change in grade between the old and new work results.

Chapter 11. ROADWAYS & PAVEMENTS

11.1 Introduction

11.1.1 Purpose

This section contains minimum criteria to be met on newly designed and constructed public and private (open to general public) streets and parking lots in the City. Roadway design shall meet or exceed these STANDARDS AND SPECIFICATIONS. Policies and technical criteria shall not be specifically addressed in this document and shall follow the provisions of the American Association of State Highway and Transportation Officials (AASHTO), CDOT Standard Specifications for Road and Bridge Construction (CDOT S&S), Highway Capacity Manual, Manual on Uniform Traffic Control Devices (MUTCD), and the Colorado Department of Transportation's Standard Plans ("M-Standards"). Improvements shall also be in conformance with the City of Northglenn Unified Development Ordinance.

11.1.2 City Capital Improvement Projects

It is recognized that the minimum requirements contained in these STANDARDS AND SPECIFICATIONS are not necessarily sufficient for plans, specifications, and contract administration purposes for City administered street capital improvement projects. Accordingly, the Engineering Division is authorized to develop and/or approve such additional requirements and procedures necessary for bidding, awarding, and administering for such projects, provided said additional requirements and procedures are substantially consistent with these STANDARDS AND SPECIFICATIONS and applicable provisions of other City ordinances and resolutions.

11.2 Roadway Design & Technical Criteria

This section sets forth the minimum design and technical criteria and specifications to be used in the preparation of all roadway plans. Within this chapter is, "A Policy on Geometric Design of Highways and Streets" as published by the American Association of State Highway and Transportation Officials (Latest Edition).

11.2.1 Drainage

The minor and major storm drainage systems shall be designed in accordance with the Urban Drainage and Flood Control District's Criteria Manual (UDFCD) (Latest Edition). Because safe and efficient movement of traffic is the primary function of roadways, the storm drainage function of roadways, (such as allowable gutter capacity and street overtopping), shall be designed to the limits set forth in the drainage criteria. Please refer to **Chapter 9 – Storm Drainage & Other Concrete Facilities** and **Chapter 10 – Concrete Sidewalks & Other Concrete Facilities** for the design standards for crosspans, inlets and sidewalk chases.

11.2.2 Geometric Design

Geometric design elements, such as horizontal and vertical alignments and sight distances shall be in accordance with the "A Policy on Geometric Design of Highways and Streets" by the American Association of State Highway and Transportation Officials (Latest Edition). Geometric design elements must also consider the requirements of the local Fire District.

Geometric Cross Section

Street cross sectional elements shall conform to the Standard Drawing as determined by the Engineering Division. Collector and arterial streets shall be constructed whenever the alignment of the proposed street is generally the same as the collector and arterial streets shown on the Comprehensive Plan, Transportation Plan, or whenever a traffic engineering analysis of the future traffic volumes indicates the need of a cross section greater than that of a local residential street. These cross sections can be found in **Standard Drawings R-1 and R-2**.

Additional Right of Way may be required to satisfy other criteria contained in these Standards and Specifications. Areas outside the Right of Way shall be contour graded, compacted, and sloped, as required for proper drainage, soil stability, and maintenance accessibility.

Curb Radii

Curb radii criteria for various intersections are listed on Table 11.1.

Table 11.1: Curb Radii Criteria

Classification	Major Arterial	Minor Arterial	Collector	Local
Major Arterial	45 feet	45 feet	45 feet	N/A
Minor Arterial	45 feet	40 feet	35 feet	N/A
Collector	45 feet	35 feet	30 feet	25 feet
Local	N/A	N/A	25 feet	20 feet

Horizontal Alignment

Streets shall intersect or connect to other streets at right angles, and intersections shall be constructed so that lanes are not offset through the intersection. If a street approaching another street is at an oblique angle, then the design shall have the intersecting streets at right angles for 100 linear feet from the intersecting flowlines. Horizontal and vertical alignment and Right of Way limits shall be coordinated so as not to obstruct sight distance at intersections, in accordance with City Code.

Street Design Criteria

Street design criteria for various street types are listed on Table 11.2. The requirements of the City of Northglenn Development Code, the City Transportation Plan, and the City's Comprehensive Plan shall be adhered to.

Table 11.2: Street Design Criteria

	Parking Lots & Private Streets	Local Streets	Minor Collector	Major Collector	Minor Arterial	Major Arterial
Design Speed	N/A	30	35	40	45	50
Posted Speed	N/A	25	30	35	40	45
Traffic Volumes		< 2,500 /day		<12,000	>12,000	
Continuity		Limited		< 2 miles	Several miles, generally connecting with inter-city routes	
Safety		Designed for the safety of pedestrians and bicyclists and the ease of access to adjacent parcels of land	Designed to handle traffic volumes loading from and onto local, other collector, and arterial roadways			

	Parking Lots & Private Streets	Local Streets	Minor Collector	Major Collector	Minor Arterial	Major Arterial
Traffic Control		Stop signs, yield signs or Right of Way rules for uncontrolled intersections. Traffic requirements in other than residential areas may require special design consideration by the applicant's Designer and the City's Transportation Engineer	Regulation of traffic accomplished using stop signs and channelization. Traffic signals normally use only at intersections with major collectors and arterial streets		Regulation of traffic accomplished by signs and channelization. Traffic signals will normally be located only at intersections with streets of high classification. Parking should be prohibited	
Driveways - Drive Cut see Chapter 10		Back-out drives permitted	No back-out drives permitted			
Function		Local streets provide direct access to adjacent property. Traffic carried by local streets should have an origin or a destination within the neighborhood. Local streets are utilized in single family residential areas. Utility line easements should be available	Collector streets collect and distribute traffic between arterial and local streets and serve as main connectors within communities, linking one neighborhood with another. Traffic carried by collector streets should have an origin or a destination within the community. Utility easements should be available		Arterial routes permit relatively unimpeded traffic movement and are intended for use on these routes where four (4) moving lanes and one (1) left-turn lane are required but where a major arterial cross-section would not be warranted. No parking is allowed	
Right of Way		Sixty feet (60') with detached walk. Attached walks to be used only with written permission from the Engineering Division.		Seventy-feet (70') minimum, eighty-foot (80') average	One hundred feet (100') minimum	
Number of Moving Lanes		2		2	4 (minimum)	
Access Conditions		In accordance with Chapter 11 of these STANDARDS AND SPECIFICATIONS	In accordance with Chapter 11 of these STANDARDS AND SPECIFICATIONS			

	Parking Lots & Private Streets	Local Streets	Minor Collector	Major Collector	Minor Arterial	Major Arterial
Planning Characteristics		Local streets should not intersect major arterial streets	Collector streets should have continuity throughout a neighborhood but need not extend beyond the neighborhood intersections with collectors, major collectors and arterial streets should be at least one-quarter (1/4) mile apart		Arterials should be spaced from one-half (1/2) to one (1) mile apart and should, where possible, be continuous. Arterials should act as boundaries between neighborhood areas. Arterial cross-section should be employed where traffic demands are high and Right of Way acquisition costs are prohibitive. Detached sidewalk required. Separate major land uses	
Type of Curb and Gutter		Six inches (6”) vertical with detached walk. Four-inch (4”) combination curb, gutter and walk, with attached walk only with written permission from the Engineering Division	Six (6) inch vertical		Six (6) inch vertical	
Sidewalk Width		Five-foot (5’) minimum, attached or detached from curb	Five feet (5’) minimum. Detached from curb		Eight-foot (8’) minimum, detached from curb or as required by the Engineering Division	
Cul-de-sacs		In accordance with Chapter 11 of these STANDARDS AND SPECIFICATIONS				
Street Widths		Thirtyfoot(30’) minimum paved width plustwo (2) two and a half foot (2.5’) curb and gutter pans	Thirty-seven-foot (37’) - forty-nine foot (49’) paved with two (2) two and a half foot (2.5’) gutter pans		Four (4) - twelve-foot (12’) travel lanes, one (1) sixteen-foot (16’) left-turn lane/striped or curbed median, and two (2) two and a half foot (2.5’) gutter pans plus acceleration/deceleration lanes at intersections. Variation from these dimensions must be approved by the Engineering Division	
Streetlight Spacing		200’ (+/- 40)			150’ (+/-50)	
Right & Left Turn Lanes	Required at all accesses along arterials. May be required at accesses along collectors but shall be determined at time of development by the Engineering Division. Minimum dimensions: 150’ storage, 100’ taper, except for arterial/arterial intersections which shall be designed to accommodate 200’ storage and 100’ taper					
Cross Slope	Max 4% – Min	Maximum 4% - Minimum 2%				

	Parking Lots & Private Streets	Local Streets	Minor Collector	Major Collector	Minor Arterial	Major Arterial
without Super Elevation	1%					
Maximum Curb Line Grade Break without Vertical Curve	1%	1% at Curb Returns, 0.5% at Other Locations				
Super Elevation Maximum	N/A	N/A	4%	4%	4%	4%
Minimum Degree Curve	N/A	38.2 (150'R)	22 (260'R)	10 (575'R)	8.5 (675'R)	7 (820'R)
Maximum Street Grade	N/A	N/A	150'	300'	400'	500'
Minimum Street Grade	0.75%					
Maximum Grade at Intersection	4% for 50% when approaching ROW	4% for 50'	4% for 150'	3% for 300'	2% for 300'	2% for 400'
Tangents between Horizontal Curves	N/A	N/A	150'	300'	400'	500'
K-Values – Sag	N/A	37	37	64	79	96
K-Value - Crest	N/A	19	19	44	61	84

The corner sight distance is measured from a point on the minor road, parallel to the roadway, 15 feet from the edge of the major road pavement, and from an eye height of 3.5 feet on the minor road to the height of the object and an eye height of 4.25 feet on the major road.

Stopping Sight Distance (Table 11.3) is measured from the driver's eye, 3.5 feet above the pavement to the top of an object 0.5 feet high on the pavement.

Table 11.3: Stopping Sight Distance

	Arterial	Collector	Residential Local
Minimum Corner Sight Distance	500'	400'	300'
Minimum Stopping Sight Distance	350'	275'	200'

Sight Obstructions are determined by any object more than 30 inches above the flowline elevation of the adjacent street. Those items, including berms, buildings, cut slopes, hedges, trees, bushes, utility cabinets or other plantings shall be removed.

Emergency Access Requirements

The access shall be a minimum of twenty (20) feet from edge to edge of roadway and shall be in an access easement. The slope shall be a minimum of one-half percent and a maximum of eight (8) percent. The cross slope shall be no less

than one (1) percent and no more than four (4) percent with a minimum vertical clearance of thirteen and one-half (13.5) feet. The surface must be paved.

Sidewalks, Curb & Gutters, Ramps, & Driveways

Refer to **Chapter 10– Concrete Sidewalks & Other Concrete Facilities** for these features.

Cul-De-Sacs

The following criteria shall be used for cul-de-sac horizontal geometry:

- The minimum property line radius shall be fifty feet (50').
- The minimum flowline radius shall be forty feet (40'). See the detail drawing in **Appendix G.4.**
- The maximum length of the cul-de-sac as measured along and between the radius point and the Right of Way line on the abutting street shall be five hundred feet (500') or a maximum of fifteen (15) residential dwelling units, whichever is greater.

Deceleration Lanes

The design of the arterial street system depends upon the proper control of access to developments. The location and design of access points must minimize traffic hazards and interference to through traffic movements. To ensure proper control, the following standards for deceleration lanes have been established. The need for deceleration lanes is established by the approved traffic study for the final plat or final development plan. Design criteria shall be in accordance with AASHTO "A Policy on Geometric Design of Highways and Streets", (Latest Edition).

Acceleration Lanes

At intersections, it is desirable to provide acceleration lanes for vehicles turning right onto the arterial from a cross street. The design elements of these acceleration lanes shall be in accordance with the Colorado Department of Transportation Roadway Design Manual, Latest Edition.

Off-Site Design

The design grade, and existing ground at that design grade, of all roadways that dead end due to project phasing, subdivision boundaries, etc., shall be continued in the same plan and profile as the proposed design for at least three hundred feet (300') or to its intersection with an arterial roadway.

If the off-site roadway adjacent to the proposed development is not fully improved, the developer is responsible for the design and construction of a transition for the safe conveyance of traffic from his improved section to the existing roadway. The following formula shall be applied to the taper of lane change necessary for this transition:

$$L = WS / 60 \quad S \leq 40 \text{ MPH}$$

$$L = WS \quad S > 45 \text{ MPH}$$

Where:

L = Length of Transition in Feet W = Width of Offset in Feet

S = Speed Limit or 85th Percentile Speed

The City of Northglenn Engineering Division should be contacted to establish unusual transition criteria. This contact is the responsibility of the applicant.

Barricades

Whenever roadways terminate due to project phasing, subdivision boundaries, etc., barricades are required across the width of terminated roadway. Design and construction shall comply with the requirements of the Manual of Uniform Traffic Control Devices, most recent edition. Details shall be shown on the construction drawings and installation shall be provided by the Developer/Contractor.

Requirements of Improvements Adjacent to Existing Roadways

Where proposed street construction will widen existing roadways or add a right turn lane, then the following requirements shall apply:

- Existing cross slope of adjacent lanes shall be maintained. Where this is not possible, the change in cross slope for the new lane shall not exceed 2.0%.
- The removal limits shall be sawcut in a clean straight line and shall not be in the traveled wheel path.
- The entire adjacent lane along the new improvements shall be roto-milled two (2) inches and overlaid with the final lift of the new improvements. Geosynthetic fabric may be required at the joint to prevent the pavements from reflective cracking.
- A geotechnical investigation shall be conducted on all roadways adjacent to the development to evaluate the condition of the asphalt. (Refer to **Chapter 5 – Design Report Requirements**) The investigation shall consist of borings or other suitable method of sampling, at spacing of no more than 250 feet unless otherwise accepted by the Engineering Division. The results of this investigation shall be submitted to the Engineering Division for determination of what, if any, existing asphalt may be utilized to meet the requirements of the Developer's Agreement.

Type 4 object markers shall be accompanied by a “future street extension” sign for the entire cross section of the roadways if it is planned for the street to be continued in the future.

Pavement markings, striping, signs, traffic signals and streetlights are addressed in **Chapter 12- Traffic Operation Devices**.

Chapter 12. TRAFFIC OPERATION DEVICES

12.1 Introduction

12.1.1 General

The standards contained in this chapter regulate all improvements and private work to be dedicated to the public and accepted by the City and all work within the public Right of Way. They are intended to provide for policies to ensure consistent and proper traffic planning and engineering with required facilities to serve and protect the potential users of the various areas of the community.

The standards in this chapter apply to new developments and capital projects which are not constrained by already existing improvements. This chapter will address in-fill development and projects with some existing infrastructure. Improvements may be required to the existing infrastructure dependent on the change in uses for each development.

12.2 Design Standards

12.2.1 Access Requirements & Criteria

General

New access may occur as one of two types: direct access to individual property (driveway) and new public street access as new intersections:

- For new developments, access is granted through the Planning Commission approval of the Final Development Plan; Planned Development (PD) or subdivision plat.
- New access to City streets from existing developed property is dependent upon zoning.
 - For property classified as a standard zoning district, the application should be made to the Planning and Development Department and accompanied by plans of the proposed access and technical justification for the access and associated public improvements.
 - For Planned Developments, new or altered access shall be obtained through the Planned Development (PD) amendment process. This involves applying through the Planning and Development Department for an amendment to the appropriate PD. The application should be accompanied by appropriate plans for the proposed access and technical justification, including justification for the extent of the improvements proposed at the access point.

12.2.2 Designing Placement of Accesses

Direct Access Restricted

New direct access to individual lots from Arterials is restricted. The City may implement Access Management Plans for Arterials and State Highways to ensure that Arterials are not overly burdened with too many accesses that substantially slow speeds of the Arterials.

Avoiding Conflicts in Center Left Turn Lane

When establishing the placement of offset accesses (either driveways or intersections), ensure that the traffic making left-hand turns into the accesses does not conflict or compete for the simultaneous use of a center left turn lane.

Setbacks from Intersections

When establishing the placement of accesses near intersections, ensure that the distance is sufficient to provide adequate site distance in accordance with these STANDARDS AND SPECIFICATIONS.

Separation Distances

The specific separation distances between accesses shall be as shown in ***Chapter 11 – Roadways and Pavement***.

Access Control Plan

For a street controlled by an adopted Access Control Plan, the proposed access shall conform with the applicable Access Control Plan.

12.2.3 Review and Approval

Review Procedure

- **Pre-Application Meeting.** The Planning and Development Staff is available to provide advice on the extent of technical justification required for any access request. It is recommended that this advice be sought prior to submitting any application.
- **Access Approval.** All new access shall be reviewed and approved through the City. Access is granted through the acceptance of the final plat, final construction plans or final site plan. The number and location of access points shall conform to the criteria in this chapter.
- **CDOT Approval for State Highway Access.** The Colorado Department of Transportation shall review and approve all State Highway access. These accesses will be governed by the State Highway Access Code. CDOT will issue the access permits for any approved State Highway approved access.
- **Permit Required.** This approval is finalized through City accepted plans and an approved Right of Way permit. All new accesses can only be constructed after approval of Right of Way permit from the Engineering Division (or CDOT, if required).

12.2.4 Criteria for Access onto Roadways

Access to State Highways

Access to State Highways is governed by the State Highway Access Code, State highway access plans and these Standards. All access issues on state highways within the City of Northglenn shall be submitted to the Colorado Department of Transportation and approved before access permits will be issued by CDOT.

Access to Existing Frontage Roads

Proposed access to all frontage roads shall comply with the requirements of the Colorado Department of Transportation State Highway Access Code, any applicable access control plan and the requirements of these Standards. All access issues on State Frontage Roads within the City of Northglenn shall be submitted to the Colorado Department of Transportation and approved before access permits will be issued by CDOT.

Freeways

Any new freeway access in the City of Northglenn shall meet the requirements of the Colorado Department of Transportation. All design issues shall meet CDOT Standard Specifications.

Arterials

- Private, direct access to arterials shall be permitted only:
 - When the property in question has no other reasonable access to the general street system; or
 - When denial of direct access to the arterial and alternative direct access to another roadway would cause unacceptable traffic operation and safety problems to the overall traffic flow of the general street system.
- When direct private access must be provided, the following shall be considered:
- **Temporary Approval.** Such access shall continue only until such time that some other reasonable access to a lower function category street is available and permitted. The Right of Way permit should specify the future reasonable access location(s), if known, and under what circumstances what changes will be required.
- **Limited Accesses.** No more than one (1) access shall be provided to an individual parcel or to contiguous parcels under the same ownership unless it can be shown that allowing only one access conflicts with safety regulations (i.e., fire access) or if additional access would significantly benefit safety and operation of the Arterial and is necessary to the safe and efficient use of the property.
- **Right Turns Only.** An access shall be limited to right turns only unless it has the potential for signalization, left turns would not create unreasonable congestion or safety problems and lower the level of service, or if alternatives to the left turns would not cause unacceptable traffic operation and safety problems to the general street system.
- **Spacing and Signalization.** Public direct access to arterial where left turns are to be permitted shall meet the signal-spacing criteria of this chapter. Those that do not meet these requirements shall be limited to right turns only, unless they meet the requirements mentioned above. No local streets shall be permitted to intersect arterials.
- In general terms, full access to Arterials shall be limited to one-half (1/2) mile intervals, plus or minus approximately two hundred feet (200'), to achieve good speed, capacity, and optional signal progression.
- To provide flexibility for both existing and future conditions, an approved engineering analysis of signal progression shall be made to properly locate any proposed access that may require signalization.
- **Local Street Access.** No local streets may intersect Arterials.

Collectors

- Private access to collectors shall be governed by the curb opening and driveway criteria.
- Single-family residence access to collectors is not permitted.
- Public streets shall intersect collectors not closer than three hundred and thirty feet (330') from each other (centerline to centerline).

Local

- Private access to local streets shall be governed by the following curb opening and driveway criteria.

- Public streets should not intersect local roadways closer than one hundred and fifty feet (150') from each other (centerline to centerline).

12.2.5 Basic Principles for Curb Openings, & Driveways

General

- **Purpose.** The design of curb openings and driveways within the range of minimum and maximum dimensions will provide for good service on the part of the motorist using the driveway while at the same time minimizing the interference to the traffic using the street.
- By controlling the location and width of openings of driveways along the street, it will be possible to avoid or eliminate long, open stretches where motorists can indiscriminately drive onto the street. The width of opening established in these STANDARDS AND SPECIFICATIONS are based on studies which indicate that the various width openings will accommodate vehicles of maximum size authorized on City streets.
- **Layout Criteria.** The opening or driveway width should be adequate to properly handle the anticipated traffic volume and character of traffic, as well as being within the limits specified for the type of property development. The controls established for curb openings and driveways shall apply to existing streets as well as new streets that may be developed in the future.
- **Site Distance.** All openings for driveways shall be located at the point of optimum sight distance along the street. For openings and driveways to commercial establishments and service stations, there shall be sufficient space reasonably cleared of any obstructions such that drivers entering the property will have sufficient sight distance to enable them to make proper and safe movements. The profile of a driveway approach and the grading of the adjacent area shall be such that when a vehicle is located on the driveway outside the traveled portion of street the driver can see a sufficient distance in both directions to enable him to enter the street without creating a hazardous traffic situation.
- **Adjustments.** Any adjustments which must be made to utility poles, street light standards, fire hydrants, catch basins or intakes, traffic signs and signals or other public improvements or installations which are necessary as the result of the curb openings or driveways shall be accomplished without any cost to the City of Northglenn. Also, any curb opening or driveway which has been abandoned shall be restored by the property owner except where such abandonment has been made at the request of or for the convenience of the City.
- **Signage for Exit and Entrance.** Driveway approaches, whereby the driveway is to serve as an entrance only or as an exit only, shall be appropriately signed by and at the expense of the property owner. The property owner will be required to provide some means of ensuring that the motorists will use the driveway either as an entrance only or an exit only, but not both.

Number of Openings

Single-Family Residential - In general, each single-family residential property shall be limited to one (1) access point.

Multi-Family Residential - In general, access shall be determined by information provided by the Owner/Developer in the traffic impact study and by comments generated during the Engineering Division's review and acceptance of that study.

Commercial - In general, commercial property having less than one hundred and fifty feet (150') of frontage and located mid-block shall be limited to one (1) access point to the street. An exception to this rule may be where a building is constructed in the middle of a lot and parking is provided for on each side of the building. A second access point may

be allowed for commercial property having more than one hundred fifty feet (150') of frontage. For commercial property located on a corner, one (1) access to each street may be permitted.

Service Stations - Where there is sufficient frontage to provide for minimum and maximum requirements, two (2) access points to a street may be permitted.

Industrial - Access shall be determined on a case-by-case basis. The City shall consider good traffic engineering practice and the information provided by the Applicant in the traffic impact study accompanying the submittal. Refer to **Chapter 5- Design Report Requirements**.

Amount of Curb Opening Permitted

The total length of curb opening on a street for access to a commercial property or service station shall not exceed thirty-five feet (35'). This requirement does not apply to residential-type drive cuts.

Entrance Angle

In general, the entrance angle for all driveway approaches shall be as near ninety degrees (90o) to the centerline of the street as possible. The minimum angle which will be permitted is sixty degrees (60o).

Minimum Space Between Openings

The minimum spacing between curb openings shall be thirty-five feet (35') measured at the curb line. This spacing shall apply to double drives that serve a single property, as well as the distance between drives serving adjoining properties. A fifty-foot (50') spacing applies to commercial openings.

Joint Entrances

Whenever possible and feasible, joint entrances shall be provided to serve two adjacent properties. Joint entrances are to be centered on the common property line.

12.2.6 Control Dimensions

To accomplish the objectives of the basic principles stated earlier, certain control dimensions are necessary. There are many variables which affect these control dimensions. Some of the variables are as follows: type of street classification, type of private property development, volume and type of traffic and width of Right of Way.

Width of Curb Opening (W)

The total width of curb opening for properties on various function street classifications shall be in conformance with the Standard Drawings in **Appendix G.4** of these STANDARDS AND SPECIFICATIONS.

Curb openings of thirty-five feet (35') or more shall be constructed as radius curb returns.

- **Residential.** No edge clearance is required for residential access. However, the drive shall not extend beyond the property line extended.
- **Commercial.** Access onto an Arterial -- 75 Feet Minimum. NOTE: Joint access with adjoining property is encouraged. Joint access shall be the only justification for reducing the minimum edge clearance dimension.
- **Corner Clearance.** It is important to locate driveways away from major intersections. This constraint is as much for the ability to enter and leave the property as for the benefit of intersection safety and

operations. Exiting a driveway during peak-hour conditions at traffic signals is difficult where the queue of standing or slow-moving vehicles never allows a sufficient gap for entry from the driveway.

- **Sight Distance.** Sight distance for curb openings to private property shall be in accordance with CDOT Requirements and **Chapter 11 – Roadways and Pavements** of these STANDARDS AND SPECIFICATIONS.

12.2.7 Street Lighting & Street Lighting Procedure

The Developer/Designer shall submit a written request for street light design to the relevant power authority. The relevant power authority will submit the final design and cost estimates to the Engineering Division for review and approval. Developer will pay the relevant power authority the total costs of installation for all street lighting within the prescribed time period. Developer will be responsible for street lighting within the development as well as on side streets surrounding the development site.

12.3 Traffic Signal Specifications

12.3.1 General Requirements

Scope and Intent

These specifications describe the installation of necessary material, equipment, and work procedures to complete traffic signals and/or other electrical systems, for projects in the City of Northglenn. These specifications provide minimum functional requirements that must be satisfied for all such work. Contractor as specified herein shall be defined as the individual, firm, or corporation who undertakes responsibility for the execution of the work, including the provision of labor and materials, in accordance with the terms of the contract specifying cost and schedule for completion of the work.

Permits

For all work within the City of Northglenn Right of Way, the Contractor shall obtain a Right of Way Use Permit from the Engineering Division. For new installations, the Contractor shall also obtain an electrical permit through the Building Department.

Inspections

For all required inspections, the Contractor shall give at least 48 hours' prior notice to the Engineering Division. Inspections will be completed by the Engineering Division except the electrical permit that is inspected through the Building Department.

Access

The Contractor will be required to maintain access to all roads and driveways throughout the period of construction.

Testing

The Contractor shall retain the services of an independent testing lab to perform all material testing, including but not limited to concrete, asphalt, and soils.

Field Location

The Contractor shall field survey all proposed poles, control cabinets, pull boxes, and pole foundations. The Engineering Division will field verify the proposed equipment locations before final placement.

Equipment Salvage

Unless otherwise specified, all traffic signal equipment which is removed shall remain the property of the City. Such property is to be removed from the work site and returned by the Contractor to the City of Northglenn at a City specified location.

Existing Traffic Signals

When existing traffic signal installations are modified or completely rebuilt, the Contractor shall work around existing traffic signal equipment until the new or modified traffic signal system has been installed and put into operation. At all times, the Contractor shall maintain a minimum of two three section (red, yellow, and green) traffic signal heads for each roadway approach. These displays, and all other signal elements, shall be in conformance with the MUTCD.

Intersection Power

Unless otherwise directed in the plans, the Contractor shall be responsible for coordinating with the local electric company to obtain power hook-up to the intersection in a timely fashion. The City's Building Division shall inspect all installations prior to meter installations.

Utilities

Utilities will be shown on the plans to the extent that they can be identified, based upon records and surface field indications. All utility locations will require field verification in cooperation with the affected utility companies and public agencies. The Contractor shall be responsible for locating all valve boxes, manholes, etc., and ensure that they are properly protected and that signal equipment locations are adjusted accordingly.

Job Site Supervision

At all times, all workers shall wear appropriate clothing and safety equipment and conduct themselves in a safe manner. An International Municipal Signal Association (IMSA) Level II supervisor shall be on-site when any work is performed in the controller cabinet.

12.3.2 Regulations & Codes**Reference Documents**

All equipment and material shall conform to these standards: Colorado Department of Transportation (CDOT), the Institute of Transportation Engineers (ITE) or IMSA, whichever is applicable. In addition to requirements of all these specifications, the plans, standard details, and the special contract provisions, all material and work shall conform to the requirements of the MUTCD, the Rules for Overhead Electrical Line Construction of the Colorado Public Utilities Commission (Rules), the standards of the American Society for Testing and Materials (ASTM) and of the American National Standards Institute (ANSI), and local ordinances which may apply. The City shall have final authority on specifications.

12.3.3 Underground Facilities**Foundations**

Concrete foundations shall be Class BZ per the Colorado Department of Transportation, Supplemental Specifications to Standard Specifications for Road and Bridge Construction, most recent edition. The bottom of concrete foundations shall rest on firm ground. Cast-in-place foundations shall be poured monolithically where practicable. The exposed portions shall be formed to present a neat appearance. Forms shall be true to line and grade. Tops of foundations, except as noted on plans, shall be finished to curb or sidewalk grade or as shown on the accepted construction plans or as directed by the Engineering Division. Forms shall be rigid and securely braced in place and inspected prior to the pouring of concrete. Conduit ends and anchor bolts shall be placed in proper position and in a template until the concrete sets. Forms shall be completely removed prior to signal turn on. Anchor bolts shall conform to the

manufacturer's specifications and each individual bolt shall have two flat washers and two nuts. Shims or other similar devices for plumbing or raking will not be permitted. Both forms and ground that will be in contact with the concrete shall be thoroughly moistened before placing concrete. Forms shall not be removed until the concrete has thoroughly set. Whenever excavation for a foundation requires removal of excess ground materials, the excavation shall be backfilled to within 12 inches of ground level with 90-150 psi flow fill concrete, and then backfilled to ground level with native material compacted per the Engineering Division. Any abandoned foundation shall be fully or partially removed and disposed of by the Contractor per the Engineering Division direction. Any conduit runs associated with an abandoned foundation shall be extended or abandoned as called for on the accepted construction plans.

Conduit

All cables and conductors not shown on the plans as aerial cable shall be installed in conduit unless installed in poles, pedestals, cabinets, or mast arms. All buried conduit shall be PVC Schedule 80 or heavier. All exposed conduit shall be galvanized, rigid, ductile steel. The conduit schedule as shown below (Table 12.1) shall be in effect unless otherwise specified in the plans:

Table 12.1: Conduit Schedule

Run Type	Quantity	Size	Use
Street Crossings	1	3"	120 voltage load wiring
	1	3"	Low voltage detection & communications
	1	2"	Luminaire load
Signal Pole	1	3"	All signal cables
	1	2"	Luminaire load
Controller Cabinet	2	3"	120 voltage load wiring
	3	2"	Low voltage detection & communications
Interconnect	1	2"	Interconnect run & communications
Service Points – Signal & Luminaire Power	1	2"	Utility company service run

The Contractor, at its sole expense, may use larger conduit if desired. Where larger conduit is used, it shall be for the entire length of the run. No reducing couplings will be permitted underground.

The ends of all metal conduit, existing or new, shall be well reamed to remove burrs and rough edges. Field cuts of existing or new conduit shall be made square and true, and the ends shall butt together for the full circumference. Slip joints or running threads will not be permitted for coupling metal conduit. When a standard coupling cannot be used, an approved threaded union coupling shall be used. All couplings shall be screwed up tight until the ends of the metal conduits are brought together.

Where factory bends are not used, conduit shall be bent without crimping or flattening, using the longest radius practicable. Conduit bends feeding pull boxes and foundations shall be as shown on the standard details, typically 18 inches.

Conduit shall always enter a pedestal base, pull box, or any other type structure from the direction of the run only. Conduit connections at junction boxes shall be tightly secured.

All conduit shall terminate in a pull box or pedestal and extend approximately two inches above the rock bedding vertically.

All conduit runs shall have a continuous 3/8-inch nylon mule tape pulled into the conduit along with the specified electrical cables. The line shall be firmly secured at each end of the conduit run with a minimum slack of three feet.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel or blown out with compressed air.

Any spare or unused conduits shall be sealed with duct seal and shall include continuous 3/8-inch nylon mule tape.

Pull Boxes

Pull boxes shall be 20k polymer concrete Quazite® pull boxes (with open bottoms), or approved equivalent (ANSI Tier 15).

Pull boxes shall be installed at all locations shown on the accepted construction plans and at such additional points as directed by the Engineering Division.

Pull boxes shall be installed so that the covers are level with curb or sidewalk grade or level with the surrounding ground (as applicable). The bottoms of all pull boxes shall be bedded in crushed rock or squeegee – 6" thick minimum.

When a new conduit run enters an existing pull box, the Contractor shall temporarily remove the pull box, or tunnel under the side at no less than eighteen inches (18") below the pull box bottom and enter from the direction of the run.

Stop Line Detection

Stop line detection for designated phases shall be provided, as indicated in the plans. Advance detection may be provided on a site-specific basis, to extend green time on high-speed approaches.

Vehicle Loop Detectors

Each individual loop detector is to be terminated and spliced within a side-of-road pull box. Each loop detector shall consist of one continuous wire, without splicing, to this termination point. Any required series or parallel connections are to be completed at the termination point. Detector lead-in wire shall be continuous from the controller cabinet to the side-of-road pull box. All detectors shall have a color-coded tag attached to the lead-in to indicate the relative location and the direction served by the detector. Loop sealant is required in all saw cuts whether or not the roadway is to be overlaid. The use of preformed loop detectors shall not be allowed.

Grounding and Bonding

Bonding and Grounding. Metallic cable sheaths, conduit, metal poles and pedestals shall be made mechanically and electrically secure to form a continuous system and shall be effectively grounded.

Bonding and grounding jumpers shall be a #6 AWG bare copper wire or copper strap of the same cross-sectional area.

Sheath for detectors shall be grounded in control cabinet only. The other end of the sheath shall be taped and left ungrounded.

A ground electrode shall be installed at each pole, pedestal, and control box. Each ground electrode shall be one-piece copper-weld rod of 5/8 inch diameter and 8 feet in length, driven to a depth of at least 8 feet below the surface of the ground.

Bonding of poles and pedestals shall be by means of connecting to the ground rod a bonding strap attached to an anchor bolt or a 3/16-inch diameter or larger brass or bronze bolt installed in the lower portion of the shaft.

12.3.4 Conductor & Cable

General

Signal cables shall conform to the appropriate IMSA specifications. Wiring within cabinets, junction boxes, etc., shall be neatly arranged and tagged.

Powdered soapstone, talc, or other approved lubricant shall be used in placing conductors in conduit. Unless otherwise approved by the Engineering Division, wiring shall not occupy more than 40 percent of the inside area of all conduit.

At least five feet (5') of slack shall be left for each conductor at each support pole.

Splices will not be allowed in pull boxes except for luminaires. Splices shall be kept to a minimum and will only be allowed in handholes at pole bases. A minimum of 24 inches of slack shall be left on each splice wire. In no case shall any shellac compounds be used.

Signal load splices shall utilize copper crimp sleeves that compress from four directions; for example, those manufactured by the Buchanan Company. The crimped sleeve shall then be protected within a flexible rubber insulating cover (Ideal Wrap Cap)

When conductors and cables are pulled into the conduit, all ends of the conductors and cables shall use duct seal to exclude moisture and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall be taped and marked.

A small permanent tag on which the direction and phase is printed, using the codes given in section 12.3.4.2 Conductor Schedule below, shall be securely attached near the end of each conductor at each controller and signal pole.

Conductor Schedule

Detector conductors shall be tagged at their ends with color-coded electrical tape following the below schedule, including the movement "Codes" (e.g., "1-NBLT").

Table 12.2: Conductor Schedule

Key Phase	Color of Signal Load Conductor	"Code" (on tag at each end of conductor)
1. Northbound Left Turn	Red/White	"x-NBLT"
2. Northbound	Red	"x-NB"
3. Southbound Left Turn	Green/White	"x-SBLT"
4. Southbound	Green	"x-SB"
5. Eastbound Left Turn	Orange/White	"x-EBLT"
6. Eastbound	Orange	"x-EB"
7. Westbound Left Turn	Blue/White	"x-WBLT"
8. Westbound	Blue	"x-WB"
9. Pedestrian	Yellow	"x-PED"

Note: x = phase number. This is a typical conductor schedule and shall be used for the wiring of all signal installations. A new conductor schedule will be noted on the plans at each intersection where different phasing and/or special equipment is required. It should be noted that a band of white is used to indicate a left turn, and yellow is used for pedestrian movement.

Each pedestrian push button shall have a dedicated wire pair lead-in to the controller cabinet. Where included in the plans. Separate luminaire wire shall be two conductors, black and white in color with ground.

Signal heads mounted on mast arms are to be wired individually from the head to the handhole splice. At least three (3) spare conductors shall be provided from the controller cabinet to the handhole of each signal pole.

12.3.5 Signal Start-Up Procedures

Signal heads installed on standards or poles at new signal locations which are not ready for actual electrical operation shall be bagged with orange material.

Immediately prior to signal turn-on, signals shall be flashed from two to five days, with the exact duration of flashing determined by the Engineering Division.

A functional test shall be made in which it is demonstrated that each and every part of the system functions as specified or intended herein. The functional test for each traffic signal system shall consist of not less than twenty days of continuous, satisfactory operation commencing with full operation of all electrical facilities.

During the twenty-day period, the Contractor shall maintain the system or systems. The cost of any maintenance necessary, except electrical energy and maintenance due to damage by public traffic, shall be borne by the Contractor and will be considered as included in the price paid for the contract item involved, and no additional compensation will be allowed.

12.3.6 Maintenance

Maintenance During Construction

The Contractor shall have full maintenance responsibility of the traffic signal from the time of the Notice to Proceed (or Pre-Construction Meeting) to the date of written acceptance of the work performed. Continuous maintenance and emergency service shall be provided by the Contractor twenty-four (24) hours each day during the time-period defined above. The Contractor shall provide and maintain a 24-hour continuous telephone answering service with one number.

Emergency and Non-Emergency Repairs

During the period of full maintenance responsibility, 1) all hazardous conditions or 2) all malfunctions of a controller and its accessory equipment following turn-on shall be considered an emergency unless otherwise identified by the Engineering Division. Site conditions, equipment malfunctions and/or damage, which in the opinion of the Engineering Division constitutes a serious hazard or inconvenience to the public, shall be considered an emergency. Such malfunctions or damage may include, but not necessarily be limited to, situations such as:

- all indications are out, including bulbs and lenses, for any one traffic movement
- signal heads give conflicting indications to any intersection approach or approaches
- a signal has been knocked down

The Contractor shall dispatch personnel to ensure each such repair is underway no later than two hours after the City notifies the Contractor of the emergency. In instances of repairs that are of a non-emergency nature, such repairs shall be undertaken at the site within two working days after the City notifies the Contractor of the needed repair.

Should the Contractor fail to perform any maintenance responsibilities within the prescribed time periods, the Engineering Division shall perform said maintenance work. The Contractor shall reimburse the City for labor and equipment charges associated with the repair plus the City's administration fee.

12.3.7 Traffic Signal Material Specifications

Vehicle Signal Head

All vehicle signal heads shall be the modular section type and shall be adjustable with respect to positioning and lens replacement. Heads shall be polycarbonate and black in color and shall meet the requirements of the latest version of the ITE Vehicle Traffic Control Signal Heads standard.

Mounting hardware shall be Sky Bracket type. Visors shall be the detachable tunnel type, polycarbonate, black in color, and twelve (12") inches in length. All faces shall be LED inserts.

Doors on the signal heads for the installation of lamps and lens replacement or other maintenance shall not require use of any tool to be opened. Doors and lenses shall be equipped with neoprene weatherproof gaskets to insure against infiltration of moisture, road film, and dust. Each three-color signal unit shall have the socket leads from all signal sections connected to a terminal board stamped with identifiable terminals. There shall be a terminal for color indication plus a common terminal where one lead from each socket shall terminate. The terminal board shall be mounted in the middle section and be fully insulated. Gaskets shall be supplied for top and bottom openings.

Backplates shall be required for all mast arm signal faces. Backplates shall be yellow in color, louvered aluminum, and five inches (5") in width and have a one inch (1") yellow reflective strip around the outside perimeter.

Pedestrian Signal Head

Pedestrian signal heads shall be sixteen (16") inch, aluminum and shall be adjustable with respect to positioning. Heads shall be provided without egg crate visors. Heads shall be black in color and shall meet the requirements of the latest version of the ITE Pedestrian Traffic Control Signal Indications standard. Pedestrian inserts shall be LED, filled "countdown" style GE Model GT1 or approved equivalent. "Walk/Don't Walk" indications shall be the symbol type, with a minimum height of eleven inches (11"). "Countdown" numerals shall have a minimum height of nine inches (9"). Doors and lenses shall be installed with weatherproof gaskets.

Traffic Signal Lamp

All permanent and temporary traffic signal applications will require LED lamps. Red, yellow, and green signal sections shall be twelve inches (12") in diameter in all cases. All circular and arrow red, yellow, and green signals and pedestrian ("hand" and "walkman") indications shall use LEDs. Traffic signal section optical units shall meet or exceed ITE Adjustable Face Vehicular Traffic Control and Pedestrian Signal Head standards. In addition to this, LED optical units shall conform to CDOT Standard Specifications for Road and Bridge Construction, latest edition, Section 713.

Electrical Cable

All electrical cable shall be in conformance with the CDOT Standard Specifications for Road and Bridge Construction, latest edition, Sections 614 and 713.

Signal cable shall be multi-conductor, stranded, copper wire manufactured to meet IMSA Specification 19-1 or 19-2. Each conductor in the cable shall be individually insulated and rated at 600 volts.

Traffic Signal Communication

The Traffic Signal may be connected to the Engineering Division's traffic signal communications system as specified in the project plans. The traffic signal communication system shall be easily maintained and compatible with the City's current traffic signal management software system.

The traffic signal communication system shall be approved by the City of Northglenn prior to showing in the project plans and shall consist of one of the following communication types:

- Fiber optic communication
- Cellular communication
- Ethernet communication
- Radio communication

The Contractor will be responsible for verifying that the traffic signal communication properly connected, terminated and integrated with the City's Traffic Signal Management Software in the City's Engineering Division.

Fiber Optic Cable

Fiber optic cable shall be loose-tube all-dielectric outdoor cable consisting of twelve single-mode fibers and complying with the following specification for fiber optic cable. Fiber optic cable installation in conduit shall meet applicable portions of IMSA Specification 60.2 or approved equal and include a 14-gauge (min) copper tracer wire. All fiber optic cable runs shall include nylon mule tape. Extra length of fiber optic cable shall be provided with fifty feet (50') of slack in the controller cabinet and twenty-five feet (25') of slack in each pull box.

General Considerations

- The fiber optic cable shall meet all requirements stated in the specification. The cable shall be an accepted product of the United States Department of Agriculture Rural Electrification Administration (REA) as meeting requirements of 7CFR1755.900.
- The cable shall be new, unused, and of current design and manufacture.

Fiber Characteristics

- All fibers in the cable must be usable fibers and meet this specification.
- All optical fibers shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical, and environmental requirements of this specification.
- Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.
- The single-mode fiber utilized in the cable specified herein shall conform to the following specifications:
 - Typical Core Diameter: 8.3 μm
 - Cladding Diameter: 125 \pm 1.0 μm
 - Core to Cladding Offset: \leq 0.8 μm
 - Cladding Non-Circularity: 1.0%. Defined as: $[1 - (\text{min. Cladding dia.} + \text{max. Cladding dia.})] \times 100$
 - Coating Diameter: 245 \pm 10 μm
 - Attenuation Uniformity: No point discontinuity greater than 0.10 dB at either 1310 nm or 1550 nm
 - Attenuation at the Water Peak: The attenuation at 1883 \pm 3 nm shall not exceed 2.1 dB/km

- Cutoff Wavelength: The cabled fiber cutoff wavelength shall be ≤ 1250 nm.
- Mode-Field Diameter (Petermann II):
 - 12.30 ± 0.50 μm at 1310nm
 - 10.50 ± 1.00 μm at 1550nm
- Zero Dispersion Wavelength (λ_0): $1301.5 \text{ nm} \leq (\lambda_0) \leq 1321.5 \text{ nm}$
- Zero Dispersion Slope (S_0): $\leq 0.092 \text{ ps}/(\text{nm}^2 / \text{km})$
- The coating shall be a dual layered, UV cured acrylate applied by the fiber manufacturer.
- Coating shall be mechanically strippable without damaging the fiber.

Fiber Specifications Parameters

All fibers in the cable shall meet the following requirements:

- When tested in accordance with FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components, (single-mode only), the average change in attenuation at extreme operational temperatures (-40°C to $+70^\circ\text{C}$) shall not exceed 0.05 dB/km at 1550 nm. The magnitude of maximum attenuation change of each individual fiber shall not be greater than 0.15 dB/km at 1550 nm.
- Required fiber grade = Maximum Individual Fiber Attenuation.
- The maximum dispersion for single-mode optical fibers shall be $\leq 3.3 \text{ ps}/(\text{nm km})$ for 1285 nm through 1330 nm and $\leq 18 \text{ ps}/(\text{nm km})$ at 1550 nm.

Specifications for Outdoor Cables

- Optical fibers shall be placed inside a loose buffer tube.
- Each buffer tube shall contain up to 6 fibers.
- The fibers shall not adhere to the inside of the buffer hole.
- Each fiber shall be distinguishable from the others by means of color coding according to the following:
 - Blue
 - Orange
 - Green
 - Brown
 - Slate

- White

These colors shall meet EIA/TIA-598, Color Coding of Fiber Optic Cables.

- Buffer tubes containing fibers shall also be color-coded with distinct and recognizable colors according to the following:
 - Blue
 - Orange
 - Green
 - Brown
 - Slate
 - White
 - Red
 - Black
 - Yellow
 - Violet
 - Rose
 - Aqua

These colors shall meet EIA/TIA-598, Color Coding of Fiber Optic Cables.

- Buffer tubes containing multiple fibers, the colors shall be stable during temperature cycling and not subject to fading or smearing onto each other or the gel filling material. Colors shall not cause fibers to stick together.
- Buffer tubes shall be of a dual-layer construction with the inner layer made of polycarbonate and the outer layer made of polyester.
- Fillers may be included in the cable core to lend symmetry to the cable cross section.
- The central anti-buckling member shall consist of a glass reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.
- Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogeneous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.
- Buffer tubes shall be stranded around a central member using the reverse oscillation, or “SZ” stranding process.

- The cable core interstices shall be filled with a water-blocking compound. The compound shall be a thixotropic gel containing a Super Absorbent Polymer (SAP) material. The gel shall be non-nutritive to fungus, electrically non-conductive and homogeneous. The gel shall be free from dirt and foreign matter and shall be readily removable using nontoxic solvents.
- Binders shall be applied with sufficient tension to secure buffer tubes to central member without crushing the buffer tubes. Binders shall be non-hygroscopic, non-wicking (or rendered so by the flooding compound), and dielectric with low shrinkage.
- The cable shall contain at least one ripcord under the sheath for easy sheath removal.
- Tensile strength shall be provided by high tensile strength aramid yarns and/or fiberglass yarns.
- The high tensile strength aramid and/or fiberglass yarns shall be helically stranded evenly around the cable core.
- All dielectric cables (with no armoring) shall be sheathed with medium density polyethylene. The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and flooding compound. The polyethylene shall contain carbon black to provide ultraviolet light protection and shall not promote the growth of fungus.
- The jacket or sheath shall be free of holes, splits and blisters.
- The cable jacket shall contain no metal elements and shall be of a consistent thickness.
- Cable jackets shall be marked with sequential meter or foot markings, year of manufacture and a telecommunications handset symbol, as required by section 350G of the National Electric Safety Code. The actual length of the cable shall be within 0 to 1% of the length markings. The marking shall be in contrasting color to the cable jacket. The height of the marking shall be approximately 2.5 mm. The maximum pulling tension shall be 2,700 N (608 lbf) during installation (short term) and 890 N (200 lbf) long term installed.
- The shipping, storage, and operating temperature range of the cable shall be -40°C to +70°C. The installation temperature range of the cable shall be -30°C to 70°C.

General Cable Performance Specifications

- The unaged cable shall withstand water penetration when tested with a one-meter static head or equivalent continuous pressure applied at one end of a one-meter length of filled cable for 24 hours. No water shall leak through the open cable end. When a one-meter static head or equivalent continuous pressure is applied at one end of a one-meter length of aged cable for one hour, no water shall leak through the open cable end. Testing shall be done in accordance with FOTP-82, "Fluid Penetration Test for Filled Fiber Optic Cable."
- When tested in accordance with FOTP-81, Compound Flow (Drip) Test for Filled Fiber Optic Cable, Method A; the cable shall exhibit no flow, drip or leak of filling or flooding compound at 80°C. If material flow is detected, the weight of any compound that drips from the sample shall be less than 0.05 g (0.002 ounce).
- The cable shall withstand a minimum compressive load of 220 N/cm for non-armored cables applied uniformly over the length of the compression plate. The cable shall be tested in accordance with FOTP-41, Compressive Loading Resistance of Fiber Optic Cables, except that the load shall be applied at the rate of 3 mm to 20 mm per minute and maintained for 10 minutes. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not

experience attenuation greater than 0.1 dB at 1500 nm (single mode). The average increase in attenuation for the fibers shall be < 0.20 dB at 1300 nm (multimode). The repeatability of the measurement system is typically 0.05 dB or less. No fibers shall exhibit a measurable change in attenuation after load removal.

- When tested in accordance with FOTP-104, Fiber Optic Cable Cyclic Flexing Test, the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycles per minute, with a sheave diameter not greater than 20 times the cable diameter. The magnitude of the attenuation change shall be within the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm. The repeatability of the measurement system is typically ± 0.05 dB or less. The cable jacket shall not exhibit evidence of cracking or splitting when observed under 5x magnification.
- When tested in accordance with FOTP-25, Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies, cable shall withstand 25 impact cycles. Magnitude of the attenuation change shall be within repeatability of measurement system for 90% of test fibers. The remaining 10% of the fibers shall not experience attenuation change greater than 0.1 dB at 1550 nm. The repeatability of measurement system is typically ± 0.05 dB or less. The cable jacket shall not exhibit evidence of cracking or splitting at the completion of the test.
- When tested in accordance with FOTP-33, Fiber Optic Cable Tensile Loading and Bending Test, using a maximum mandrel and sheave diameter of 560 mm, the cable shall withstand a tensile load of 2700 N (608 lbf) applied for one hour (using Test Condition II of the procedure). In addition, cable sample, while subjected to a minimum load of 2660 N (600 lbf), shall be able to withstand twist of 360 degrees in a length of 115 inches. Magnitude of attenuation change shall be within repeatability of the measurement system for 90% of the test fibers. Remaining 10% of the fibers shall not experience an attenuation change greater than 0.1 dB at 1550 nm. Repeatability of the measurement system is typically ± 0.05 dB or less. The cable shall not experience a measurable increase in attenuation when subjected to the rated residual tensile load of 890 N (200 lbf).
- When tested in accordance with FOTP-85, Fiber Optic Cable Twist Test, a length of cable no greater than 2 m will withstand 10 cycles of mechanical twisting. The magnitude of the attenuation change will be within the limit of the repeatability of the measurement system for 90% of the test fibers. The remaining 10% of the fibers will not experience an attenuation change greater than 0.1 dB at 1550 nm. The repeatability of the measurement system is typically ± 0.05 dB or less. The cable jacket will exhibit no cracking or splitting when observed under 5x magnification following completion of the test.
- When tested in accordance with the proposed FOTP-181, Lightning Damage Susceptibility Test for Optic Cables with Metallic Components, the cable shall withstand a simulated lightning strike with a peak value of the current pulse ≤ 105 kA. The test current used shall be damped oscillatory with a maximum time-to-peak value of 15 μ s (which corresponds to a minimum frequency of 16.7 kHz and a maximum frequency of 30 kHz). The time to half-value of the waveform envelope (t_2) shall be 40-70 μ s. In addition to the analysis criterion set forth on FOTP-181, the integrity of the buffer tubes (or analogous loose tube, i.e. core tube) and strength members must be intact after removal of the cable specimens from the test box.

Quality Assurance Provisions

- All optical fibers shall be proof tested by the fiber manufacture at a minimum load of 100 ksi.
- All optical fibers shall be 100% attenuation tested. The attenuation of each fiber shall be provided with each cable reel.

Packaging

- The completed cable shall be packaged for shipment on non-returnable wooden reels.
- Top and bottom ends of the cable shall be available for testing.
- Both ends of the cable shall be sealed to prevent the ingress of moisture.
- Each reel shall have a weatherproof reel tag attached identifying the reel and cable.
- Each cable shall be accompanied by a cable data sheet that contains significant information on the cable.

Miscellaneous

The cable manufacturer shall provide installation procedures and technical support concerning the items contained in this specification.

The Contractor shall provide the Engineering Division with two copies of the cable manufacturer's installation instructions for fiber optic cable in conduit or provided electronically in a PDF file. The bend radius shall be maintained at a minimum of twenty times the outside diameter of the cable during installation. After installation, the bend radius shall be maintained a minimum of ten times the outside diameter of the cable. Additional cable costs due to damage caused by the Contractor's neglect of recommended procedures shall be the responsibility of the Contractor.

Single-mode fiber optic cable shall be installed in continuous runs between controllers. The manufacturer's recommended limits for cable lengths shall not be exceeded. Cable ends shall be stored in controller cabinets or pull boxes immediately adjacent to cabinets or as directed by the Engineering Division. All fibers shall terminate to a rack mounted patch panel.

Under no conditions shall single mode fibers be cut out or spliced at intermediate points without express written direction from the Engineering Division.

Prior to installation of interconnect cable, the Contractor shall submit an interconnect schematic diagram to the City for approval. The diagram shall clearly indicate cable routing, splice points, and fiber connections including identifying the color-coded fibers and buffer tubes. Installation of the cable will not be permitted until the schematic diagram has been approved by the Engineering Division.

The same color-coded pairs of fibers and/or wires shall be used throughout the entire project. At the terminal points the jackets shall be stripped and the ends taped. Gel filling compound shall be removed using filled cable cleaner.

For all fiber optic cables, each fiber shall be checked with an Optical Time Domain Reflectometer (OTDR) and full traces documenting fiber performance shall be provided to the City within thirty (30) days of test. All optical fibers shall be within the manufacturer's recommended tolerances. In addition, any other acceptance testing recommended by manufacturer shall be provided. Data shall be supplied to the Engineering Division prior to completion of the project.

If the fiber cable reel is left outside overnight during installation, the Contractor shall provide security for the cable.

The Contractor shall keep a log that notes the meter (foot) marking on the cable at every pull box to facilitate determining the exact location along the cable run of problems during the OTDR testing.

Fiber Optic Cable

Fiber Optic Cable Testing of single-mode (SM) fiber optic cable shall include both new cable and existing cable. The test procedures involve an OTDR test and an Optical Power Meter Test.

The guidelines for fiber optic cable testing include:

- Test jumpers and patch cords must be of the same fiber core size and connector type as the cable system (SM fiber 8.3/125 μm)
- The light source and OTDR must operate within the range of 1310 \pm 10 nm or 1550 \pm 10 nm for SM testing in accordance with ANSI/EIA/TIA-526-7.
- The power meter and the light source must be set to the same wavelength during testing.
- The power meter must be calibrated and traceable to the National Institute of Standards and Technology (NIST).
- All system connectors, adapters, and jumpers must be cleaned as per the manufacturer's instructions before measurements are taken.

Materials

The following items are required to perform fiber optic cable tests:

- An OTDR
- A test reel, if necessary
- A light source at the appropriate wavelength
- Optical power measurement equipment
- Test jumpers as specified below:
 - CPR Test Jumper-1 and Jumper-2 shall be 1-5 meters long with connectors compatible with the light source and power meter and have the same fiber construction as the link segment being measured.

Fiber Optic Cable Testing with Optical Time Domain Reflectometer

- The Contractor shall perform an OTDR test of all fibers in all tubes on the reel prior to installation of the fiber. The Test results shall be supplied to the City prior to installation of the cable.
- If the fiber is specified as "Install Only," the Contractor shall test the fiber on the reel and provide the test results to the City prior to accepting the cable. After installation, if there are unused portions of cable remaining on the reel, the Engineering Division may request the Contractor or other qualified technician to perform a reel test. The Contractor shall provide the Engineering Division the test results prior to delivering the cable to the Engineering Division. Any cable damaged while in the Contractor's possession shall be replaced at the Contractor's expense.
- All fiber testing shall be performed on all fibers in the completed end-to-end system. Testing shall consist of a bi-directional, end-to-end OTDR trace performed per TIA/EIA-455-61. The system margin loss measurements shall be provided at 1310 nm and 1550 nm. If the plans require installation of a fiber optic patch panel, the Contractor shall supply patch cords to patch all terminated fibers through the panel for all fiber testing. If patch cords are specified in the plans for final equipment installation, these patch cords shall be connected using a test coupling for the end-to-end test.

- OTDR readings will be used to ensure proper installation and to troubleshoot faults. OTDR signature traces will be used for documentation and maintenance. An OTDR provides an indirect estimate of the loss of the cable plant, generally, more accurate or reliable values will be obtained by using an Optical Power Meter. For fibers that are identified in the plans to be left non-terminated, an OTDR shall be used to test end-to-end attenuation.
- Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.
- The Contractor shall use an OTDR that is capable of storing traces electronically and shall save each final trace.
- To ensure the traces identify the end points of the fiber under test and the fiber designation, the Contractor shall use a test reel, if required, to eliminate the “dead zone” at the start of the trace so that the start of the fiber under test can be identified on the trace. Indicate the length of the test reel for all test results.
- If the fiber designation is not indicated on the trace itself, the Contractor shall provide a cross-reference table between the stored trace file name and the fiber designation.
- In compliance with EIA/TIA-455-61 “Measurement of Fiber or Cable Attenuation Using an OTDR”, the Contractor shall record the following information during the test procedure:
 - Names of personnel conducting the test
 - Type of test equipment used (manufacturer, model, serial number, calibration date)
 - Date test is being performed
 - Optical source wavelength and spectral width
 - Fiber identification
 - End point locations
 - Launch conditions
 - Method of calculation for the attenuation or attenuation coefficient
 - Acceptable link attenuation

The complete end-to-end OTDR test on one fiber, including document submission, represents one OTDR test.

Fiber Optic Cable Testing with Optical Power Meter

- The Contractor shall conduct an Optical Power Meter Test for each fiber installed. Single-mode segments shall be tested in one direction at both the 1310 nm and 1550 nm wavelength.
- In compliance with TIA/EIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, the following information shall be recorded during the test procedure:
 - Names of personnel conducting the test

- Type of test equipment used (manufacturer, model, serial number, calibration date)
 - Date test is being performed
 - Optical source wavelength and spectral width
 - Fiber identification
 - End point locations
 - Test direction
 - Reference power measurement (when not using a power meter with a Relative Power Measurement Mode)
 - Measured attenuation of the link segment
 - Acceptable link attenuation
- The minor attenuation differences due to test direction are on par with the accuracy and repeatability of the test method. Lateral segments within a building are limited to 90 meters. Therefore, the attenuation differences caused by wavelength are insignificant, and as a result, single wavelength testing is sufficient.
 - The complete end-to-end optical power meter test on one fiber, including document submission, represents one optical power meter test.

Acceptable Attenuation Values

- Acceptable attenuation values shall be calculated for each fiber tested. These values represent the maximum acceptable test values.
- The general attenuation equation for any SM link is as follows:

$$\text{Acceptable Link Attn.} = \text{Cable Attn.} + \text{Connector Attn.} + \text{Splice Attn.}$$

- 8.3 μm Single-mode Attenuation Coefficients:
 - Cable Attn. = Cable Length (km) x (0.34 dB/km@1310 nm or 0.25 dB/km@1550 nm)
 - Connection Attn. (ST or SC connectors) = (No. of Connections x 0.39 dB) + (0.42 dB)
 - Connection Attn. (LC connectors) = (No. of Connections x 0.14 dB) + (0.24 dB)
 - Splice Attn. (Mechanical or Fusion) = Splices x 0.30 dB

Test Procedures

- All fiber testing shall be performed on all fibers in the completed end-to-end system.
- The SM Optical Power Meter fiber test shall be conducted as follows:
 - Clean the test jumper connections and the test coupling per manufacturer's instructions.

- Follow the test equipment manufacturer's initial adjustment instructions.
- Connect Test Jumper-1 between the light source and the power meter. Avoid placing bends in the jumper that are less than 100 mm (4inches) in diameter.
- If the power meter has a Relative Measurement Mode, select it. If it does not, reduce the Power Meter Measurement (Pref). If the meter can display power levels in dBm, select this unit of measurement to simplify subsequent calculations.
- Disconnect Test Jumper-1 from the power meter. Do NOT disconnect the test jumper from the light source.
- Attach Test Jumper-1 to one end of the cable plant to be measured and Test Jumper-2 to the other end.
- Record the Power Measurement (Psum). If the power meter is in Relative Power Measurement Mode, the meter reading represents the true value. If the meter does not have a Relative Power Measurement Mode, perform the following calculation:
 - If Psum and Pref are in the same logarithmic units (dBm, dBu, etc.): $CPR (dB) = Psum - Pref$
 - If Psum and Pref are in watts: $CPR (dB) = 10 \times \log_{10}[Psum / Pref]$

Test Acceptance

- The Contractor shall demonstrate that each Optical Power Test results in acceptable attenuation values.
- The Contractor, solely at the Contractor's cost, shall remake any fusion splices that have test results exceeding acceptable attenuation values.
- The Contractor, solely at the Contractor's cost, shall retest any fiber links that have been re-spliced.
- The Contractor, solely at the Contractor's cost, shall bring any link not meeting the requirements of this specification into compliance.

Submittals

- The Contractor shall submit test results documentation as both a hard copy and an electronic copy (PDF file format) to the Engineering Division.
- After each test reel, the Contractor shall submit one hard copy of the OTDR trace for every fiber on the reel. After installation, the Contractor shall submit one hard copy of the OTDR trace for every spliced fiber. Hard copy traces shall be organized and bound in logical order in an 8.5" x 11" hard cover binder.
- The Contractor shall submit, after approval of the hard copy traces, electronic copies of all traces and appropriate software to allow reading the traces.

Fiber Optic Cable Termination

- Color-coded pairs of fibers shall be used for all installations. At the terminal points, the jackets shall be stripped and the ends taped. Gel-filled compound shall be removed using the filled cable cleaner.

- At every cabinet or closure, only fibers shown to be spliced and/or connectorized and connected to a patch panel or other internal device are required to be landed. All cut or unconnectorized fibers shall be sealed in a manner recommended by the cable manufacturer.
- The same color-coded pairs of fibers and/or wires shall be used throughout the entire project. At the lateral cable terminal points, the jackets shall be stripped and the ends shrink-tubed. Gel filling compound shall be removed using the filled cable cleaner.
- The Contractor shall terminate the loose-tube lateral cable at the controller using a buffer tube fan-out kit, Siecor Catalog FAN-BT or approved equal. Fanned-out cables shall be terminated in the contractor furnished termination enclosure as shown in the plans.
- The fiber optic patch cord cables shall consist of SM fibers housed individually in protective jackets. Both ends of the cable shall be connected. Fiber optic patch cord cable shall be suitable for operation over a temperature range of -30°C to +60°C. Fiber optic patch cord cables shall be of sufficient length to be connected between the interconnect panel and the communications equipment (i.e., modems). Appropriate strain relief in the cabinet (through cable ties) shall be installed at a minimum of three locations. Sufficient slack shall be left to allow relocation of the equipment anywhere in the cabinet. The attenuation of a fiber optic patch cord cable after installation, not including the connector loss, shall not exceed 0.1 dB measured at 1310 nm and 1550 nm.
- The connector shall have a ceramic ferrule with a nickel-plated nut and body. The connector shall be an AT&T ST-style compatible field mounted connector. The connector shall be compatible with a physical contact (PC) finish. All connectors shall be polished to a PC finish such that the return loss per mated pair of connectors is at least 25 dB. The return loss when the connector is mated with previously installed connectors shall be at least 18 dB. The connector mean loss shall not be greater than 0.3 dB with a standard deviation of not greater than 0.2 dB. The connector loss shall not vary more than 0.2 dB after 1000 repeated matings and shall withstand an axial load of 135 N.
- Index matching fluids or gels shall not be used. The connectors shall be compatible with the optical fiber surrounding the jacket and shall be installed on one end of the optical fiber in accordance with the manufacturer's recommended materials, equipment, and practices. The connector shall be suitable for the intended environment and shall meet the following environmental conditions:
 - Operating Temperature: -20° to +50°C
 - Storage Temperature: -30° to +60°C
- The connector loss shall not vary more than 0.2 dB over the operating temperature range. Connectors shall be protected by a suitably installed waterproof protection cap.
- Each cabinet to be interconnected shall include slot-mountable interconnect center(s). They are to be complete with connector panels of suitable capacity for all lateral cables. Each interconnect panel shall be compatible for connection to the AT&T ST-style connectors of the lateral and fiber optic patch cord cables. A panel of sufficient size to provide all requisite connections shall be provided.
- Installation shall be in accordance with the cable manufacturer's recommendation.

Emergency Vehicle Detector

All approaches to the signal shall have emergency vehicle pre-emption detection.

Optical detectors for emergency vehicle pre-emption shall be the Global Traffic Technologies (GTT) Model 752 Optical Detector, as needed. Placement of the detectors shall be determined by the City. Two GTT Model 752 Phase Selectors shall be provided in every cabinet.

Pedestrian Detector

Pedestrian push buttons shall be Polara Engineering BullDog III series with LED momentary pedestrian buttons (Part Number BDL3) or approved equivalent. The pedestrian push buttons shall be equipped with a push button instruction sign and shall provide directional arrows on the push button.

The assembly shall be weatherproof and constructed to prevent electrical shock under any weather conditions. The housing shall be shaped to fit the curvature of the pole to which it is attached to provide a rigid installation. Saddles shall be provided to make a neat fit as required. Pedestrian push button housing shall be black in color.

Pedestrian Push Button Sign

Pedestrian push button signs shall normally be an aluminum sign panel. Payment for pedestrian push button signs shall be incidental to the pedestrian push button pay item.

Signs shall be a minimum of 5"x 9" and conform to the 2009 MUTCD R10-3e signage.

Mast Arm and Pole

Mast arm and pole shall consist of a pole with four anchor bolts, a mast arm for support of signs and traffic signals, and, if specified, a luminaire arm and extension for roadway lighting.

Fabricator shall be certified under Category 1, "Conventional Steel Structures," as set forth by the American Institute of Steel Construction Quality Certification Program. Proof of this certification will be required prior to bid opening to assure that the fabricator has the personnel, organization, experience, procedures, knowledge, equipment, capability and commitment to fabricate quality structures.

Pole shaft, base plate, anchor bolts, mast arm, luminaire arm, and structural connecting hardware shall be designed in accordance with loading and allowable stress requirements of the latest edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals. Loading shall be based on 2001 AASHTO Category II with group consideration. If requested, calculations and detail drawings shall be submitted for verification of compliance to these specifications.

The tubular member's cross section shall be round and shall have a constant linear taper of 0.14 in./ft. It shall be fabricated from United States-produced coil or plate steel conforming to the requirements of ASTM A595 Grade A or ASTM A 572 Grade 65.

The mast arms shall have a horizontal length as called for on the plans. All mast arms that are 45 feet or less shall be manufactured and shipped in one piece with no circumferential splices. Each arm shall be provided with a painted end cap secured in place with setscrews.

For pole shafts, a 6" x 10" handhole reinforcing rim shall be welded into the shaft at eighteen inches from the base of the pole and supplied with a cover attached by bolts. Each pole shall be provided with a pole cap secured in place with setscrews or other suitable fasteners. A J-hook wire support and grounding attachment shall be provided in each pole shaft.

The base plate shall be of steel meeting or exceeding the requirements of ASTM A36 or ASTM A 572 Grade 42. It shall be integrally welded to the pole shaft with either a telescopic welded joint or a full penetration butt weld with a backup bar.

Anchor bolt material shall have a minimum yield strength of 55,000 psi and a minimum tensile strength of 75,000 psi. The bolts shall be galvanized to ASTM A153 for a minimum of eight to ten inches on the threaded end. Each anchor bolt shall be supplied with two hex nuts and two flat washers. The strength of the nuts shall be equal or exceed the proof load of the bolts.

Welding shall be in accordance with AWS (American Welding Society) Structural Welding Code D1.1, sections 1 through 8, and shall be performed by welders certified in accordance with the AWS Code. The tube's longitudinal seam welds shall be free of cracks and undercutting, performed with automatic processes, and visually inspected with questionable areas inspected by magnetic particle to AWS D1.1.

All miscellaneous hardware shall be galvanized per ASTM A153.

All materials and products shall be produced in the United States of America. They shall be of the ASTM type as called forth in this specification. Mill certifications shall be supplied for proof of compliance to this specification.

Traffic signal poles, mast arms, luminaire arms, and all incidental mounting hardware (nut covers), excluding banding straps and side of pole hardware, shall be galvanized per ASTM A123.

When specific color code is specified in the plans, all traffic signal poles, mast arms, luminaire arms, and all incidental mounting hardware (nut covers) shall be factory painted in a baked enamel finish on top of the galvanized finish.

Span Wire Pole

Span wire poles are intended for temporary use only, prior to installation of permanent mast arm signals or for emergency use. In all cases, span wire signals will be allowed only with written authorization of the Engineering Division. Span wire poles and cable shall be in conformance with the CDOT Standard Specifications for Road and Bridge Construction, latest edition, section 614. Span wire poles shall be painted Federal Green, color #14056 (or approved equivalent) and the luminaire mounting height shall be 30 feet.

Pedestal Pole

Pedestal poles shall be designed to meet the structure requirement given in the most recent edition of Standard Specifications for Structural Support for Highway Signs, Luminaries and Traffic Signals, published by AASHTO, for a wind velocity of 90 mph. The pole base shall be frangible and shall include a locking base collar.

Pedestrian Push Button Pole

Pedestrian push button pole shall be illustrated in the standard details. Pole base shall be frangible and shall include a locking base collar.

Controller and Cabinet

Each controller and cabinet assembly shall be in conformance with section 614 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, most recent edition, as clarified by the following.

Each controller and cabinet assembly shall include:

- A Cobalt, or ATC or equivalent controller to be shelf mounted
- Econolite TS type 2 cabinet with precast polymer concrete base
- 2 Ventilation fans controlled with a separate thermostat.

- 1 Heater inside cabinet to reduce cabinet moisture with separate thermostat
- Clary SP1000R traffic uninterruptible power supply (UPS) with a 100-amp hour backup supply or an equivalent 100 amp hour battery backup unit as approved by the Engineering Division.
- A Generator Panel as specified in 12.3.7.19

Notes:

- All products provided, excluding the conflict monitor, shall be on the State of California's latest qualified products listing (QPL).
- The cabinet drawings shall be non-fading prints using the xerography method. No blue line drawings will be acceptable.
- The City's signal maintenance contractor shall be supplied a computer printout of the complete environmental testing results.
- The cabinet shall have eight flash jumper blocks.
- The cabinet field terminals shall be silk-screened with the appropriate phase/color designations.
- Controllers shall be interconnected to the signal system, unless otherwise directed by the Engineering Division. Operation satisfactory to the City shall be demonstrated during the normal twenty-day testing period. The controller and cabinet shall be tested by the Contractor at least ten days prior to installation. When specific color code is specified in the plans, all traffic signal cabinet shall be factory painted in a baked enamel finish to match the traffic signal poles and mast arm structures.

Miscellaneous Hardware

All ferrous mounting hardware and weather heads shall be galvanized, cadmium-plated or made of stainless steel to resist corrosion. Payment for miscellaneous hardware, including pole plates for side-of-pole mounting, shall be incidental to the pay item to which the miscellaneous hardware items are attached.

Instructions and Wiring Diagrams

All equipment shall be provided with a minimum of two sets of complete installation and operating instructions, including a chart of field connections, as well as a service manual for the controller containing service instructions, wiring diagrams, and trouble-shooting procedures. For each component used, it shall be clearly referenced in the service manual, and its value, ratings and manufacturer part number shall be given.

Generator Panel

A generator panel consisting of a manual transfer switch, and a 30-amp twist-lock connector for generator hookup. The transfer switch knob and twist-lock connector shall be located and labeled on a panel easily accessible behind a separate lockable door.

The door shall be equipped with a tamper resistant hinge. The door assembly shall be weatherproof and dustproof. The door shall have a movable plate to cover an opening for the generator cable.

The generator panel shall be located as close as possible to the AC main circuit breaker and shall not be located on main cabinet doors.

The connection to a generator or other external power source shall be a waterproof, secure connection.

The generator panel shall be permanently wired inside the cabinet through the UPS power supply so that the cabinet can remain secure during operation.

Warning or Regulatory Sign Flashing Beacon Assembly

A warning or regulatory sign flashing beacon assembly shall be as shown in the CDOT Standard Plan S614-14. Payment for these items shall be inclusive of all work to provide an operational flashing assembly, including materials, installation, and electrical service connection. Signs shall be installed as an integral part of the flashing assembly.

School flashers shall be a pelco break away base with a 10-foot (10') to 15-foot (15') long four inch (4") diameter pole with cap and collar. Then the school flasher equipment will be from Gades technologies AI units and be integrated into the existing system.

Video Detection

The uses of Video detection will be determined on a site-specific basis. Video detection shall be approved by the City of Northglenn prior to showing in the project plans. The Video detection unit, if shown in the plans, shall be Grid smart camera system or an approved equivalent. If Video detection is specified in the plans all video feeds shall be streamed into the City's Engineering Division.

12.3.8 Paint Equipment

Paint Existing Structures

Previously installed signal poles shall be field painted when indicated on the plans. When so indicated, all exterior surfaces shall be cleaned and examined for damaged paint, and any such damage shall be removed, given a spot coat of primer and the entire exterior surface repainted. Previously painted services, whether finish or prime coated, shall be scuff sanded and particular attention paid to the lower eight feet of the pole.

Inspection of the poles by the City or It's designee prior to application of the finish coats is required. Two finish coats of paint selected by the City shall be applied over the primer or previously painted surfaces.

The painting shall be done in a neat and workmanlike manner and may be applied either by hand brushing or spraying. The City reserves the right to require the use of brushes for the application of paint, should the work done by the paint-spraying machine prove unsatisfactory or objectionable.

Touch-up painting shall be completed at the direction of the Engineering Division. Nicks and abrasions shall be cleaned, and the Engineering Division shall designate the appropriate primer coat and finish coat, if applicable.

When indicated on the plans, traffic and pedestrian signal heads shall be painted flat black.

12.3.9 General Guarantees & Warranties

Materials and Parts

The Contractor shall supply the Engineering Division with all manufacturer warranties and/or guarantees covering materials and parts.

12.3.10 General Signal Design Requirements

Scope

This section describes general signal design requirements for use in the City of Northglenn.

Signal Head Placement and Sizes

For all installations, one signal head shall be provided centered over each exclusive left turn and through lane. If mast arms do not reach the left turn lane(s), the number and configuration of signal heads should be adjusted in consultation with the City. Far left and far right pole-mounted signal heads shall also be provided. The need for one signal head per right turn lane should be determined on a site-specific basis.

Pedestrian signal heads shall be provided with corresponding pedestrian push buttons. Pedestrian signal heads shall be located for the pedestrian crossing sight line. Pedestrian push button locations shall meet ADA standards for height and horizontal reach. An exclusive pedestrian push button pole may be required.

Where left turn arrows are included, at least two signal heads with left arrow sections shall be provided, with one of these located on the far-left pole.

All mast arm mounted signal heads shall have 5-inch-wide, black aluminum, louvered backplates with one-inch (1") yellow reflective strip along the outside perimeter.

Red, yellow, and green signal sections shall be twelve inches in all cases.

Where mast arms extend over the left turn lane(s), left turn only sign(s) should be provided. Double lefts may be covered with one left turn only sign (R3-5L) per lane, or one double left turn only sign located over the lane line between the double lefts. Where a right turn lane is provided, a right turn only sign (R3-5R) should be provided and centered over the lane.

Pole and Cabinet Placement

All signal poles, pedestals and cabinets shall be placed a minimum of three feet (3') from face of traffic signal item to face of curb where curbing is present, with a desirable separation of a minimum of five feet. The same separations apply from face of traffic signal item to outside edge of shoulder where pavement and shoulder exist with no curbing. Where only pavement exists without shoulder and curbing, a minimum of five feet from face of traffic signal item to edge of pavement shall be maintained, with a desirable separation of a minimum of seven feet (7').

Future Signal Considerations

All intersections undergoing initial development or construction that are anticipated to require signalization in the future shall include signal conduit at the time of initial road construction, in conformance with these specifications. The Developer/Applicant should consult with the Engineering Division to identify intersections to which this requirement applies.

All conduit shall be Schedule 80 PVC and shall include pull boxes, locate wire, pull string and locate balls.

Luminaires

Unless otherwise indicated, the Contractor shall provide luminaires and luminaires' wiring, and shall fully install these items for all corners of the intersection. Luminaire mounting height shall be a minimum of thirty feet (30'). A complete luminaire includes the housing, lens, Light Emitting Diode (LED) luminaire, luminaire housing, driver or power generator, slip-fitting clamp or approved manufacturer mounting, all necessary internal wiring, and photoelectric control. Luminaires shall operate at either 120 VAC, 60 Hz or 277 VAC, 60 Hz. Luminaires shall meet electrical utility company requirements and comply with all requirements identified in the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction or any Revised Standard Special Provision that apply to Sections 613 and 715 LED Roadway Luminaire.

Vehicle Detectors

Stop bar protection shall be provided on all approaches with free-flow speeds of 40 to 45 mph and greater.

Consideration should be given to providing advance detection for dilemma zone protection. Site-specific conditions such as grades or sight distance obstructions may also justify use of advance detection. The potential need for advance detection in these cases should be reviewed with the City.

Signal Power

In general, circuit breakers and power disconnects should be located internal to service meter assemblies and signal controller cabinets, and should not be readily accessible to the public.

The City of Northglenn Building Division is responsible for inspecting service installations and certifying acceptability to the utility company for hook-up.

12.4 Construction Standards

12.4.1 Regulations & Code

All electrical equipment and material shall conform to the standards of the National Electrical Manufacturers Association (NEMA) the Colorado State Highway Department, whichever is applicable. In addition to requirements of these specifications, the plans, the special contract provisions, all material and work shall conform to the requirements of the National Electrical Code (hereinafter referred to as the "Code"), the Rules for Overhead Electrical Line Construction of the Public Utilities Commission, the Standards of the American Society for Testing Materials (ASTM), the American Standards Association (ASA) and any local ordinance which may apply. Wherever reference is made in these specifications or in the special contract provisions to the code, rules or the standards mentioned above, the reference shall be construed to meet the code, rule or standard that is in effect at the date of bidding.

12.5 Traffic Signing & Pavement Markings

12.5.1 General

The installation of all traffic control devices shall conform to the Manual on Uniform Traffic Control Devices and the Colorado Standard Specifications for Road and Bridge Construction, latest edition.

12.5.2 Traffic Control Devices on Public Property

All permanently fixed traffic signals will generally be installed by the City at the developer's expense. However, if the developer submits a signage plan which is subsequently approved by the Engineering Division, the developer may install these traffic signs. Traffic signs shall be placed to conform to the drawing details.

12.5.3 Traffic Control Devices on Private Property

- **Responsibility.** All traffic control devices on private property, i.e., pavement markings, regulatory signs, fire lane signs and handicapped parking signs shall be installed and maintained by the property owner.
- **Placement.** A signage and striping plan specifying the various types and combinations of traffic control devices shall be submitted to the Engineering Division for approval.

12.5.4 Pavement Markings

All Pavement Markings required to be installed as a result of new construction or development shall be THERMOPLASTIC as per CDOT Standard Specifications. Temporary pavement markings necessary to facilitate construction (i.e. detours) may be installed using paint.

The contractor shall submit a plan for all pavement markings to the Engineering Division for approval prior to the beginning of the work. The pavement marking plan shall meet the requirements for such work as outlined in the Manual on Uniform Traffic Control Devices. All pavement marking materials must be approved by the Engineering Division.

12.6 Traffic Signs

12.6.1 General

This section provides the sign materials, design requirements and sign specifications for all signs placed in City Right of Way.

12.6.2 Type and Location of Signs

The Engineering Division shall make the final determination regarding the type and location of signage controls within the Right of Way. These controls shall include traffic control signs, street name signs, delineators, and permanent barricades.

12.6.3 Design, Installation & Maintenance

The City maintains the permanent traffic control devices on public rights-of-way, all traffic control devices shall be fabricated and installed in accordance with this chapter. All design shall be in accordance with this chapter and the latest revision of the MUTCD.

12.6.4 New Roadway or Reconstructed Streets

Permanent signage, unless otherwise approved by the Engineering Division, shall be completed in place before any new roadway or reconstructed roadway is opened to the public.

12.6.5 Signpost, Supports & Mountings

Signposts and their foundations and sign mountings shall be constructed to hold signs in a proper and permanent position, to resist swaying in the wind or displacement by vandalism.

Sign Post

The post shall be constructed in two sections:

- **Anchor (Stub).** A 2-1/4-inch 12-gauge galvanized steel square stub section with holes, three (3) long, is driven into the ground thirty (30) inches with at least 4 inches remaining above the final grade. The signpost system's material specification is Telspar 22F1A 03PG, 2 1/4 inch x 3 feet anchor post with holes or perforated.
- **Sign Post.** A 2-inch square galvanized steel post section with holes is inserted into the stub and bolted. The material specification is Telspar 20F12P-10PG, 2-inch square 12-gauge 10-foot post with holes. The post shall be installed 8 inches into the anchor (stub). ***See Standard Drawing T-1.***

Post Bolts

Two 2 1/2 inch long 3/8-inch hex head bolts are used to attach sign post to sign anchor (stubs). These bolts shall be installed in adjacent holes at the top of the anchor (stub), at 90 degrees to one another.

Sign Bolts

Signs shall be mounted to the post with a minimum of one drive rivet (TL3806 EG) and nylon washer (against the face) at the top of sign. The bottom of the sign shall be attached with one 5/16" hex bolt, one metal washer and one nylon washer against sign face. The bolt or rivet system is used to fasten signs to the Telspar post.

Other Sign Mounts

Streetlights and approved utility poles, when located appropriately, may be used for signs such as warning, parking, and speed limit signs. Streetlight locations should be checked for potential sign installation during the design process and shown on the sign plan sheets.

Breakaway Post System

Post must be of appropriate length to comply with MUTCD specifications for the location, must conform to Federal breakaway standards.

Sign Reflectivity

All traffic control signs must be fabricated with reflective materials. All reflective materials to be a minimum of diamond grade, except all stop signs, yield signs and "Do Not Enter" sign faces. These signs shall be fabricated from Scotchlite reflective sheeting, high intensity grade or approved equal.

- **Materials Warranty.** All signs shall have a seven-year (7) materials warranty.
- **Backing Plates.** Aluminum blanks of 0.080 gauge are standard, except for signs larger than 36" x 36", which shall be 0.100 or 0.125 gauge aluminum.

Street Name Signs

- **General.** All street name signs must conform to these standards. If the intersection has a traffic signal, the street name signs will be designated as part of the traffic signal.
- **Minor Intersection Street Name Signs.** Eight-inch plates shall be used at all minor intersections; lengths vary to fit street names.
- **Major Intersection Street Name Signs.** Ten-inch plates shall be used at all major intersections which include the intersections with Collector and Arterial Roadways.
- **Color.** Letters and numbers are to be white on a green background face.
- **No Outlet Signs.** On any cul-de-sac, temporary dead-end street, or any other streets with only one access point a "No Outlet" sign is required. The "No Outlet" signs may be placed under the street name signs.
- **Stop Signs.** The location of all stop signs shall be determined and discussed in the Traffic Impact Study. The stop signs shall be placed in accordance with the TIS, approved construction plans and the MUTCD. In general, stop signs should be placed at point of curvature and behind attached sidewalk. All stop signs should be a minimum of 30" x 30" in size.

Traffic Control Signs

- **Design & Size.** Sign specifications and diagrams are detailed in the latest revision of the Federal "Standard Highways Sign," latest version. This publication is available from the U.S. Department of Transportation, Federal Highway Administration.

- **Mounting.** Signs should be mounted on existing streetlight and power poles, with new posts being used only if necessary. Streetlight locations should be checked for potential sign installation during the design process and shown on the signing and striping plan sheets. $\frac{3}{4}$ " stainless steel banding shall be used to mount signs to fiberglass and steel poles.
- **Crosswalk Signs.** Crosswalks shall be signed where adjacent to a school and on an established school pedestrian route. There are usually a minimum of four (4) signs per crosswalk. The color and installation shall be completed according to MUTCD. The color shall be fluorescent yellow green.
- **Fire Lane Signs**
 - The sign is 12 Inches X 18 Inches.
 - The sign shall be black letters on a white background.
 - "No Parking" or "Fire Lane" with arrow
 - The sign shall follow the MUTCD.

12.7 Pavement Marking & Striping

12.7.1 General

Type and Location of Striping and Markings

The Engineering Division shall make the final determination regarding the type and location of pavement markings within the Right of Way.

Design, Installation & Maintenance

- The signing and striping plans should be designed in accordance with these specifications and MUTCD.
- The pavement markings shall be installed with the materials specified herein and in accordance with MUTCD.
- The City will maintain permanent pavement markings after completion of the warranty period.
- On rehabilitated or new roadways, the pavement markings are required to be in place before the roadway is opened to the public.

12.7.2 Pavement Markings (Symbols, Arrows, "ONLYs")

Preformed Thermoplastic Pavement Marking Specifications

- **Thickness.** The prefabricated markings described shall be 125 mils (90 mils for bike symbols) in thickness and consist of white or yellow pigmented plastic film with imbedded reflective glass spheres, uniformly distributed throughout their entire cross-sectional area.
- **Adhesive.** It shall be possible to affix the markings to bituminous or Portland cement concrete pavements by a two-part epoxy adhesive and shall have a black contrasting border.
- **Shapes.** Prefabricated legends and symbols shall conform to the applicable shapes and sizes as outlined in the MUTCD.

- **Removal of Concrete Curing Compound.** All concrete curing compound shall be removed before installing thermoplastic in specific marking locations.

Crosswalks

Crosswalks shall be used at all signalized intersections, approved crossings, school routes, adjacent to schools, and as otherwise directed.

- **Standard Crosswalk.** White 9-foot long x 18-inch wide “Continental” style bars should be used for all crosswalks.

Stop Bars

- **Size and Color.** All stop bars shall be white and a minimum of 18 inches wide.
- **Locations.** Stop bars are required at signalized locations where the speed limit is 35 mph or higher and other locations specified by the Engineering Division.

Symbols

- **Thickness.** Performed thermoplastic pavement marking standard material shall be a minimum of 125 mils thick or approved equal. This shall be used for all arrows, “ONLY”, railroad crossing symbols.

12.7.3 Striping

General

- **Typical.** Typical striping widths for lane lines are four (4”) inches, unless otherwise noted. Double yellow centerline must have a four-inch (4”) gap between stripes according to MUTCD.
- **Pavement.** Epoxy (highway type high-solids fast-dry) shall be used for asphalt and concrete pavement striping. Refer to CDOT Highway Specifications.
- **Layout.** All striping on sealcoats shall require a layout line. Prior to striping, tabs are required for sealcoats (prior to the sealcoat process). All other conditions require spot taping at an interval of twenty-five feet (25’) or closer.
- **Retro-Reflectivity.** The two (2) coats of paint shall be applied with beads for each coat. The application rate for beads shall be 6.5 pounds per gallon. The beads shall be type 2, non-floating, water resistant.

Broken Line

All broken lines shall be 4-inch wide or 8 inches using a 6-foot cycle (two-foot (2’) paint or thermoplastic, four-foot (4’) gap).

Turn Bay Line

All turn bay lines shall be created with a minimum eight-inch (8”) wide line. However, if a turn bay occurs on a horizontal curve, the bay taper from the start of the double wide eight inch (8”) shall be marked with short eight-inch (8”) wide dotted lines. (2’ long with 4’ gap).

Centerline

All centerline striping shall be double yellow, each a minimum of four inches (4”) wide, with a 4-inch minimum gap between the two.

12.7.4 Temporary Striping

All temporary striping shall conform to “Standard Specifications for Road and Bridge Construction,” published by CDOT, the latest revision except as herein amended. When approved, temporary striping shall be required prior to the opening of a roadway for travel where pavement and/or permanent striping cannot be completed due to weather and/or time constraints.

Specifications

Temporary striping shall be the same color and width as for permanent striping. Temporary striping shall consist of tabs of four (4”) x four (4”) inch (min.) tape, depending on the pavement surface, spaced at 25-foot intervals.

Time Duration Limit

Temporary striping is permitted on Collectors and Arterials for no more than seven (7) days.

Chapter 13. RIGHT-OF-WAY GRADING & EROSION CONTROL

13.1 Right of Way Grading & Erosion Control

13.1.1 Site Remediation

Disposal of Waste Materials

Burning is not permitted on Developer's property.

Removal from Developer's Property. Removal of waste materials and unsuitable or excess topsoil from the Developer's property shall be legally disposed of.

These standards and specifications provide the requirements for site preparation and grading. This chapter addresses Right of Way grading as well as site grading for development.

13.1.2 Site Demolition

Removal of Structures & Obstructions

- **General.** The work shall consist of removal, salvaging, and backfilling according to CDOT Standard Specifications Section 202.01.
- **Salvage.** Salvageable material shall be handled according to CDOT Standard Specifications Section 202.03 in locations designated by the Designer.
- Disposal.
 - *Designer Responsibility.* The Designer shall make all necessary arrangements for securing legal and suitable disposal sites.
 - *Unestablished Dump Sites.* If disposal is to be at other than established dump sites, the Engineering Division may require the Contractor to furnish written permission from the property owner on whose property the materials are placed.
 - *Concrete and Asphalt.* Broken concrete and asphalt, with no other waste material, may be taken to City's recycling yard. Asphalt and concrete must be separated. Mingling of materials is prohibited.
- **Backfill.** Except in areas to be excavated, all cavities left by structure removal shall be cut to clean undisturbed material and backfilled with suitable material and compacted in accordance with **Chapter 14- Trenching, Backfilling, & Compacting – Utilities** of these STANDARDS AND SPECIFICATIONS. Jetting or ponding will not be allowed.

Construction Requirements

- **Structures.** The Developer shall raze, remove, and dispose of all structures, according to CDOT Standard Specifications Section 202.02.
- **Demolition Permit.** Building demolition requires a demolition permit issued by Building Division.

- **Abandoned Pipelines/Conduits.** Abandoned pipelines and conduits shall be removed or abandoned in place by plugging and filling with sand or appropriate alternative in accordance with direction from the Engineering Division.
- Other Obstructions.
 - Miscellaneous Obstructions. The Developer shall remove miscellaneous obstructions and properly dispose of them.
 - Traffic Signals and Signs. Removal of traffic signals and related materials shall be per CDOT Standard Specifications Section 202.04. All traffic signal equipment shall remain the property of the City. Contact the Engineering Division for disposal instructions.
 - Portions of Structures. Removal of portions of structures shall be per Section 13.1.2 of these standards.
 - Detour Structures. Materials used in detour structures for the project shall be removed according to CDOT Standard Specifications Section 202.06.

13.1.3 Site Clearing & Grubbing

General

The work shall consist of clearing, grubbing, removing, and disposing according to CDOT Standard Specifications Section 201.01. This work does not include objects designated to remain nor which are to be removed in accordance with other sections of these Standards.

Construction Requirements

Construction requirements for site clearing and grubbing shall follow those requirements outlined in CDOT Standard Specifications Section 201.02 with the addition of the following:

- **Construction Limits.** The Developer will establish construction limits in accordance with the City requirements.
- **Buried Perishable Objects.** Buried perishable objects shall be removed to a depth of 3 feet below the existing ground or subgrade, whichever is lower.
- **Disposal.** Disposal of materials or debris shall be done in accordance with Section 13.1.1.

13.1.4 Embankment & Excavation

General Construction Requirements

Excavation and embankment operations shall be done in accordance with CDOT Standard Specifications Section 203.04. Prior to beginning grading operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 13.1.3.

Embankment Material

Embankment material shall consist of approved material acquired from excavations and shall be hauled and placed in embankments in reasonably close conformity with the line, grades, thicknesses, and typical cross-sections shown on the plans.

- **Compaction.** The embankment shall be free of organic material and shall be moisture treated to within 2% (or as specified on the plans or geotechnical report) of optimum moisture content and placed in 6-inch lifts compacted to 95% standard proctor.
- **Source of Material.** When the source of embankment materials is not designated on the plans, approval of the source will be contingent on the material meeting the requirements of **Chapter 5 – Design Report Requirements** and having a resistance value that matches or exceeds the R-value of the in-situ material or as shown on the plans when tested by the Hveem Stabilometer.
- **Unsatisfactory Material.** Refer to the unacceptable soil classification groups from ASTM which apply for locally available material. No topsoil shall be used for fill. In addition, no gap graded material nor material weighing less than 90 pounds per cubic foot shall be used for fill.

Excavation

- **General.** This work shall consist of excavation, disposal, shaping, or compaction of all material encountered within the limits of the work, including excavation for ditches and channels.
 - *Protection of Property and Workmen.* Excavation shall be performed in a careful and orderly manner with due consideration given to protection of adjoining property, the public, and workmen.
 - *Damage Repair Responsibility.* Any damage to streets, parking lots, utilities, irrigation systems, plants, trees, building or structures or private property, or the benchmarks and construction staking shall be repaired and restored to its original conditions by the Developer at the Developer's expense. Following completion of construction, should any of these trees, shrubs, or irrigation facilities, etc. require replacement, it shall be done at the Developer's expense.
 - *Compliance with Standards.* All excavation and the like shall comply with OSHA's "Construction Industry Standards" as well as all applicable Federal and State regulations.
- **Stockpile.** The Contractor shall not leave stockpiles in the Right of Way without the appropriate temporary traffic control and Right of Way Permit requirements.
- **Disposal.** Excess excavated material shall be disposed of outside of the Right of Way unless approval is given by the Engineering Division to do otherwise.
- **Unsanitary Materials.** Unacceptable material defined as any earthen material containing vegetable or organic silt, topsoil, frozen material, trees, stumps, certain manmade deposits, or industrial waste, sludge, or landfill, or other undesirable materials will be removed from the site and disposed of in accordance with applicable City, State, and Federal requirements.
- **Unauthorized Excavation.** Unauthorized excavation consists of removal of materials beyond specified elevations without the specific direction of the Engineering Division. Unauthorized excavation shall be backfilled and compacted as specified for authorized excavations.
- **Rock.** Rock shall be excavated and disposed of according to CDOT Standard Specifications Section 203.05(a), or City Requirements. Rock shall be removed to a level 3 feet below the subgrade surface within the right-of-way. Drainage facilities may be required by the Engineering Division in accordance with **Chapter 9 – Storm Drainage & Other Concrete Facilities**.

13.1.5 Embankment Construction

General

Embankment construction shall consist of constructing roadway embankments within project areas where unsuitable material has been removed as well as in other areas as noted in CDOT Standard Specifications Section 203.06.

- **Water in Material.** Free running water shall be drained from the material before the material is placed.
- **Maximum Size of Solid Material.** Rocks, broken concrete, or other solid materials more than 3 inches in greatest dimension shall not be placed in embankment, unless approved by the Engineering Division.
- **Archaeological Sites or Artifacts.** When the Developer's excavating operations encounter remains of prehistoric peoples' dwelling sites or artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. The Developer shall contact archaeological authorities to determine the disposition thereof. When directed, the Developer shall excavate the site in such a manner as to preserve the artifacts encountered and shall remove them for delivery to the custody of the proper state or City authorities.
- **Protection of Existing Installations.** The Developer shall at all times take precautions for the protection of culverts, irrigation crossings, mailboxes, driveway approaches, valve boxes, manholes, survey monuments, underground or overhead utility lines, and all other public or private installations that may be encountered during construction. The Developer shall be responsible for the repair of any installations damaged due to their work. Manholes and valve boxes shall be observed by the Engineering Division for displacements and introduction of foreign matter. It shall be the Developer's responsibility to correct any displacement and to remove any foreign matter resulting from the Developer's work.

13.1.6 Borrow Material

General

Provide approved borrow soil materials from off-site locations when sufficient approved soil materials are not available from excavations on-site. Borrow material shall be placed only after the approved excavation material has been replaced in the fill. Borrow areas shall be finished so that water will not collect or stand therein. The "R" value of the borrow shall be equal or greater than the design "R" value required for the existing subgrade soil. In addition, the LL and PI shall be equal to, or better than, the LL and PI of the subgrade material. Refer to **Chapter 5 – Design Report Requirements**.

Satisfactory Borrow Materials

Borrow material must be free of rock or gravel larger than 3 inches, and free of debris, waste, frozen materials, vegetation, and other deleterious matter. Refer to ASTM soil classification groups which apply for locally available material.

Unsatisfactory Borrow Materials

Refer to the unacceptable soil classification groups from ASTM which apply for locally available material. No topsoil shall be used for fill. In addition, no gap graded material nor material weighing less than 90 pounds per cubic foot shall be used for fill.

13.1.7 Earthwork Grading

General

Grade all areas to a uniformly smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross-sections, lines, and elevations indicated. Provide a smooth transition between existing adjacent grades and new grades.

Remove soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

Grading During Construction

Grading shall be done as necessary to prevent surface water from entering the excavation. Any other water accumulation therein shall be promptly removed.

Accessibility During Construction

Earthwork construction shall be performed in a manner that does not obstruct surface drainage or prohibit access to operational driveways, fire hydrants, manholes, and water valves.

Site Grading

- **Slope and Elevation of Grades.** The ROW shall be sloped to direct storm runoff flow to the roadway, unless otherwise specified on the plans. Finish subgrades to required elevations within the following tolerances:
 - *Lawn or Unpaved Areas.* Plus or minus 0.25 feet.
 - *Walks.* Plus 0 or minus 0.1 feet.
 - *Pavements.* Plus 0 or minus .04 feet.
- **Construction Stakes.** The Developer shall provide all stakes necessary for curb, gutters, sidewalks and structures and furnish all necessary information relating to lines and grades. The Developer shall be held responsible for preservation of all such stakes.
 - *Stake Removal.* The Developer shall not remove stakes until three working days after placement of concrete unless approved by the Engineering Division.
 - *Vertical Curves.* Curb stakes shall be placed at 25-foot intervals and at the lowest and highest elevations along the vertical curve. This is intended to minimize flat grades at the high and low points.

13.1.8 Erosion Control

Soil Protection

All disturbed soil, on or off-site and related to work at the project site, is required to be protected from wind and storm water erosion. To mitigate erosion, the contractor shall use standard erosion control techniques described in "Volume 3 – Best Management Practices of the Urban Storm Drainage Criteria Manual," published by the Mile-High Flood District.

All cleared lands shall be at least temporary seeded within fourteen (14) days of removal of grasses. Refer to **Chapter 17– Revegetation & Seeding**.

13.1.9 Erosion & Sedimentation Controls

This section includes erosion and sediment control for all disturbed soil, on or off-site and related to work at the project site, is required to be protected from wind and storm water erosion through the use of the following:

- Swales
- Sediment Basins
- Sediment traps
- Silt Fences
- Straw and Bales
- Planting and Ground Cover
- Maintenance of Erosion Control Improvements
- Clean-up and removal of silt from roadways on-site and off-site
- Dust Alleviation and Control by watering or magnesium chloride
- Other techniques described in “Volume 3 – Best Management Practices of the Urban Storm Drainage Criteria Manual”, published by the Mile-High Flood District (MHFD).

Soil Protection

The Contractor is responsible for temporary erosion control on any project that disturbs a half acre or larger projects or when required in the construction drawings.

Temporary Silt Fence

- The height of silt fence shall not exceed thirty-six inches (36"). On slopes, the fence line shall follow the contour as closely as possible. In small swales, the fence line shall be curved upstream at the sides to direct the flow toward the middle of the fence.
- If possible, the filter fabric shall be cut from a continuous roll to avoid the use of joints. When joints are necessary, filter cloth shall be spliced only at a support post, with a minimum six-inch (6") overlap and both ends securely fastened to the post.
- Posts shall be spaced a maximum of ten feet (10') apart and driven securely into the ground, a minimum of twelve inches (12"). When extra strength fabric is used without the wire support fence, post spacing shall not exceed six feet (6').
- A trench shall be excavated approximately four inches (4") wide and four inches (4") deep along the line of posts and upslope from the barrier.
- When standard strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least one inch (1") long, tie wires or hog rings. The wire shall extend into the trench a minimum of two inches (2") and shall not extend more than thirty-six inches (36") inches above the original ground surface.
- The standard strength filter fabric shall be stapled or wired to the fence, and eight inches (8") of the fabric shall extend into the trench. The fabric shall not extend more than thirty-six inches (36") above the original ground surface. Filter fabric shall not be stapled to existing trees.
- When extra strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric is stapled or wired directly to the posts with all other provisions of Subparagraph 6, above, applying.

- The trench shall be backfilled and the soil compacted over the toe of the filter fabric.
- Silt fences shall be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized.
- Silt fences and filter barriers shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs shall be made immediately.
- Should the fabric on a silt fence or filter barrier decompose or become ineffective prior to the end of the barriers expected usable life and the barrier is still necessary, the fabric shall be replaced promptly.
- Sediment deposits should be removed when deposits reach approximately one-half (1/2) the height of the barrier.
- Any sediment deposits remaining in place after the silt fence or filter barrier is no longer required should be dressed to conform to the existing grade, prepared and seeded.

Special Requirements

- All basins and check dams shall have been pumped dry, and all debris and silt removed within twenty-four (24) hours after each storm.
- Hydro-seed all fill and cut slopes as approved by the Engineering Division, with a vertical height of five feet (5') or more.
- Changes to the erosion and sediment control plans to meet field conditions will be made only with the approval of, or at the direction of, the Engineering Division.
- During the rainy season, all paved areas will be kept clear of earth material and debris. The site will be maintained so that a minimum of sediment-laden runoff enters the storm drainage system.
- **CONTROL OF GROUND WATER** The Contractor shall be solely responsible for dewatering excavations and subsequent control of ground water. Permits for Dewatering actions may be required by the CDPHE. Contractor/Developer is responsible for obtaining and complying with all permit requirements. The Contractor shall provide and maintain such pumps or other equipment as may be necessary to control ground water and seepage, to the satisfaction of the Engineering Division, until backfilling is completed.

Sediment Basins

- Areas under the embankment and any structural works shall be cleared, grubbed, and stripped of any vegetation and root mat. In order to facilitate cleanup and restoration, the basin area shall be cleared also.
- A cut-off trench shall be excavated along the centerline of earth-fill embankments. The minimum depth shall be two feet (2'). The cut-off trench shall extend up both abutments to the riser crest elevation. The bottom width shall be wide enough to permit operation of excavation and compaction equipment and a minimum of four feet (4') in width. The side slopes shall be no steeper than one to one (1:1). Compaction requirements shall be the same as those for the embankment. The trench shall be dewatered during the backfilling and compacting operations.
- Fill material for the embankment shall be taken from approved fill areas. It shall be clean material soil free of roots, woody vegetation, oversized stones, rocks or other objectionable material. Relatively pervious materials such as sand or gravel (Unified Soil Classes GW, GP, SW, and SP) shall not be placed in the embankment. Areas on which fill is to be placed shall be scarified prior to placement of fill. The fill material shall contain sufficient moisture so that it can be formed by hand into a ball without crumbling. If water can be squeezed out of the ball, it is too wet for proper compaction. Fill material shall be placed in six to eight inch (6" - 8") thick continuous layers over the entire length of the fill. Compaction shall be obtained by routing the hauling equipment over the fill so that the entire surface of each layer of the fill is traversed by at least one wheel or

tread track of the equipment, or by the use of a compactor. The embankment shall be constructed to an elevation ten percent (10%) higher than the design height to allow for settlement if compaction is obtained with hauling equipment. If compactors are used for compaction, the overbuild may be reduced to not less than five percent (5%).

- The principal spillway riser shall be securely attached to the discharge pipe by welding all around and all connections shall be watertight. The pipe and riser shall be placed on a firm, smooth soil foundation. The connection between the riser and the riser base shall be watertight. Pervious materials such as sand, gravel or crushed stone shall not be used as backfill around the pipe or anti-seep collars. The fill material around the pipe spillway shall be placed in four-inch (4") layers and compacted under the shoulders and around the pipe to at least the same density as the adjacent embankment. A minimum of two feet (2') of hand-compacted backfill shall be placed over the pipe spillway before crossing it with construction equipment. Steel base plates shall have at least two and one-half feet (2-1/2') of compacted earth, stone or gravel placed over them to prevent flotation.
- The emergency spillway shall not be installed in fill. Elevations, design width, and entrance and exit channel slopes are critical to the successful operation of the emergency spillway.
- Baffles shall be constructed of four-inch by four-inch (4" x 4") posts and four feet by eight-feet (4' x 8') by one-half inch (1/2") exterior plywood. The posts shall be set at least three feet (3') into the ground, no further apart than eight feet (8') center to center and shall reach a height six inches (6") below the riser crest elevation. The plywood shall be securely fastened to the upstream side of the posts.
- The embankment and emergency spillway shall be stabilized with vegetation immediately following construction.
- Construction operations shall be carried out in such a manner that erosion and water pollution will be minimized. State and local laws concerning pollution abatement shall be complied with.
- State and local requirements shall be met concerning fencing and signs warning the public of hazards of soft sediment and floodwater.
- Maintenance and repairs shall be carried out as follows:
 - All damages caused by soil erosion or construction equipment shall be repaired before the end of each working day.
 - Sediment shall be removed from the basin when it reaches the specified distance below the top of the riser. This sediment shall be placed in such a manner that it will not erode from the site. The sediment shall not be deposited downstream from the embankment or in or adjacent to a stream or floodplain.
- When temporary structures have served their intended purpose and the contributing drainage area has been properly stabilized, the embankment and resulting sediment deposits shall be leveled or otherwise disposed of in accordance with the approved erosion and sediment control plan.

Sediment Traps

- The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat. The pool area shall be cleared.
- The fill material for the embankment shall be free of roots or other woody vegetation, as well, as oversized stones, rocks, organic material, or other objectionable material. The embankment shall be compacted by traversing with equipment while it is being constructed.

- Sediment shall be removed, and the trap restored to its original dimensions when the sediment has accumulated to within one foot (1') of the outlet elevation. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.
- The structure shall be inspected after each rain and repairs made as needed.
- Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
- The structure shall be removed, and the area stabilized when the remaining drainage area has been properly stabilized.
- All cut-and-fill slopes shall be two-to-one (2:1) or flatter.
- When a riser is used, all pipe joints shall be watertight.
- When a riser is used, at least the top two-thirds of the riser shall be perforated with one-half inch (1/2") diameter holes spaced eight inches (8") vertically and ten to twelve inches (10"-12") horizontally.
- When a pipe outlet is used, fill material around the pipe spillway shall be hand compacted in four-inch (4") layers. A minimum of one and one half feet (1.5') of hand-compacted backfill shall be placed over the pipe spillway. At least two feet (2') of backfill shall be placed if construction equipment will cross over the pipe spillway.

Temporary Straw Bale Dikes and/or Fiber Rolls

- Bales/Waddles shall be placed in a row with ends tightly abutting as shown on the Plan.
- Each bale shall be embedded in the soil a minimum of four inches (4").
- Bales shall be securely anchored in place by two (2) wood stakes driven through the bales. The first stake in each bale shall be driven toward the previously laid bale to force bale together.
- The dike shall be inspected after each storm, and repair or replacement shall be made promptly as needed.
- Bales shall be removed when they have served their purpose so as not to block or impede storm flow or drainage.

Chapter 14. TRENCHING, BACKFILLING, & COMPACTING - UTILITIES

14.1 General

This chapter addresses trenching, backfilling and compacting for wet and dry utilities in the public Right of Way and public easements for both new projects and repair. All trenching activities shall comply with the requirements of OSHA's "Construction Industry Standards" as well as all applicable Federal and State regulations for safety.

14.2 Equipment

14.2.1 Trenching Equipment

The use of trench digging equipment will be permitted in places where its operation will not cause damage to existing structures or features, in which case hand methods shall be employed.

14.2.2 Tracked Vehicles

No tracked vehicles shall be permitted on streets' subgrade unless otherwise accepted by the Engineering Division. Damaged facilities will be restored to original condition at the Developer's expense.

14.2.3 Haul Routes

Haul routes for equipment and materials may be restricted as a condition of the Permit.

14.3 Trenching for Utilities

14.3.1 Excavation for Utility Trenches

General

Contractors are responsible for the location of utilities prior to digging and responsible for the protection of Existing Underground Utilities. The Engineering Division requires all contractors working in the City of Northglenn to implement the Subsurface Utility Engineering requirements.

Types of Utility Excavation

The construction of any repair activity within the street or alley shall be accomplished by open cut, jacking, boring or a combination of these methods, as approved by the required permit(s). The Engineering Division is the entity to approve any change from the approved permit(s). Only for pipes 6" or less in diameter, crossings under sidewalks or curbs may be made by tunneling.

Location of Underground Structures

The Developer shall proceed with caution in the excavation of the trench, so that the exact location of underground structures, both known and unknown, may be determined. The contractor shall locate all existing underground utilities, by non-destructive means, before trench excavation. The Engineering Division may require "potholing" and visual location of certain utilities.

Open Trenches

Once trenches are excavated, the Contractor shall proceed diligently towards completion of the work and completion of the backfill. The Engineering Division reserves the right to limit the length of open trench during construction.

Flow Fill

Excavated material may be used as fill for the trench if the material meets requirements of borrow material and approved in the Right of Way permit. If the material is unacceptable, it shall be stockpiled separated and disposed of by the Contractor. All small projects are required to utilize flow fill instead of native soil backfill. The Right of Way Permit process shall determine if the Contractor is required to use flow fill.

Trees

The Contractor shall protect trees that are adjacent to their excavation to ensure that roots and/or branches are not adversely affected by the excavation equipment.

14.3.2 Removal of Pavement**Open Pavement Cuts**

Open pavement cuts shall not be permitted on any street unless approved in the Right of Way permit.

Placement of Pavement Cuts

The pavement cut shall follow a line parallel to the roadway centerline and at least two (2) feet beyond the trench side wall. All pavement cuts parallel to the direction of travel shall be placed on the lane line or at the center of the aligned travel lane. For bicycle lanes, the cut shall be at the line or the edge of the gutter. Longitudinal joints are not allowed in the wheel path.

Repair of Damage Beyond Original Cut

If pavement adjoining the original pavement cut is damaged during construction, additional pavement shall be removed and repaired after trench backfilling. The additional pavement shall be removed with the original cuts. The additional pavement damaged by the Contractor shall be repaired at the Contractor's expense.

Disposal of Excavated Paving

The Contractor shall be responsible for the disposal of pavement. If the asphalt pavement is milled and/or concrete pavement is rubblized, it may be acceptable as backfill as accepted by the Engineering Division.

Excavation Near Failed Pavement

When the proposed excavation falls within three (3) feet of a section of failed pavement, the failed area shall be removed up to sound pavement and patched. Scarring, gouging, or other damaged pavement adjacent to a patch shall be removed and the pavement repaired.

14.3.3 Utility Crossings

All utility trenches that are located in existing streets shall be backfilled with flowable fill after the utility line has been installed. Refer to Section 14.3.4 for flowable fill criteria.

14.3.4 Backfill**Ordinary/Native Backfill**

This shall consist of material excavated from the site except rubbish, frozen material, broken pavement, stones, or other consolidated material greater than three (3) inches in diameter, organic muck, or other materials considered unacceptable by the Inspector.

Imported Backfill

Imported backfill for trenches shall meet the requirements of CDOT Class 6.

Structure Backfill

This material shall be Class I structure backfill, conforming to CDOT Standard Specifications, Section 703. Class I structure backfill shall be used on all bridges, box culverts, or where otherwise specified.

Flowable Fill

This material shall be required as utility trench backfill unless otherwise directed by the Engineering Division. This requirement applies to all locations under existing pavement. Vibration of flowable fill shall be required unless otherwise approved by the Engineering Division. The approved mix for flowable fill is shown below:

Table 14.1: Flowable Fill Mixtures

Flow Fill Ingredients	Pounds/Cubic Yard
Cement	42 (0.45 sack)
Water	325 (39 gallons as needed)
Coarse Aggregate (No. 57)	1700
Sand (ASTM C-33)	1845

The maximum desired 28-day strength is 90-150 psi. The combination of material listed above, or an equivalent, may be used to obtain the desired flowable fill. Flowable fill shall not be used as a temporary or permanent street surface. Trenches shall be initially backfilled to the level of the original surface. After flowable fill has cured, the top surface of the flowable fill shall be removed to the depth necessary to allow repair of the permanent surface.

Conventional Backfill

Conventional backfill is “nonflowable fill.”

Backfill Lifts

Backfill material shall be placed in uniform loose lifts, not to exceed eight (8) inches prior to compaction. Alternate methods may be considered by the Engineering Division.

Compaction

Each layer shall be compacted to a density not less than 95 percent of maximum density, in accordance with AASHTO T99 and at the moisture content as specified in the soils or pavement design report. If the moisture content is not specified, soils shall be compacted at +/- 2 percent.

Categories of Conventional Backfill

Backfill lifts under existing or proposed streets, curbs, gutters, sidewalks, and alleys is divided into 3 categories: initial, intermediate, and final lifts as defined below.

- **Initial Lift (bedding).** This is designated as Class B and generally comprised of a washed, clean gravel material, consisting of the section from the bottom of the excavation to a point 12 inches above the top of the underground structure installation. Placement and compaction of the initial layer shall be as specified by the utility to protect their installation. Sections deeper than described above for class B will not be allowed.
- **Intermediate Lift.** This is generally comprised of native material, consisting of the section above the initial layer to a point within six (6) inches of the ground level or the bottom of the pavement section, whichever is

greater. Excavated material may be used in the intermediate layer provided that it is deemed suitable by the Engineering Division.

- **Final Lift.** This includes both roadbase and surfacing material. Roadbase material shall be CDOT Class 6 aggregate course as specified in the Pavement Design Report or as specified by the Engineering Division.

14.3.5 Trench Cover

Subgrade

- **Compaction.** After the backfill has been placed and compacted as specified, it shall be cut and trimmed to the required depth and cross section (Refer to **Standard Drawing R-16**). Trench cover subgrade shall be free of all rock over three (3) inches in size. It shall be compacted to not less than the densities required for the given soil classification as required in the Geotechnical Report (Refer to **Chapter 5 – Design Report Requirements**). This density requirement also applies to all utility trenches within the public Right of Ways. Compaction shall be evaluated by standard tests, at the time of constructing curb, gutter, sidewalk, pavement, and/or other permanent trench cover structure.
- **Excess Excavated Material.** All excess excavated material shall be removed and disposed of outside the legal limits of the Right of Way as the work progresses, unless the approval of the Engineering Division is obtained for disposal of the material within the legal limits of the Right of Way.
- **Condition Restored.** All parts of the roadway and various structures disturbed shall be restored in accordance with these Standards.
- **Compaction Equipment.** Compaction equipment must be on the job site before excavation is started. Compaction equipment must be capable of compacting within the trench width limits to avoid bridging the ditch.

14.3.6 Backfill Materials

Native Soils Backfill

The Contractor may use native soil from the trench for backfill if it is suitable, compactable and is free of asbestos, organic matter, roots, debris, rocks larger than 6” in diameter, clods, clay balls, broken pavement and other deleterious materials. Backfill material shall be so graded that at least 40% of the material passes a No. 4 sieve. The coarser materials shall be well distributed throughout the finer material. The backfill material shall not be used as pipe bedding. The native backfill is not permitted unless specifically approved by Engineering Division on the Construction Plans and/or Right of Way permit.

Imported Material for Backfill

Imported material shall conform to that specified for native earth backfill or imported sand.

14.3.7 Pipe Bedding

Imported sand used for pipe bedding shall consist of natural or manufactured granular material, or combination thereof, free of deleterious amounts of organic material, mica, loam, clay, and other substances. Under no circumstances will decomposed granite, rock dust, or native earth backfill be allowed or used for bedding.

Table 14.2: Pipe Bedding Gradation

Sieve Size	Percent Passing by Weight
3/8 inch	100
No. 4	75-100
No. 30	12-50
No. 100	5-20
No. 200	0-15

Imported sand shall have a coefficient of permeability greater than 0.014 measured in accordance with ASTM D2434 or a minimum sand equivalent of 30 per ASTM D2419. Imported sand shall have a saturated resistivity greater than 1,000 ohm-cm, a neutral pH, and chlorides less than 100 ppm.

Table 14.3: Crushed Rock Gradation

Sieve Size	Designated Rock Size			
	1-1/2 Inch	1-Inch	3/4-Inch	3/8-Inch
	Percent Passing	Percent Passing	Percent Passing	Percent Passing
2 inches	100	-	-	-
1-1/2 inches	90 - 100	100	-	-
1 inch	20 - 55	90 - 100	100	-
3/4 inch	0 - 15	30 - 60	90 - 100	-
1/2 inch	-	0 - 20	30 - 60	100
3/8 inch	0 - 5	-	0 - 20	90 - 100
No. 4	-	0 - 5	0 - 5	30 - 60
No. 8	-	-	-	0 - 10

Use 3/4 inch size unless indicated otherwise in the Construction Drawings.

14.3.8 Crushed Rock for Below Ground Installations

Gravel or crushed rock material shall contain less than 1% asbestos by weight or volume and conform to the following gradation:

14.3.9 Granular Material for Structural Backfill

Granular material for structural backfill shall be free of asbestos, organic materials, clay balls, and shall have the following gradation:

Table 14.4: Backfill Gradation

Sieve Size	Percent Passing by Weight
3/4 Inch	100
1/2 Inch	95 - 100
3/8 Inch	50 - 100
No. 4	20 - 65
No. 8	10 - 40
No. 40	0 - 20
No. 200	0 - 5

Excavated material may be used for structural backfill provided it conforms to the specifications for structural backfill material.

14.3.10 Concrete for Below Ground Installations

- Concrete Anchors, collars, cradles, encasements, supports, and thrust blocks shall be Class B.
- Provide anchor blocks at valves in pipe having unrestrained mechanical joints.
- Provide support blocks at valves in ductile iron pipe or steel pipe.

14.3.11 Mortar

Mortar and grout shall be a mixture of cement, sand and water. Mortar shall consist of not more than one-part cement to two and one-half parts sand by damp loose volume. The quantity of mixing water shall be not more than necessary for handling and placing.

14.3.12 Water for Compaction

Water used in compaction shall have a pH of 7.0 to 9.0. Water shall be free of acid, alkali, or organic materials injurious to the pipe or coatings. Saltwater will not be allowed.

14.3.13 Structures

All structures construction shall be completed as per CDOT Requirements.

Chapter 15. STREET CONSTRUCTION STANDARDS

15.1 General

The purpose of this section is to set forth the criteria to be used in the construction of all streets and appurtenances within the City of Northglenn.

15.2 Compaction in Utility Trenches

Before street construction will be permitted, all utility trenches within the street Right of Way (including service lines) shall be compacted to ninety-five percent (95%) of maximum standard density at one percent (1%) (plus or minus) optimum moisture, as determined by ASTM D 698-78 or as specified in the approved soils report. This compaction shall extend to the street Right of Way lines as a minimum. Water settlement of trenches shall not be permitted. All water and sewer services, including water and sewer main stub-outs, shall be installed prior to street construction except that curb and gutter and sidewalk shall be installed prior to water service line installation.

15.3 Excavation & Embankment

15.3.1 General

The intent of this section is to specify methods and standards to be used in the construction of embankments or excavations for City streets or for other purposes, as indicated on the accepted drawings or contract documents. The work will include excavation, embankment, grading, compacting, clearing, and grubbing, removal of topsoil, trees, stumps or other vegetation, removal and/or resetting of minor obstructions, subgrade preparations and any other work incidental for the construction of excavations and embankments. All workmanship and materials shall be in accordance with the requirements of the CDOT Standard Specifications for Road and Bridge Construction (Latest Edition) and in conformity with the lines, grades, quantities, and the typical cross-section shown on the plans or as directed by the Engineering Division.

15.3.2 Salvage

All salvageable material shown on the plans shall be removed without unnecessary damage in sections or pieces which may be readily transported and shall be stored by the Contractor in locations approved by the Engineering Division.

The Contractor shall be required to replace any materials lost from improper storage methods or damaged by negligence.

15.3.3 Disposal

The Contractor shall make all necessary arrangements for obtaining suitable disposal locations and the cost involved shall be included in the work. If disposal will be at other than established dump sites, the Engineering Division may require the Contractor to furnish written permission from the property owner on whose property the materials will be placed.

15.3.4 Select Borrow Material

In the event the material found on site is unsatisfactory for constructing subgrade, embankments or filling excavations, the Contractor shall provide material from off-site. The selected borrow material shall be a well-graded mixture of sound mineral aggregate particles containing sufficient quality bonding material to secure a firm stable foundation when placed and compacted on the roadway. The R-value of the borrow material shall be equal to or greater than the design R-value required for the street. The R-value of the borrow shall be provided to the Engineering Division prior to placing borrow. If tests reveal that material being placed is not of suitable quality and structural value, the Contractor shall provide other material as approved by the Engineering Division.

15.4 Subgrade Preparation & Grading

15.4.1 General

The work covered by this section concerns the furnishing of all labor, equipment, supplies, and materials needed to perform preparation of subgrade within the public Right-Of-Way. The bottom of the excavation for the pavement, or top of the fill, will be known as the pavement subgrade and shall conform to the lines, grades, and cross-sections shown on the accepted plans. Prior to the street being excavated, all service cuts shall be checked to see if the backfill meets density requirements. If deficient, they shall be recompact and brought up to the density as specified in **Chapter 14- Trenching, Backfilling & Compacting – Utilities**.

15.4.2 Subgrade Stabilization

Embankment and subgrade soils shall be compacted to ninety-five percent (95%) of maximum standard density at plus or minus two percent (+2%) optimum moisture or as recommended in the approved soils report. Maximum density shall be determined by ASTM D 698-78. Soft and yielding material and other portions of the subgrade which will not compact when rolled or tamped shall be removed as directed by the Engineering Division and replaced with suitable material.

Subgrade surfaces below excavated areas such as cut areas and undisturbed areas shall require additional preparation. Said subgrade shall be scarified to a minimum depth of twelve inches (12"), wetted or aerated as needed and compacted until the required density is obtained, unless otherwise approved by the Engineering Division. No paving, subbase or base shall be placed on soft, spongy, or frozen unstable subgrade which is considered unsuitable by the Engineering Division.

The Contractor, when requested by the Engineering Division, shall furnish the necessary equipment to proof roll, even though density tests may indicate compliance. Heavy construction equipment or loaded trucks acceptable to the City shall be driven over the finished subgrade and deflections noted. Soft and yielding material and portions of the subgrade which show deflection shall be scarified and re-rolled or shall be removed and replaced with subgrade course material and then placed and compacted as specified herein. Subgrade shall not be approved for base course construction or paving until it is uniformly stable and unyielding.

15.4.3 Subgrade Surface Tolerance

The excavation and embankments for the street, intersections and driveways shall be finished to a reasonably smooth and uniform surface. Variations from the subgrade shall not be more than one-half inch (1/2") in solid nor more than one inch (1") above or six inches (6") below in rock.

15.5 Subbase Construction

15.5.1 General

The subbase shall consist of a foundation course composed of granular material constructed on the prepared subgrade in accordance with these STANDARDS AND SPECIFICATIONS and in reasonable conformity to the lines and grades and typical cross-sections as shown on the accepted plans.

15.5.2 Placement & Compaction

Each layer of subbase material shall be placed in layers not to exceed six inches (6") in compacted depth. Each layer shall be wetted or aerated, if necessary and compacted to ninety-five percent (95%) maximum density at plus or minus two percent (+2%) of optimum moisture as determined by ASTM D 698-78. No subbase material shall be placed upon a soft, spongy, or frozen subgrade or other subgrade, the stability of which is unsuitable for the placement thereof.

15.5.3 Subbase Surface Tolerance

The prepared surface of the subbase shall not vary from the approved grade by more than a half inch (1/2").

15.6 Base Construction

15.6.1 General

The intent of this section is to specify methods to be used for the construction, overlaying, sealcoating and pavement rejuvenating of streets, parking lots, walks, drainageways and other miscellaneous work requiring the use of aggregates. The work covered shall include general requirements that are applicable to aggregate base course, bituminous base and pavements of the plant-mix type, bituminous prime coat, bituminous tack coat, rejuvenating applications and asphalt concrete overlay. All workmanship and material shall be in accordance with requirements of these STANDARDS AND SPECIFICATIONS and in conformity with the lines, grades, depths, quantity requirements and the typical cross-section shown on the accepted plans or as directed by the Engineering Division.

15.6.2 Base Course

This item shall consist of a foundation course composed of crushed gravel or crushed stone and filler, constructed on the prepared subgrade or subbase course. Construction shall be in accordance with the requirements of the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction (Latest Edition) and the accepted pavement design. The composite base course material shall be free from vegetation and lumps or balls of clay.

15.6.3 Placement & Compaction

The base course material shall be deposited and spread in a uniform layer without segregation of size to a compacted depth not to exceed six inches (6"). The material shall be compacted to a minimum ninety-five percent (95%) density as determined by ASTM D 698-78. No base course material shall be placed upon a soft, spongy, or frozen subgrade or subbase with an unsuitable stability. Base material shall not be placed on a dry or dusty foundation where the existing condition would cause rapid dissipation of moisture from the base material and hinder or preclude its proper compaction. Such dry foundations shall have water applied and shall be reworked and recompacted.

Rolling shall be continuous until the base material has been compacted thoroughly in accordance with these STANDARDS AND SPECIFICATIONS. Water shall be uniformly applied as needed during compaction to obtain optimum moisture content and to aid in consolidation. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly placed.

15.6.4 Base Surface Tolerance

The prepared surface of the base shall not vary from the approved grade by more than one-half inch (1/2").

15.7 Bituminous Construction

15.7.1 Hot Bituminous Pavement

General

All pavements shall be hot bituminous pavement of the plant mix type unless otherwise approved in writing by the Engineering Division. Construction shall be in accordance with the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction, (Latest edition).

When tack coats, seal coats, rejuvenating agents or the heating and scarifying process are specified on the accepted construction plans or required by the Engineering Division, all materials and construction shall be in accordance with the CDOT Standard Specifications for Road and Bridge Construction (Latest Edition).

The intent of this section is to specify materials and methods to be used for the construction, overlaying, seal coating and pavement rejuvenating of streets, parking lots, walks, and other miscellaneous work requiring the use of aggregates. The work covered shall include general requirements that are applicable to aggregate base course, bituminous base and pavements of the plant mix type, bituminous prime coat, bituminous tack coat, rejuvenating applications, and asphalt concrete overlay. Workmanship and material shall be in accordance with requirements of these Standards and Specifications and in conformity with the lines, grades, depths, quantity requirements, and the typical cross section shown on the plans or as directed by the Engineering Division.

These specifications include general requirements applicable to all types of plant mixed hot mix asphalt (HMA). Also included are requirements for Stone Matrix Asphalt (SMA). Reference to HMA shall also mean SMA is Included. This work consists of one (1) or more courses of asphalt mixture constructed on a prepared foundation in accordance with specifications. The design intent is to provide pavement with adequate thickness and quality to provide a serviceable life of at least 20 years. It is also the intent to provide construction in accordance with these specifications with a high standard of practice. This item shall include all labor, equipment, and materials to manufacture, place and compact asphaltic concrete for pavement purposes.

TEST PROCEDURE DEFINITION

- CP-## Colorado Department of Transportation: Field Materials Manual (Colorado Testing Procedures)
- ASTM American Society for Testing & Materials
- AASHTO American Association of State Highway & Transportation Officials
- CP-L ##### Colorado Department of Transportation: Laboratory Manual of Test Procedures (Lab Testing Procedures)

When references to both an AASHTO and either a CP or CP-L and test procedure are given, CP or CP-L shall be used, unless the Engineering Division has stipulated to ONLY use and require AASHTO test procedures.

Materials

Pavement shall be hot mix asphalt plant mix type unless otherwise approved in writing by the Engineering Division. Materials and construction shall be in accordance with the CDOT Standard Specifications, Section 403, and the following requirements:

The hot mix asphalt shall be composed of a mixture of aggregate, filler, hydrated lime and asphalt binder. Some mixes may require polymer modified asphalt binder. Some mixes may allow up to 20% reclaimed asphalt pavement (RAP) as approved by the Engineering Division. All RAP introduced shall meet the requirements of Designing and Constructing SMA Mixtures by National Asphalt Pavement Association. Stone Mastic Asphalt (SMA) mixtures are to be used in the top lift only and are required at intersections in accordance with Federal Highway Administration, Designing and Constructing SMA Mixtures.

Experimental materials such as Warm Mix Asphalt shall be approached as a variance and is subject to the approval of the Engineering Division.

NOTE: SMA specifications are adapted from the CDOT Standard Specifications and incorporated throughout other sections of this specification.

Aggregate

Aggregates for HMA shall be of uniform quality, composed of clean, hard, durable particles of crushed stone, crushed gravel, or crushed slag. Excess of fine material shall be wasted before crushing. The material shall not contain clay balls, vegetable matter, or other deleterious substances and shall meet the following requirements:

Table 15.1: Aggregate Properties

Aggregate Test Property	Coarse: Retained on #4	Fine: Passing the #4
Fine Aggregate Angularity, CP-L 5113 Method A or AASHTO T 304 Note: Fine aggregate angularity does not apply to RAP aggregates		45% Min
Two Fractured Faces, P-45 or ASTM D 5821 SG Mixtures Top and Middle Lifts Bottom Lifts SMA Mixtures	90% Min. 80% Min. 70% Min. 100% required	
LA Abrasion, AASHTO T 96	45% Max.	
Flat and Elongated (Ratio 5:1) %, AASHTO M 283	10% Max.	
Adherent Coating (Dry Sieving) ASTM D 5711	0.5% Max.	
Sand Equivalent. AASHTO-T 176		45% Min.
Micro Deval CP-L 4211 or AASHTO T 327	18% Max	

Reclaimed Asphalt Pavement material (RAP) may be allowed and shall be of uniform quality and gradation with a maximum size no greater than the nominal aggregate size of the mix. Mixes shall not contain more than 20% RAP.

The Proposed Design Job Mix Formula (PDJMF) gradation shall be wholly within the control point gradation range set forth in the following applicable Table 15.2 for dense graded mix designs or Table 15.3 for Stone Matrix Asphalt (SMA). The Allowable Job Mix Formula (AJMF) gradation for production shall be the PDJMF gradation with the tolerances of Section 504.14 B of Designing and Constructing SMA Mixtures by National Asphalt Pavement Association applied. The PDJMF and the final AJMF gradation for production shall report all sieve sizes listed in the applicable Table 15.2 or Table 15.3.

Mineral filler for the Stone Matrix Asphalt pavement shall be limestone dust and shall meet the requirements of this subsection and have a maximum Plasticity Index (AASHTO T90) of four (4) %.

The Contractor shall submit hydrometer analysis (AASHTO T88) for the gradation of mineral filler used in the SMA mixture.

Table 15.2: Dense Graded HMA Gradation Range

Mixture Grading Sieve Size	SX (1/2" nominal)		S (3/4" nominal)		SG (1" nominal)	
	Control Points	Caution Zone*	Control Points	Caution Zone*	Control Points	Caution Zone*
1 1/2"					100	
1"			100		90-100	
3/4"	100		90-100		@	
1/2"	90-100		@		@	
3/8"	@		@		@	
#4	@		@		@	39.5
#8	28-58	39.1	23-49	34.6	19-45	26.8-30.8
#16	@	25.6-31.6	@	22.3-28.3	@	18.1-24.1
#30	@	19.1-23.1	@	16.7-20.7	@	13.6-17.6
#50	@	15.5	@	13.7	@	11.4
#200**	2.0-8.0		2.0-7.0		1.0-7.0	

(% by weight passing square mesh sieves, CP-31, AASHTO T 11 & T 27)

*The caution zone is a guideline only. It is recommended that mix design gradations go above the caution zone boundaries, on the "fine" side.

**These limits shall include the required one (1) % of lime by weight.

@ These sieve sizes used only to determine the final Allowable Job Mix Formula (JMF).

Table 15.3: SMA Aggregate Gradation Range Properties

Sieve Size	Stone Mastic Grading Designation (% by weight passing square mesh sieves)			
	#4 Nominal	3/8" Nominal	1/2" Nominal	3/4" Nominal
1"				100
3/4"			100	90-100
1/2"	100	100	90-100	50-88
3/8"	100	90-100	50-80	25-60
#4	90-100	26-60	20-35	20-28
#8	28-65	20-28	16-24	16-24
#16	22-36			
#30	18-28	12-18	12-18	12-18
#50	15-22	10-15		
#200	12-15	8-12	8-11	8-11

(% by Weight Passing Square Mesh Sieves, CP-31, AASHTO T 11 & T 27) (Ref: CDOT Table 703-5)

Performance Graded Asphalt Binders

The Contractor shall provide to the Engineering Division acceptable Certifications of Compliance of each applicable asphalt binder grade from the supplier. Upon non-conformance with the specifications, the asphalt binder may be rejected as directed by the Engineering Division. When production begins, the Contractor shall, upon request, provide

to the Engineering Division a one (1) quart can of each specified asphalt binder. Additionally, when requested, the Contractor shall provide the refinery test results that pertain to the asphalt binders used during production.

Asphalt binder shall meet the requirements of the Superpave Performance-Graded Binders (PG) as presented in Table 15.4 below.

Table 15.4: Properties of Performance Graded Binders

Usage for each Binder Grade	PG 58-28	PG 64-22	PG 76-28
Traffic Loading, Total 18 kip ESALs Over Design Life (Usually 20 Years)***	Low Volume (0-100,000)	100,000 to <10.0 Million	3.0 Million to <10 Million
Superpave Compactor Design gyrations Recommended Usage	N _{design} = 50	N _{design} = 75	N _{design} = 100
Property of Binder Grade	PG 58-28	PG 64-22	PG 76-28
Flash Point Temperature, °C, AASHTO T 48	230 Min.	230 Min.	230 Min.
Viscosity at 135 °C, Pas, ASTM D 4402	3 Max.	3 Max.	3 Max.
Dynamic Shear, Temperature °C, where $C^{\circ}/\sin\delta @ 10 \text{ rad/sec.} \geq 1.00 \text{ KPa}$, AASHTO TP 5	58 °C	64 °C	76 °C
Rolling Thin Film Oven Residue Properties, AASHTO T 240			
Mass Loss, %, AASHTO T 240	1.00 Max.	1.00 Max.	1.00 Max.
Dynamic Shear, Temperature °C, where $G^{\circ}/\sin\delta @ 10 \text{ rad/sec.} \geq 2.20 \text{ KPa}$, AASHTO TP 5	58 °C	64 °C	76 °C
Elastic Recovery ¹ , 25°C, % Min.*	N/A	N/A	50 Min.
Pressure Aging Vessel Residue Properties, Aging Temperature 100 °C AASHTO PP1			
Dynamic Shear, Temperature °C, where $G^{\circ}/\sin\delta @ 10 \text{ rad/sec.} \leq 5,000 \text{ KPa}$, AASHTO TP 5	19 °C	25 °C	28 °C
Creep Stiffness @ 60 sec Test Temperature °C, AASHTO TP 1	-18 °C	-12 °C	-18 °C
S, MPa, AASHTO TP 1	300 Max.	300 Max.	300 Max.
m-value, AASHTO TP 1	0.300 Min.	0.300 Min.	0.300 Min.
**Direct Tension Temperature in °C, @ 1.0 mm/min., Where Failure Strain >1.0%, AASHTO TP 3	-18 °C	-12 °C	-18 °C

* Elastic Recovery by Task Force 31, Appendix B Method.

** Direct tension measurements are required when needed to show conformance to AASHTO MP.1.

*** Engineering Division is to determine PG Binder.

*** Use PG Binder 76-28 for all Major Arterial surface course.

Tack Coat

When tack coat is specified on the plans or required by the Engineering Division, the materials and construction shall be in accordance with the requirements of the CDOT Standards Specifications, Section 702. The emulsified asphalt, for Tack Coat shall be CSS-1h or SS-1h and conform to AASHTO M208 or M140.

Reclaimed Asphalt Pavement

- Reclaimed Asphalt Pavement (RAP) may be allowed in the HMA mixture by the Engineering Division.
- It shall be of uniform quality and gradation with a maximum size particle no greater than the maximum size allowed in the HMA mixture.
- HMA mixtures containing RAP shall meet the same gradation requirements as a virgin HMA mix.
- The Engineering Division may allow mixtures with a maximum of 20% RAP of any HMA pavement. RAP is not allowed in Stone Mastic Asphalt Mixtures, except by agreement by the Engineering Division.

The reclaimed asphalt pavement shall meet all the requirements for HMA pavement, as contained herein. The Contractor shall have an approved mix design for RAP to be used prior to placement.

The Engineering Division may require the Contractor to maintain separate stockpiles for each type of RAP material. All processed material shall be free of foreign materials and segregation shall be minimized. Any RAP material that cannot be readily broken down in the mixing process, and/or affects the paving operation, shall be processed prior to mixing with the virgin material.

Fine Aggregate Angularity requirements shall not apply to any RAP aggregate. The RAP will not contain clay balls, vegetable matter, or other deleterious substances.

Verification testing for asphalt content and gradation will be performed on RAP at the frequencies listed in Section 504.2 G of Designing and Constructing SMA Mixtures by National Asphalt Pavement Association, below. The Engineering Division may request the mix supplier's testing results on RAP at any time. In addition, the mixture shall be tested for properties as listed in Table 15.5.

When the use of RAP is allowed, the following additional conditions shall apply:

The processed RAP must be 100% passing the one and one-fourth inch (1¼) inch sieve. The aggregate obtained from the processed RAP shall be 100% passing the one (1) inch sieve. The aggregate and binder obtained from the processed RAP shall be uniform in all the measured parameters in accordance with the following schedule:

Table 15.5: Rap Aggregate Uniformity Tolerance

Element	Uniformity*
Binder Content	0.5
% Passing ¾"	4.0
% Passing ½"	4.0
% Passing 3/8"	4.0
% Passing #4	4.0
% Passing #8	4.0
% Passing #30	3.0
% Passing #200	1.5

*Uniformity is the Maximum allowable Standard Deviation of test results of processed RAP.

The Contractor shall have an approved RAP Quality Control (QC) Plan that details how the RAP will be processed and controlled. The QC plan must address the following:

- **RAP Processing Techniques.** This requires a schematic diagram and narrative that explains the processing (crushing, screening, and rejecting) and stockpile operation for normal plant operation or a specific project.
- **Control of RAP Asphalt Binder Content:** - Minimum Testing Frequency: 1/1,000 tons of processed RAP material (minimum 3 tests) for recent production of the mix type.
- **Control of RAP Gradation (CP31 or AASHTO T-30):** Minimum Testing Frequency: 1/1,000 tons of processed RAP material (minimum 3 tests) for recent production of the mix type.
- Process Control Charts shall be maintained for binder content and each screen listed, during addition of any RAP material to the stockpile. The Contractor shall maintain separate control charts for each RAP stockpile. The control charts shall be displayed and shall be made available to the Engineering Division upon request.

Example of Rap Quality Control Plan

Initial quality control of the reclaimed asphalt pavement shall be performed prior to and during crushing. Material for reclamation shall be separated by quality and source before being accepted for processing. Reclaimed asphalt must be free of concrete, dirt, and organic materials. These stockpiles shall be built from the ground up, completely mixing all loads as they come in.

Crushing of the reclaimed asphalt pavement shall be accomplished by means of a cone crusher and a screen deck. Oversize material shall be rejected on a three-fourths ($\frac{3}{4}$) inch scalping material, which reprocesses the material through the cone additional times. The processed material shall be stockpiled at the crushing facility and kept in separate piles and separate from other products to prevent intermingling of products, as well as the feed bins to prevent intermingling of the aggregates.

The reclaimed asphalt pavement material shall be sampled during the crushing operations according to AASHTO T 2 at frequencies greater than 1/1000 tons and tested for gradation and asphalt content in accordance with AASHTO T 27 AND T11, and AASHTO T 308. Testing shall be done randomly daily to ensure conformance to specifications.

The reclaimed asphalt pavement material at the asphalt plant shall be again sampled and tested according to the appropriate procedures to ensure that the asphalt content and gradation meet specifications and represent initial quality control data. Once data is collected, a statistical analysis shall be performed to determine the blend for the asphalt mixture design. This analysis shall be provided with the Asphalt Mixture Design submittal. The RAP will meet the Uniformity Specification of Table 15.6 above.

The RAP system at the asphalt plant consists of a feed bin with a variable speed motor controlled by the plant computer, which ensures the proper quantity of RAP material called for by the mix design. Material is delivered to the asphalt-mixing chamber of the asphalt plant by means of conveyor belts. The RAP material falls from one conveyor to another through a shaker screen that serves to break up any RAP material that has recompacted. Any oversize material shall be rejected at the shaker screen. While in production, the front-end loader shall work the full face of the stockpile, to ensure a representative batch is being produced.

Prior to starting a project and at any other time necessary, the RAP feed system shall be calibrated by placing an amount of RAP measured by certified external scales into the feed bin. That measured material is fed from the RAP bin across the belt scales. The weights are compared and, if outside of accepted tolerances for the blending system, adjustments are made by the plant-blending computer. This process is the same for all other components of the mix design.

15.7.2 Mix Design & Plant Produced Mixture Requirements

The mix design materials shall be those listed and used for the project. No substitutions are allowed during production, unless approved by the Engineering Division.

The Contractor shall indicate the project specific criteria concerning mix design method, traffic level, asphalt binder type, mixture grading, and maximum amount of RAP allowed. This information shall be provided on Mix Design, or other construction documents.

Grading SG (1-inch nominal aggregate) shall only be designed using the 150 mm Superpave molds. Hveem Stability and Lottman test are not required for Grading SG mixtures. Grading S and SX shall be designed using 100 mm Superpave molds.

Superpave Mixture Design Method

The Contractor shall submit a Proposed Design Job Mix Formula (PDJMF) for each mixture required by the Contract. The mixture design shall be determined using AASHTO T-312 or Colorado Procedure CP-L 5115 for the Superpave Method of Mixture Design. Guidance is provided in "Superpave Level 1 Mix Design" SP-2 published by the Asphalt Institute. Mixture design and field control testing shall meet the following requirements of Table 15.6: Superpave Mixture Properties for Dense Graded HMA.

Mixture design and field control testing of SMA shall meet the following requirements of Table 15.6.

Table 15.6: Superpave Mixture Properties for Dense Graded HMA

Property or Test	Traffic Levels (ESALs)		
Traffic Loading, Total 18 kip ESALs Over Design Life (Usually 20 Years)	Low (0-100,000)	Medium (100,000 to <3.0 Million)	High (3.0 Million to <30 Million)
Design gyrations, N design (Air Void: 3.5% to 4.5%) (See Note 1,2)	50	75	100
Air Voids in Total Mix (VTM) CPL 5115 or AASHTO T 312	(See Note 1)	(See Note 1)	(See Note 1)
Hveem Stability CP-L 5106 or AASHTO T 246 (Grading S & SX only) (See Note 3)	N/A	28 Min.	30 Min.
Voids Filled with Asphalt (VFA), MS2	70-80	65-78	65-75
Lottman, Tensile Strength Ratio, % Retained, CP-L 5109 or AASHTO T 283, Method B	80 Min.	80 Min.	80 Min.
Lottman, CP-L 5109 or ASHTO T 283 Dry Tensile Strength, psi	30 Min.	30 Min.	30 Min.
See Notes 2,3,4 VMA %. CP-48 or AASHTO PP 19	Minimum VMA criteria applies to the mix design only (Table 500- 7). The minimum VMA criteria shall be linearly interpolated based on actual air voids. See 504.14 B for production tolerances		

Note 1: Select the target Job Mix Optimum Binder Content for HMA gradings as close to 4.0% air voids as possible (3.5% to 4.5% air voids). VTM is also referred to as Pax in CPL 5115, and %Gmmx in T 312

Note 2: Maximum Theoretical Specific Gravity of mix by CP-51 or AASHTO T 209.

Note 3: Refer to Section 504.13 B for production tolerances.



Note 4: VMA shall be based on tests of the Bulk Specific Gravity of the Compacted Mix (CP-L 5103 or AASHTO T 166) and Aggregate (AASHTO T 84 & T 85) and calculated according to CP-48 or AASHTO PP 19. All mixes shall meet the minimum VMA specified in Table 15-9, below.

Table 15.7: Superpave Mixture Properties for Open Graded SMA

Property	Test Method	Value for SMA
Lab compaction (Revolutions) N Design	CPL 5115 or AASHTO T 312	100
Air Voids, % at: N Design (See Note 1)	AASHTO T 312	3.0 – 4.0
Hveem Stability	CP-L 5106 or AASHTO T 246	30 Min.
Accelerated Moisture Susceptibility, Tensile Strength Ratio, (Lottman)	CPL 5109 or AASHTO T 283, Method B	80 Min.
Dry Split Tensile Strength, psi	CPL 5109 or AASHTO T 283, Method B	30 Min.
Grade of Asphalt Binder	n/a	PG 76-28
Voids in the Mineral Aggregate (VMA) %, minimum (see note 2)	CP 48 or AASHTO PP 19	17
Drain down at Production Temperature	AASHTO T 305	0.3 maximum
% VCAMIX (See Note 3)	AASHTO PP 41-02	Less than VCADRC (See Note 4)

General Note: Copies of AASHTO PP 41-02 and MP 8-02 (for designing SMA mixes) can be obtained from the Engineering Division.

Note 1: Select the target Job Mix Optimum Binder Content for SMA grading at 3.0% to 4.0% air voids.

Note 2: VMA shall be based on tests of the Bulk Specific Gravity of the Compacted Mix (CP-L 5103 or AASHTO T-166) and Aggregate (AASHTO T 84 & T 85) and calculated according to CP-48 or AASHTO PP 19. All mixes shall meet the minimum VMA specified in **Table 15-8**, below.

Table 15.8: Minimum Voids in Mineral Aggregate (VMA) for Dense Graded HMA & Open Graded SMA, %

Nominal Maximum* Particle Size	Air Voids **		
	3.5%	4.0%	4.5%
1"	12.2	12.7	13.2
¾"	13.2	13.7	14.2
½"	14.2	14.7	15.2
SMA	17.0	17.0	17.0

* Nominal Maximum Particle Size is defined as one (1) sieve size larger than the first sieve to retain more than 10% but shall not exceed the 100% passing size. The Nominal Maximum Particle Size can vary during mix production even when the 100% passing size is constant.

** Minimum VMA criteria apply to the mix design only. The minimum VMA criteria shall be linearly interpolated based on actual air voids.

15.7.3 Mix Design Submittals

General Requirements

The Contractor shall submit all mixture designs, Certificates of Compliance, and laboratory data to the Engineering Division for approval at least seven (7) calendar days before construction is to begin. The mix design (Proposed Design Job Mix) must be approved by the Engineering Division prior to the start of construction.

Mixture designs shall be performed in a materials laboratory under the direct supervision of and shall be stamped and signed by a Professional Engineer licensed in the State of Colorado and practicing in this field. In addition, the Contractor shall submit, as part of the mixture design, laboratory data documents to verify the following:

- Source of materials.

- Gradation, specific gravity, source and description of individual aggregates and the final blend.
- Aggregate physical properties.
- Source and Grade of the Performance Graded Binder (PG Binder).
- Proposed Design Job Mix: aggregate and additive blending, final gradation shown on 0.45 power graph, optimum asphalt content.
- Mixing and compaction temperatures used.
- Mixture properties determined at a minimum of four (4) asphalt contents and interpolated at optimum and graphs showing mixture properties versus asphalt content.

Engineering Division approval of any mix design for HMA or SMA must be given prior to placement.

The Engineering Division reserves the right to verify the Contractor's mix design for each hot mix asphalt grading utilizing materials produced and stockpiled. If requested, the Contractor shall provide, at no cost, enough quantity of each aggregate, mineral filler, RAP, and additive for the required laboratory tests, by the Engineering Division. The Engineering Division may request a Certificate of Conformance or Certificate of Compliance at any time on any material used. The Engineering Division may request the mix supplier's testing results on RAP at any time.

Change in Source or Grade

Should a change in the source of Lime occur, or more than one temperature grade change on either the high or low end of Performance Graded Asphalt Binders - (PG Binder) occur, a one point verification test (at optimum asphalt content) of the mix must be performed to verify that the applicable criteria shown on Table 15.6 (Dense Graded HMA) or Table 15.8 (SMA), and Table 15.9 (VMA), is still met. If this testing shows noncompliance, a new Design Job Mix will be established and approved by the Engineering Division before the new Performance Graded Asphalt Binders (PG Binder) or Lime source is used. Any change in aggregate type or source will require a new mix design. The one-point verification test may be performed on lab mixed samples or on plant mixed samples.

Mix Production Verification

Production verification shall occur prior to the start of the project. The production verification shall be performed by LABCAT Level C certified technicians with current Certification to verify the volumetric properties of the mix. If the mix has been produced for another project within the last 90 days, data from that project can be submitted for this verification. Volumetric properties of the mix verification testing shall be within the following tolerances compared to the Proposed Design Job Mix. The mix verification test reports shall be submitted to the Engineering Division prior to mix placement.

Table 15.9: Mix Design Verification Tolerances

Air Voids	+/- 1.2%
VMA	+/- 1.2%
Asphalt Binder Content	+/-0.3%
Stability	Applicable minimum

The tolerances in this table are for mix design verification only. See Section 504.13 for production tolerances.

Prior to Paving Requirements

Engineering Division may require a construction (joint) plan to be submitted at least one week prior to paving, see Section 504.9 and 504.10 of Designing and Constructing SMA Mixtures by National Asphalt Pavement Association for joint requirements.

A minimum of two (2) weeks prior to the proposed use of any Stone Matrix Asphalt pavement on the project, the Contractor shall submit to the Engineering Division, a mix design meeting the appropriate specification requirements for the items in Table 15.8.

15.7.4 HMA Equipment**Mixing Plant**

The mixing plant shall be capable of producing a uniform material, have adequate capacity, and be maintained in good mechanical condition. Defective parts shall be replaced or repaired immediately if they adversely affect the proper functioning of the plant or plant units, or adversely affect the quality of the HMA.

Dust, smoke, or other contaminants shall be controlled at the plant site to meet all air quality requirements in the "Colorado Air Quality Control Act," Title 25, Article 7, CRS and regulations promulgated there under.

Acceptable safety equipment, approved by the Engineering Division, shall be provided by the Contractor to accommodate sampling and testing.

Hauling Equipment

Trucks used for hauling HMA material shall have tight, clean, smooth beds, or functional and maintained conveyor belt bottom that is thinly coated with a minimum amount of paraffin oil, lime solution, or other approved release agent.

Petroleum distillates such as kerosene or fuel oil will not be permitted. Each truck shall have a cover of canvas or other suitable material to protect the mixture from the weather and excessive temperature loss or cooled layers of mix in truck as covered in 504.6° C. Hauling, later in this specification.

Bituminous Pavers

Self-propelled pavers shall be provided for full lane width paving capable of spreading and finishing the HMA, material in full lane widths applicable to the typical section and thicknesses shown in the Contract and shall be equipped with:

- Anti-segregation devices.
- A vibratory screed assembly capable of being heated.

Pavers used for shoulders, patching and similar construction, not requiring fine grade control, shall be capable of spreading and finishing courses of HMA material in widths shown in the Contract without segregation.

The paver's receiving hopper shall have enough capacity for a uniform spreading operation and shall have an automatic distribution system that will place and spread the mixture uniformly in front of the screed.

The paver shall be capable of operating at forward speeds consistent with uniform and continuous laying of the mixture. Stop and go operations of the paver shall be avoided. The screed or strike-off assembly shall produce the specified finished surface without tearing, shoving, or gouging the mixture. Self-propelled pavers shall be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line and maintaining the screed at the specified longitudinal grade and transverse slope. The sensors may be contact or non-contact type

devices. The sensor shall be constructed to operate from either or both sides of the paver and shall be capable of working with the following devices when they are required for the situation:

- Grade control device at least 30 feet in length.
- Joint matching device.
- Adequate length of control line and stakes if no other type of geometric control is present.
- A straight edge at least 10 feet in length will be available to verify the crown on the screed, at the request of the Engineering Division.

The controls shall be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 %. Automatic mode should be used where possible. If the automatic controls fail or malfunction, the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained.

If the Contractor fails to obtain and maintain the specified surface tolerances, the paving operations shall be suspended until satisfactory corrections, repairs, or equipment replacements are made.

Placement of HMA on a waterproofed bridge deck shall be accomplished with equipment that will not damage the membrane or protective covering.

Mixing

The dried aggregates and asphalt binder shall be combined in the mixer in the quantities required to meet the design job mix. The materials shall be mixed until the aggregate is completely and uniformly coated, and the asphalt binder is uniformly distributed throughout the aggregate. Baghouse fines shall be fed back to the mixing plant in a uniform and continuous manner to maintain uniformity in the mixture. The Baghouse, fines feeder, auger, and related equipment, shall be in good working condition and operated in accordance with manufacturer's recommendation. If the Engineering Division determines that non-uniform operation of the equipment is detrimental to the mixture, it may suspend all paving operations until the Contractor takes appropriate action.

The minimum temperature of the mixture when discharged from the mixer shall be as shown in the following table:

Table 15.10: Mixture Discharge Temperatures

Asphalt Grade	Minimum Discharge Temperature	Maximum Discharge Temperature
PG 58-28	275° F	310° F
PG 64-22	290° F	325° F
PG 76-28*	318° F	326° F

* Contractor or Binder supplier must supply production temperature as required by their product

The Contractor may provide refinery information that recommends revised discharge temperatures depending on the base binder grade or source being used. HMA mix shall be produced at the lowest temperature within the specified temperature range that produces a workable mix and provides for uniform coating of aggregates (95 % minimum in accordance with AASHTO T 195), and that allows the required compaction to be achieved.

HMA mix may be stored provided that any and all characteristics of the mixture are not altered by such storage. If storing or holding of the mixture causes segregation, excessive heat loss, or adversely affects the quality of the finished product, corrective action shall be taken. Unsuitable mixture shall be disposed of at the Contractor's expense.

When placing hot mix asphalt over bridge decks covered by waterproofing membrane, the minimum temperature of the mixture, when rolling operations begin, shall be 250° F. The job mix temperature may be increased up to 30° F to obtain this temperature.

The mineral filler for SMA shall be stored in a separate silo and added automatically in the correct proportion. The mineral filler addition equipment shall be electronically or mechanically interlocked to the aggregate feed sensors so that the proper amount of mineral filler is added whenever SMA is produced.

The SMA mineral filler shall be added at the same point the asphalt binder is added to the aggregate.

Hauling

Each truck shall use full covers (tarps) to completely protect the mix during transport at all times. The Engineering Division can reject any mix, which shows an excess or deficiency of asphalt cement, damage due to burning or overheating, an improper gradation, or thermal segregation with cold areas 10° F below the minimum discharge temperature. The Engineering Division collects all aggregate, asphalt, concrete and materials tickets and when requested, the Contractor shall provide the tickets within 24 hours.

Tack Coat

Prior to placement of HMA, a tack coat shall be applied to all existing concrete and asphalt surfaces. The material shall be in accordance with 504.2 E. The emulsified asphalt shall be diluted 1:1 with water and applied at 0.10 ± 0.01 gallons per square yard of diluted material. The Engineering Division may direct other application rates to match the age of condition of the surface. The surface prior to receiving the tack coat shall be dry and cleaned by sweeping, or other approved method, until dust, debris, and foreign matter are removed. The tack coat shall then be applied uniformly by squeegee, brooms, or distributor. Prior to paving, all water must have evaporated from the tack coat. Contaminated areas shall be cleaned, and tack coat shall be reapplied.

Prior to placement of SMA, tack coat between the existing pavement and Stone Matrix Asphalt pavement shall be placed at a rate between 0.03 and 0.05 gallons per square yard.

Placement

Hot mix asphalt shall be placed only on approved, properly constructed surfaces that are free from loose material, water, frost, snow or ice. The hot mix asphalt and tack coat shall be placed in accordance with the temperature limitations of Table 500-16 and only when weather conditions permit the pavement to be properly placed and finished as determined by the Engineering Division. Placement temperature as stated shall be increased by 5° F for each 10 miles per hour wind velocity to a maximum increased minimum placement temperature of 70 ° F.

Table 15.11: Minimum Air & Surface Temperatures Limitations or Mix Placement(HMA)

Compaction Layer Thickness	Top Layer of Pavement*		Lower Layers*	
	PG 58-28 PG 64-22	PG 76-28	PG 58-28 PG 64-22	PG 76-28
<2 inches (not recommended)	60° F	75° F	N/A	N/A
2 inches to <3 inches	50° F	65° F	40° F	50° F
> 3 inches	50° F	50° F	40° F	40° F
SG mix only	N/A	N/A	38° F	38° F

* Air temperature is taken in the shade. Surface temperature is taken on the subgrade or base. The Engineering Division may not waive the above temperature limitations for PG 76-28.

The mixture shall not be placed at a temperature lower than 245° F for mixes containing PG 58-28 or PG 64-22 asphalt, and 290° F for mixes containing polymer modified asphalt binder. Mix which is too cold or damaged by weather will be rejected.

The mixture shall be placed on an approved surface, spread, and struck off to obtain the required grade and elevation after compaction. The minimum lift thickness shall be at least three (3) times (preferably four (4) times) the nominal particle size. The un-compacted mixture should be placed approximately 10-25 % thicker than the existing surrounding mat to account for compaction based on the materials being placed. Raking is discouraged and will not be allowed except to correct major problems of grade and elevation. Casting or raking that causes any segregation will not be permitted.

On areas where the use of mechanical spreading and finishing equipment is impracticable, the mixture shall be carefully dumped, spread, raked, screened, and luted by hand tools to the required compacted thickness plus approximately 25 % based on the materials being placed. Carefully move or minimally work the HMA mix with the use of rakes, lutes, or shovels to avoid segregation. Mixtures made with modified asphalt binder require more rapid completion of handwork areas than for normal mixtures. Hauling and placement sequences shall be coordinated so that the paver is in constant motion. Excessive starting and stopping shall not be allowed. A construction joint shall be placed any time the paver stops, and the screed drops enough to cause a surface dip in violation of Section 504.13, Production Tolerances, of Designing and Constructing SMA Mixtures by National Asphalt Pavement Association; or the max temperature falls below that allowed in Section 504.12, Compaction, of the same text. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable. Echelon paving will be permitted.

Longitudinal Joints

The longitudinal joints in both a new pavement and an overlay pavement layer shall offset the joint in the layer immediately below by a minimum of six (6) inches. The joints in any pavement layer shall not fall in a wheel track or path. The joints in the top layer of new pavement, not built on top of an existing pavement, shall be located on lane lines, or as shown on the plans. Longitudinal joints shall be minimized, where feasible, with wide paving pulls or echelon paving. Joints shall be parallel to the flow of traffic and shall not cross any centerline, lane line, or edge line unless approved by the Engineering Division. The Contractor shall submit, prior to paving, a joint plan and pavement marking plan showing locations and the methods to establish a field control line. The Engineering Division must approve such plans prior to paving. The Contractor shall use a continuous string line to delineate longitudinal joints during paving as shown on the joint plan. All string lines shall be removed at the end of each day's paving.

The free edge of the paved pass shall be laid as straight as possible, to the satisfaction of the Engineering Division. This joint, if cold, shall be tack coated prior to placement of adjacent paving.

The new compacted mat shall overlap the previously placed mat no more than one and one-half (1.5) inches. Excess overlap or thickness shall not be raked or cast onto the new mat but shall be wasted by pulling back and removing. The hot edge shall be blocked or bumped in a smooth line consistent with the previous longitudinal edge. Minor raking will only be allowed to correct major grade problems or provide mix around manholes and meter covers. The longitudinal joint shall be rolled from the hot side and overlap the joint by approximately six (6) inches on the cold side.

Transverse Joints

The Contractor shall submit, prior to paving, a joint plan showing location and the methods to be used to construct transverse joints. The Engineering Division must approve such plans prior to paving. Placing of the HMA shall be continuous with a minimum of transverse joints, and rollers shall not pass over the unprotected end of a freshly laid mixture. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. Tack coat material shall be applied to contact surfaces of all joints just before additional mixture is placed against the previously compacted material.

The end of transverse joints shall be located so they will be constructed with a full head of mix in front of the screed. When butt joints are constructed, runoff boards shall be used to support the roller on the downstream side of the joint. All tapered sections, rounded edges and segregated areas shall be removed to achieve a vertical face at the butt joint before paving is restarted. When a temporary tapered joint is required for temporary traffic access, the ramp shall be removed back to a full depth section before paving is restarted.

When restarting paving operations, the paver screed shall be placed on the starter block on the completed side of the transverse joint. The starter block should be approximately 25% greater than the thickness of the existing completed mat, so that adequate grade and compaction can be achieved on starting the paving operation. The screed should be nulled (angle removed) when on starting blocks and an up angle of attack set. Proper head of mix should be introduced into the paver prior to starting. The new compacted (downstream) side of the joint may be up to 3/16 inches higher than the old (upstream) side. Raking of this joint shall not be allowed except to correct major grade problems. The surface tolerance at the transverse joint must be verified by the Contractor with a 10-foot straight edge before the paver is more than 100 feet from the joint. If the surface tolerance is not within 3/16 inches, the Contractor shall make corrections before proceeding.

Segregation

The asphalt mixture shall be transported and placed on the roadway without segregation. All segregated areas shall be removed immediately and replaced with specification material before the initial rolling. If more than 50 square feet of segregated pavement is removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source of the segregation has been determined and corrected.

The Engineering Division will visually determine areas that are segregated and may also use density and gradation measures to help in this determination. The Engineering Division will visually determine the extent of the segregation. The Contractor will not be allowed additional compensation for correction of segregated areas.

Compaction

The temperature of the mixture immediately behind the screed shall be sufficient to allow for proper compaction of the HMA layer and at least 245° F for PG 64-22 binder, bottom lift and between 297° F and 305° F for PG 76-28 binder, top lift. The breakdown compaction should be completed as quickly as possible after placement occurs.

The HMA shall be compacted by rolling. The number, weight, and type of rollers furnished shall be sufficient to obtain the required density and surface texture while the mixture is in a workable condition. Compaction shall begin immediately after the mixture is placed and be continued until the required density is obtained. Final compaction shall be obtained using steel wheel rollers.

Pavement operations shall be suspended when density requirements are not met and the surface temperature falls below 185° F, or there is obvious surface distress or breakage, the problem shall be resolved prior to continuing paving operations. The criteria for mixtures containing PG 76-28 asphalt cements shall be 235° F. The minimum compaction temperatures may be adjusted according to the asphalt binder supplier recommendations. Adjusted minimum compaction temperatures must be shown on the approved mix design or on other asphalt binder supplier documents and be available on the job site.

All roller marks shall be removed with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted on bridge decks.

The Contractor shall establish a rolling pattern or procedure during the beginning of paving operations, which will achieve the required compaction and surface tolerances. This procedure may be re-evaluated by the Contractor and Engineering Division throughout the paving operations.

All HMA paving shall be compacted to $94.0 \pm 2\%$ of Maximum Theoretical (RICE) Density, (CP-51 or AASHTO T-209: Maximum Specific Gravity of Bituminous Paving Mixtures) as determined by ASTM D 2950. RICE values shall be used in calculating Relative Compaction according to CP-44 or AASHTO T 166. The Contractor shall determine the proper RICE value to use for the initial day's placement. Subsequent day's RICE value(s) will be based on the current day's production. The Contractor shall provide the producer's RICE value, which shall be used for production until the actual day's RICE value is determined by the testing firm of record for the project as approved by the Engineering Division.

All joints shall be compacted to $92.0 \pm 2\%$ of RICE, taken fully on each side of joint, every 200 Linear Feet. RICE values shall be used in calculating Relative Compaction according to AASHTO T 166, Cores if needed will be used to verify compaction results.

The Contractor shall core the pavement, as required by the Engineering Division, for field density tests in accordance with Colorado Procedure 44 or AASHTO T 230, Method B, or for field calibration of nuclear density equipment in accordance with the ASTM D 2950. At a minimum, cores for nuclear density equipment calibration shall be taken at the beginning of placement of each pavement layer or change of mixture materials or gradation. Untested areas during placement will also require cores to be taken to verify compaction.

Along forms, curbs, headers, walls, and all other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be immediately removed and replaced with fresh hot mixture and compacted to conform to the surrounding area.

Compaction requirements for SMA are covered in Section 504.8 E of Designing and Constructing SMA Mixtures by National Asphalt Pavement Association. Rollers shall not be used in a vibratory mode on SMA unless they are first used successfully in the demonstration control strip. Pneumatic wheel rollers shall not be used on SMA Mix.

Production Tolerances

Top Lift Surface Tolerances

The surface variation between any two (2) contacts shall not exceed three-sixteenths ($3/16$) inch in 10 feet for full lane width paving. For patching surface tolerances, the variation shall not exceed three-eighths ($3/8$) inch in 10 feet.

Irregularities exceeding the specified tolerance shall be corrected at the Contractor's expense. Transverse measurements for variations shall exclude breaks in the crown sections.

Job Mix Formula Tolerances

Production test results that deviate from the design job mix by more than shown in the following table are subject to Section 504.13 C of Designing and Constructing SMA Mixtures by National Asphalt Pavement Association:

Table 15.12: Job Mix Formula Tolerances

Item	Tolerances
Passing No. 3/8" and Larger (Note 1)	± 6%
Passing No. 4 and No.8	± 5%
Passing No. 30 to No. 50	± 4%
Passing No. 200 (Note 2)	± 2%
Air Voids	± 1.2%
VMA (Note 4)	± 1.2%
Hveem Stability	(Note 3)
Asphalt Content	± 0.3%

Note 1: There is one (1.0%) tolerance for the maximum sieve size.

Note 2: Mixes with passing No. 200 sieve material produced over seven (7.0) % are allowed only when the above Air Voids and VMA tolerances are still met.

Note 3: Hveem Stability must meet the minimum value specified in Table 15-8.

Note 4: When calculating VMA, use the most current aggregate specific gravity Gsb.

When disagreements concerning determination of specification compliance occur, only valid tests from both the Engineering Division and Contractor will be considered. The Engineering Division shall determine validity. Generally, valid tests are those in which sampling and testing have been performed according to referenced procedures and the results are within stated precision statements. When disagreements occur with asphalt content and gradation tests results, solvent extracted aggregate testing shall take precedence over burn off oven extracted aggregate, which shall take precedence over cold feed belt testing.

Grinding

Grinding shall consist of milling, grinding, or cold planing the existing pavement surface to establish a new surface profile and cross-section in preparation for a bituminous overlay. After grinding, the surface shall have a grooved or ridged finish, uniform and resistant to raveling or traffic displacement. This textured surface shall have grooves of one-quarter inch (1/4") plus or minus one-eighth inch (+1/8).

Wedge cut grinding shall consist of grinding the existing pavement surface a minimum of four feet (4') wide at the existing concrete gutter. The edge of the gutter end of the finished wedge cut shall be one-and-one-half inches (1-1/2") below the edge of the existing concrete gutter. The centerline of the street edge of the wedge cut will be cut one-eighth inch (1/8"). The depth of cut shall be determined by measuring to the top of the ridges by placing a five-foot (5') straight edge perpendicular to the grooving pattern. Full-width grinding shall consist of grinding the existing pavement surface from edge of gutter to edge of gutter to a minimum depth of two inches (2") unless otherwise directed by the Engineering Division.

In grinding around utility castings, the Contractor may choose to remove the entire existing bituminous pavement around the castings where grinding is not completed and replace it with bituminous surface course placed and compacted in three-inch (3") lifts. The Contractor shall vertically cut the limits of the area to be patched, mechanically compact the existing base course, and prime the bottom and vertical edges before backfilling. The Contractor shall remove the cuttings immediately behind the grind machine by belt loader, end loader, power sweeper and/or by hand. The removed material shall be disposed of as approved by the Engineering Division.

The grinding machine shall be a power-operated, self-propelled machine having a cutting drum with lacing patterns that will attain a grooved surface and produce grinding chips of less than one inch (1") in size. The grinding machine

shall be equipped with a pressurized watering system for dust control. The equipment shall be a type that has successfully performed similar work.

The cleaning equipment shall be a type which will efficiently remove all loosened material and load into trucks for hauling and spreading. Because of the nature of the streets to be ground and the traffic restrictions, a belt loader followed by a power sweeper and manual sweeper is the most desirable method. Flushing into the City's storm sewer system as a means of clean-up will not be allowed.

Grinding shall consist of "milling", "grinding", or "cold planing" the existing pavement surface to establish a new surface profile and cross section in preparation for a bituminous overlay. After grinding, the surface shall have a grooved or ridged finish, uniform and resistant to raveling or traffic displacement. This textured surface shall have grooves of one-fourth ($\frac{1}{4}$) inch plus or minus one-eighth ($\frac{1}{8}$) inch. The existing surface to be ground shall include bituminous pavement, concrete utility patches, and a small amount of concrete pavement.

"Wedge cut" grinding shall consist of grinding the existing pavement surface a minimum of four (4) feet wide at the existing concrete gutter. The edge of the gutter end of the finished wedge cut shall be one and one-half ($1\frac{1}{2}$) inches below the edge of the existing concrete gutter. The center line of street edge of the wedge cut shall be cut one-eighth ($\frac{1}{8}$) inch. The depth of cut shall be determined by measuring to the top of the ridges by placing a five (5) foot straight edge perpendicular to the grooving pattern. "Full width" grinding shall consist of grinding the existing pavement surface from edge of gutter to edge of gutter to a minimum depth of two (2) inches, unless otherwise directed by the Engineering Division.

Grinding around utility castings to the depth of cut before and after encountering the castings shall be included in the area of the pavement surface ground. The Contractor may choose to remove the entire existing bituminous pavement around the castings where grinding is not completed and replace it with bituminous surface course placed and compacted in three (3) inch lifts. The Contractor shall vertically cut the limits of the area to be patched, mechanically compact the existing base course, and prime the bottom and vertical edges before backfilling.

The grinding machine shall be a power operated, self-propelled machine, having a cutting drum with lacing patterns that shall attain a grooved surface and produce grinding chips of less than one (1) inch in size. The grinding machine shall be equipped with a pressurized watering system for dust control. The equipment shall be a type that has successfully performed similar work.

The Contractor shall remove the cuttings immediately behind the grind machine by belt loader, end loader, power sweeper and/or by hand. The removed material shall be disposed of as approved by the Engineering Division.

The cleaning equipment shall be a type which shall efficiently remove loosened material, load it into trucks for hauling and spreading, and utilize a watering system for dust control. Because of the nature of the streets to be ground and the traffic restrictions, a belt loader followed by a power sweeper and manual sweeper is the most desirable method.

Flushing into the City's storm sewer system as a means of cleanup shall not be allowed.

15.8 Portland Cement Concrete Pavement

15.8.1 General

Furnishing all tools, transportation, labor, equipment, accessories, services and material, and in performing all operations in constructing a single course of air-entrained Portland cement concrete pavement constructed on a prepared subgrade shall be in accordance with the CDOT Standard Specifications for Road and Bridge Construction (Latest Edition). Portland Cement Concrete Pavements will only be allowed if approved in writing by the Engineering Division.

15.8.2 Concrete Pavement

The installation of concrete pavement, including materials, equipment, foundation, and construction methods shall be in conformance with Section 412, "Portland Cement, Concrete Pavement" of the CDOT Standard Specifications, except as modified herein or as modified by the approval of the Engineering Division.

Concrete pavements shall only be designed where approved by the Engineering Division. It shall be installed as shown on the accepted plans. When concrete pavement is constructed on a curve, flexible forms shall be used having a radius of 200 feet or less, unless otherwise directed by the Engineering Division. The Contractor shall furnish steel pins to use in setting grades for concrete pavement.

This material shall consist of a mixture of coarse and fine aggregates, Portland cement, fly ash, water and other materials or admixtures as required. CDOT Class "D" mix shall be used.

- Portland cement shall comply with the CDOT requirements. The type of cement shall be Type II or Type II Modified unless sulfate conditions dictate otherwise. Table 2.2.3 in Chapter 2.2 of ACI 201 indicates recommendations for sulfate resistance.
- Fine aggregates shall meet CDOT Standard Specifications, Section 703.01 requirements.
- Coarse aggregates shall meet CDOT Standard Specifications, Section 703.02 requirements.
- Fly Ash shall comply with CDOT Standard Specifications, Section 701.02 if use is approved by Engineering Division.
- Water shall meet the requirements of CDOT Standard Specifications, Section 712.01.
- Air entraining and chemical admixtures shall meet the requirements of CDOT Standard Specifications, Section 711.02 and 711.03. No chloride containing additives shall be permitted.
- Curing materials shall be white pigmented liquefied membrane curing compound and meet the requirements of AASHTO M 148.
- Reinforcing steel shall meet the requirements of CDOT Standard Specifications, Section 709.01, grade 40 minimum.
- Minimum compressive strength shall be 4000 psi; minimum modulus of rupture or flexural strength shall be 600 psi.

15.8.3 Aggregate Base Course Material

This material shall consist of hard, durable particles or fragments of stone or gravel, crushed to required sizes, containing an appropriate quantity of sand or other finely divided mineral matter which conform to the requirements of AASHTO M 147, and to Section 703.03, CDOT Standard Specifications. In addition, the material shall have an R-value of 78 or greater or a CBR of 80 or greater and shall be moisture stable. Moisture stability is determined by R-value testing which shows a drop of 12 points or less in R-value between exudation pressures of 300 psi and 100 psi.

Only aggregate from approved sources shall be used. Approval of sources shall be at the discretion of the Engineering Division and submissions shall, at a minimum, consist of supplying documented gradation, Atterberg limits and CBR/R-value testing on an annual basis. Only two (2) types of crushed aggregate base course are acceptable. The gradation specifications for these two types of base course are listed below:

Table 15.13: Aggregate Base Course Materials & CDOT Specification

Sieve Designation	% Passing by Weight	
	Class 5	Class 6
1½"	100	---
1"	95-100	---
¾"	---	100
No. 4	30-70	30-65
No. 8	---	25-55
No.200	3-15	3-12
Liquid Limit (LL)	30, Maximum	30, Maximum

15.9 Materials & Construction Practices

15.9.1 Curing

Finishing and consolidation shall be performed per CDOT Standard Specifications. Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with the following methods. In all cases in which curing requires the use of water, the curing shall have prior right to all water supply or supplies. Failure to provide sufficient cover material or lack of water to adequately take care of both curing and other requirements shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than one-half (1/2) hour between stages of curing or during the curing period.

Impervious Membrane Method

The entire surface of the pavement shall be sprayed uniformly with an accepted white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. Curing compound shall be applied under pressure at the rate of one (1) gallon to not more than one hundred-and-fifty (150) square feet by mechanical sprayers. The spraying equipment shall be the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand-spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. Curing compounds shall not be applied to the inside faces of joints yet to be sealed.

Membrane-curing compounds shall be wax base Protex DW3 or equal and meet the requirements of AASHTO M 148, Type 2, latest edition. Should the film become damaged from any cause within the required curing period, the damaged portions shall be repaired immediately with additional compound. Upon removal of side forms, the side of the slabs exposed shall be protected immediately to provide a curing treatment equal to that provided for the surface.

Wet Burlap Curing

After completion of the finishing operations, the surface of the concrete shall be entirely covered with burlap mats. The mats used shall be in such length or width that as laid they will extend at least twice the thickness of the concrete beyond the edges of the slab or structure. They shall be placed so the entire structure and all edges of the concrete, when forms are removed, are completely covered. This covering shall be placed as soon as the concrete has set sufficiently to prevent marring of the surface. After being placed, the mats shall be thoroughly saturated with water by spraying with a mist spray. The burlap shall be placed and weighted down so it remains in contact with the surface covered and covering shall be maintained fully wetted and in position for seven (7) days after the concrete has been placed. If it becomes necessary to remove the burlap for any reason, the concrete shall not be exposed for a period of more than one-half (1/2) hour. This method of curing shall not be used when the outside air temperature is below thirty-two degrees Fahrenheit (32o F) unless heated enclosures are provided.

Plastic Sheet Curing

As soon after the completion of the finishing operation as the concrete has set sufficiently to prevent marring of the surface, the top surface and sides shall be entirely covered with plastic sheet materials. The plastic sheet as prepared for use shall have dimensions such that each unit as laid will extend beyond the edges of the concrete at least twice the thickness of the concrete. The units as used shall be lapped at least twelve inches (12") and the laps of plastic sheet shall be secured in such a manner that they do not open or separate. The plastic shall be placed and weighted so it remains in contact with the surface covered during the entire curing period of seven (7) days.

Waterproof Paper Curing

The procedures used for plastic sheet curing shall be used when waterproof paper is used in curing concrete.

Insulation Pad

Insulation pads or other thermal devices may be used to protect concrete in cold weather.

Other

Other acceptable curing methods may be used upon review and acceptance by the Engineering Division.

15.9.2 Curing in Cold Weather

When the air temperatures may be expected to fall below thirty-five degrees Fahrenheit (35o F), the Contractor's written, detailed proposal for protecting the concrete must be accepted by the Engineering Division before commencement of the paving operation. A sufficient supply of straw, hay, grass or other suitable material shall be provided along the work. The methods and materials used shall be such that a minimum temperature of forty-degree Fahrenheit (40o F) will be maintained at the surface of pavement. Acceptance of the Contractor's proposed method shall not relieve the Contractor of the responsibility for the quality and strength of the concrete placed during cold weather. Any concrete damaged by frost action shall be removed and replaced at the Contractor's expense. During paving operations, day or night, when the air temperature reaches thirty-five degrees Fahrenheit (35o F) and is falling, placement of concrete shall cease, and the previously approved protection method shall be initiated. All concrete placed within the previous seventy-two (72) hours shall be protected for a minimum of five (5) days after initial placement of the concrete.

Admixtures for curing or temperature control may be used only when permitted by the Engineering Division.

When concrete operations have been completed, the Contractor shall be responsible for the clean-up and removal of all leftover or waste materials resulting from any of his activities. All curbs shall be properly backfilled, and the adjacent ground left in an acceptably neat and presentable condition.

15.9.3 Protection Against Rain

In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor shall be required to have materials available at all times for the protection of the edges and surface of the unhardened concrete. Such protective materials shall consist of standard metal forms or wood plank having a nominal thickness of not less than two inches (2") and a nominal width of not less than the thickness of the pavement at its edge for the protection of the pavement edges and covering material such as burlap or cotton mats, curing paper, or plastic sheeting material for the protection of the surface of the pavement. When rain appears imminent or when requested by the Engineering Division, all paving operations shall stop, forms shall be placed against the sides of pavement and protective covering shall be placed over the surface of unhardened concrete.

15.9.4 Opening to Traffic

Opening to traffic, including the Contractor's vehicles, shall not be permitted until the flexural strength of the concrete, as indicated by the modules of rupture of beams tested in conformity with the latest ASTM Standard Method of Test for "Flexural Strength of Concrete Using Simple Beam With Third-Point Loading." Designation C-78 is at least five hundred (500) pounds per square inch or the compressive strength of six-inch by 12-inch (6" x 12") cylinders, tested in conformity with the latest ASTM Standard Method of Test for "Compressive Strength of Molded Concrete Cylinders." Designation C-39 is at least three thousand (3000) pounds per square inch. These tests shall be performed when the concrete is seven (7) days old unless otherwise requested by the Contractor. If permanent shoulders are not in place, a six-foot (6') wide temporary earth shoulder shall be placed against the outside pavement edges before traffic is allowed on the pavement. Opening to traffic shall not constitute a final acceptance of the pavement.

15.9.5 Defects

The City will allow either flexural or compressive Quality Control Testing at the Contractors expense. The Contractor shall be responsible for process control testing of all elements of the project. Before final inspection and acceptance, tolerances and smoothness shall be tested by means of surface-testing machine or a straightedge applied to each separate lane of pavement. All surface variations of one-eighth inch (1/8") or more in ten feet (10') shall be ground off. Brush-hammering shall not be permitted. Sections of pavement containing depressions with a depth in excess of one-eighth inch (1/8") in ten feet (10') shall be removed and replaced at the Contractor's expense. Such removed sections shall not be less than full-lane width and full distance between joints in length. Slabs containing excessive cracking, fractures, spalling or other defects shall be removed and replaced as above, when directed by the Engineering Division.

15.10 Utility Pothole Repair

15.10.1 General

Contractor shall be required to restore all utility potholes in a timely fashion as determined by the Engineering Division or designee. Potholes located in pavement sections must be backfilled with approved Controlled Low Strength Material (refer to Section 9.3.4). Potholes located in concrete pavement sections require replacement of entire concrete panel section. Potholes located in asphalt pavement sections require replacement of a minimum of 2 foot by 2-foot section. Refer to Section 5.8 for pavement depth requirements.

15.11 Bridges & Major Drainage Structures

15.11.1 General

- All culvert pipe, box culverts, and bridges which will ultimately be maintained by the City of Northglenn shall conform to the following:
- AASHTO "Standard Specifications for Highway Bridges," latest edition, and applicable interims.
- Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction," latest edition.
- Colorado Department of Transportation's "Bridge Manual," Volumes I and II
- All structures shall be designed to an HS-20 loading.
- All box culverts and bridges shall have the year of construction permanently indentured on the downstream headwall face in legible numbers. The numbers shall be three inches (3") high by one-and-one-half inches (1-1/2") deep in the headwallface.
- All box culvert and bridge designs shall be certified by a Professional Engineer registered in the State of Colorado who is competent to perform such designs.

15.12 Material Specifications

15.12.1 Subbase

Subbase material, if allowed, shall be composed of granular material consisting, essentially, of sand, gravel, rock, slag, disintegrated granite or a combination of such materials. The coarse portions of the material shall be sound fragments of the crushed or uncrushed materials enumerated above. Supplied material shall be a well-graded mixture containing sufficient soil mortar, crushed dust or other proper quality binding material which, when placed and compacted in the roadway structure, will result in a firm, stable foundation. Material composed of uniform size particles or which contains pockets of excessively fine or excessively coarse material, will not be acceptable for use.

This material need not be crushed but shall be graded within the following limits:

Table 15.14: Classification Table for Subbase

Sieve Size	% Passing
2-1/2 Inch Screen	100
2-Inch Screen	95-100
#4 Mesh Sieve	30-60
#200 Mesh Sieve	5-15

Note: Liquid Limit -- 35 Maximum
Plasticity Index -- 6 Maximum

15.12.2 Base

Base material, if allowed, shall consist of a foundation course composed of crushed gravel or crushed stone and filler constructed on the prepared subgrade or subbase course. Materials and construction shall be in accordance with the requirements of the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction," Section 703. Gradation shall be Class 6 (3/4-inch maximum) in accordance with the following gradation:

Table 15.15: Classification Table for Aggregate Base Course

Sieve Size	% Passing
3/4 Inch Screen	100
#4 Mesh Sieve	30-65
#8 Mesh Sieve	25-55
#200 Mesh Sieve	3-12

Note: Liquid Limit -- 30
Maximum Plasticity Index -- 6
Maximum R- Value Minimum -- 78

15.13 Bituminous Materials & Pavements

15.13.1 Prime Coat

Materials shall be in accordance with the requirements of the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction."

15.13.2 Hot Bituminous Pavement

All pavements shall be hot bituminous pavement of the plant mix type unless otherwise approved in writing by the Engineering Division. Materials shall be in accordance with the Colorado Department of Transportation's "Standard

Specifications for Road and Bridge Construction”, Sections 702 and 703, and the following exceptions and/or requirements:

- The asphalt cement shall be Superpave Performance Graded Binders and shall conform to the requirements listed in table 702-2 of the Colorado Department of Transportation’s “Standards and Specifications for Road and Bridge Construction” (Taken from AASHTO Provisional Standard MP1) and the following:
 - On arterial streets the grade of asphalt cement for the top layer shall be PG 76-28 (Polymer Modified). The bottom layers may be PG 64-22.
 - On all other street classifications, the grade of asphalt cement for the top layer shall be PG 64-28 (Polymer Modified). The bottom layers may be PG64-22.
- The top layer of asphalt shall be a stone matrix asphalt (SMA) or hot bituminous pavement (HBP) Grading SX. The lower layers may consist of HBP Grading SG or HBP Grading S. SMA mixes will only be required as determined by the Engineering Division. The minimum layer thickness shall be 1.5 inches and each layer should be a minimum of two times the maximum aggregate size.

15.13.3 Tack Coat

When is specified on the accepted plans or required by the Engineering Division, all materials shall be in accordance with the requirements of the Colorado Department of Transportation’s Standard Specifications for Road and Bridge Construction. Bituminous material shall be SS-1h emulsion.

15.13.4 Seal Coat

When seal coat is required, all materials shall be in accordance with the requirements of the Colorado Department of Transportation’s Standard Specifications for Road and Bridge Construction. The type of bituminous material cover aggregate and rates of application will be as shown on the accepted construction plans.

15.13.5 Rejuvenating Agent

When a rejuvenating agent is specified on the accepted construction plans or required by the Engineering Division, all materials shall be in accordance with the requirements of the Colorado Department of Transportation’s Standard Specifications for Road and Bridge Construction. The rejuvenating agent shall be as shown on the accepted construction plans or as specified by the Engineering Division.

15.13.6 Appurtenant Structures Concrete

Concrete used in the construction of curb, gutter, sidewalk, drive cuts and other appurtenant roadway concrete structures shall be in accordance with **Chapter 6 – Earthwork & Erosion Control** of these STANDARDS AND SPECIFICATIONS.

15.13.7 Structure Backfill Material

Structure backfill shall comply with Colorado Department of Transportation’s specifications for Class I material. Flowfill may be required in lieu of Class 1 backfill as determined by the Engineering Division. The requirements for flowfill are described in **Chapter 14 – Trenching, Backfilling, & Compacting – Utilities**.

15.14 Portland Cement Concrete Pavement -- Materials

15.14.1 General

Concrete materials, including fine aggregates, coarse aggregates, Portland cement, forms, reinforcing steel, water, joints, metal supports, expansion tubes, curing materials, admixtures and bonding agents shall comply with the

Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction (Latest Edition). Fly ash may be used in the concrete pavement mixtures.

15.14.2 Test Specimens

The Contractor shall furnish the concrete necessary for casting test cylinders. See Table 15.16 for the cylinders test requirements.

Table 15.16: Concrete Cylinder Test Requirements

Type of Test	Frequency
Gradation (aggregate)	1 per 2500 sq. yard or fraction thereof for each size aggregate
Moisture Content, fine aggregate	1 per day or as often as needed for quality control
Moisture Content, coarse aggregate	1 per day minimum where moisture content is ± 0.5 percent from SSD condition
Slump	1 per set of cylinders and as often as needed for quality control
Air Content	1 per set of cylinders and as often as needed for quality control
Yield and Cement Factor	1 per set of cylinders and as often as needed for quality control
Compressive Strength	1 set of four (4) cylinders per 5000 sq. yards or major fraction thereof on each day pavement is placed, with two (2) cylinders to be field cured. One additional set shall be made if the Contractor intends to open early for traffic
Thickness	1 per 1250 linear feet each traffic lane on freshly finished concrete and as often as needed for quality control

The degree and frequencies of all concrete testing beyond normal specified frequencies, if necessary, to assure quality control, shall be determined by the Engineering Division at the time of concrete construction. All concrete testing necessary beyond normal specified frequencies to assure quality control shall be paid for by the Contractor.

15.15 Portland Cement Concrete Pavement -- Equipment

15.15.1 General

All equipment necessary for the proper preparation of the subgrade, placing, finishing and curing of the concrete pavement shall be on the project in good working condition and shall have been inspected by the Engineering Division or designed before the Contractor will be permitted to begin paving operations. Throughout construction, the Contractor shall maintain sufficient, adequate equipment to assure the proper execution of the work.

15.15.2 Roller

Final subgrade compaction shall be by means of a self-propelled roller having a weight on the rear wheels of the roller of not less than two-hundred-and-fifty (250) pounds per inch of tread. Vibratory rollers may be used with the permission of the Engineering Division. The use of rubber-tired rollers is encouraged.

15.15.3 Subgrade Planer

The subgrade planer shall have an adjustable cutting edge which shall be set to leave the subgrade at the elevation necessary to produce pavement of the thickness shown on the plans. Each end of the planer shall be supported on the

forms by means of two rollers with enough spacing to maintain stability. The planer shall be of enough weight to maintain contact with the forms during planning operations. Wheels or rollers on previously placed concrete shall be rubber-faced and shall be adjusted so that bearing on concrete shall not be less than three inches (3") from the edge of a pavement.

15.15.4 Forms

Side forms shall be made of metal except on curves of less than an one-hundred-foot (100') radius where wooden forms may be used. Forms shall have base width of not less than eight inches (8") for all forms more than eight inches (8") in height. All side forms less than eight inches (8") in height shall have a base width of not less than six inches (6"). The minimum length of each section of form used shall be ten feet (10'). Each section of form shall be straight and free from bends or warps.

The maximum deviation of the top surface of any section shall not exceed one-eighth inch (1/8"). The inside face shall not deviate more than one-fourth inch (1/4") from a straight line. The method of connection between sections shall be such that the joint thus formed shall be free from movement in any direction. Forms shall be of such cross-section and strength and so secured as to resist the pressure of the concrete when placed and the impact and vibration of any equipment which they support without springing or settlement.

Each ten-foot (10') length of form shall have at least three (3) form braces and pin sockets which shall be spaced at intervals of not more than five feet (5'), having the end brace and socket not less than six inches (6") from the end of the form.

Forms that are not required to support a mechanical finishing machine, subgrade planer or other similar heavy equipment may, upon approval of the Engineering Division, be made of wood. They shall have sufficient stiffness and be so staked to remain vertical and true to lines and grade during the placing and finishing of the concrete. Straight wood forms shall have a thickness of not less than one-and-one-half inches (1-1/2"). Wood forms used at intersection radius points may be one-fourth inch (1/4") thick. All wood forms shall be dressed on the side supporting the concrete and on their upper edge.

Curb forms, if used, shall be made of steel, except where returns of small radius or other special sections make the use of steel forms impractical. Back forms for curbs shall be rigidly attached to the side forms for the pavement slab using all the fastening provided by the manufacturer of the forms. Slip forms or curb mules may be used.

15.15.5 Vibrators

Vibratory units shall be capable of frequencies of not less than ten thousand (10,000) vibrations per minute in air and shall produce vibration in vertical and horizontal planes and ensure a downward vibration of intensity as great as in other directions to provide thorough vibration through the full depth of the concrete. The unit shall be adjustable to approximately the cross-section of the finished surface. Vibration shall not be used to cause concrete to flow or run into position in lieu of placing and shall not be prolonged to the point where segregation occurs.

15.15.6 Finishing Equipment

A screed or template shall be used to roughly strike off the first layer of concrete to permit placing of required reinforcement in the specified position.

The Contractor shall furnish an approved mechanical finishing machine of the screening and troweling type. It shall be designed and operated both to strike off and to consolidate. The finishing machine shall be of adequate strength to withstand severe use and shall be fully and accurately adjustable to make the pavement conform to the required cross-section shown on the plans. If it is necessary to operate one or both sets of wheels on previously placed concrete, they

shall be rubber-faced and shall be adjusted so that bearing on concrete will not be less than three inches (3") from the edge of the pavement.

Such additional hand equipment -- including but not limited to wooden floats, straightedges, bridges, edgers, etc. required for proper finishing -- shall be furnished by the Contractor.

15.15.7 Concrete Saw

When sawing joints, the Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing with a water-cooled diamond-edge saw blade or an abrasive wheel to the required dimensions and at the required rate. The Contractor shall provide at least one stand-by saw in good working order and meeting the same requirements as stated above. An ample supply of saw blades shall always be maintained at the site of the work during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing. All of this equipment shall be on the job both before and continuously during concrete placement.

15.16 Portland Cement Concrete Paving -- Mixing

15.16.1 General Mixing

Concrete may be mixed in a central mix plant, or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials, except water, are placed in the drum.

The time elapsing from the time water is added to the mix (or cement comes in contact with aggregate) until the concrete is deposited in place at the site of the work shall not exceed forty-five (45) minutes when the concrete is hauled in non-agitating trucks nor ninety (90) minutes when hauled in truck mixers or agitating trucks. The Contractor may use approved mixes utilizing admixtures which conform to AASHTO M 194, latest edition, Types A, B, and D. The use of AASHTO M 194 admixtures Types C and E may be used only when specifically provided for in the contract or upon written permission from the Engineering Division.

15.16.2 Stationary Mixing

When mixing or in a central mixing plant, the mixing time shall not be less than fifty (50) seconds nor more than ninety (90) seconds. Four (4) seconds shall be added to the specified mixing time if timing starts the instant the skip reaches its maximum raised position. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.

The volume of concrete mixed per batch may exceed the mixer's nominal capacity in cubic feet, as shown on the manufacturer's standard rating plate on the mixer, up to ten percent (10%) provided concrete test data for strength, segregation, and uniform consistency are satisfactory and provided spillage of concrete does not occur.

The batch shall be charged into the drum such that a portion of the mixing water shall enter in advance of the cement and aggregates. The flow of water shall be uniform, and all water shall be in the drum by the end of the first fifteen (15) seconds of the mixing period. The throat of the drum shall be kept free of accumulations that may restrict the free flow of materials into the drum.

The timing device on stationary mixers shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the Contractor will be permitted to operate while it is being repaired, provided he furnishes an approved timepiece equipped with minute and second hands. If the timing device is not placed in good working order within twenty-four (24) hours, further use of the mixer will be prohibited until repairs are made.

15.16.3 Ready-Mixed Concrete

The use of ready-mixed concrete in no way relieves the Contractor or developer of the responsibility for proportion, mix, delivery or placement of concrete. All concrete must conform to all requirements of these STANDARDS AND SPECIFICATIONS and ASTM C-94 and AASHTO M 157.

The City shall have free access to the mixing plant at all times. The organization supplying the concrete shall have sufficient plant and transportation facilities to assure continuous delivery of the concrete at the required rate. (The Contractor will collect delivery or batch, tickets from the driver for all concrete used on the project and deliver them to the Engineering Division.)

Batch tickets shall provide the following information:

- Weight and type of enforcement
- Weights of fine and coarse aggregates
- Volume (in gallons) of water, including surface water on aggregates.
- Quantity (cubic yards) per batch
- Times of batching and discharging of concrete.
- Name of batch plant
- Name of Contractor
- Type of mixture (mix designations code)
- Name and amount of admixture
- Date and truck number

15.16.4 Mixing Proportions of Concrete Materials

Proportioning shall conform to the requirements set forth in the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction (Latest Edition).

15.16.5 Limitations of Mixing

Concrete shall be mixed, placed, and finished only when the natural light is enough unless an adequate and approved artificial lighting system is provided. Unless authorized in writing by the Engineering Division, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches forty degrees Fahrenheit (40° F) and not resumed until an ascending air temperature in the shade and away from artificial heat reaches thirty-five degrees Fahrenheit (35° F).

When concreting is authorized during cold weather, the aggregates may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might injure the materials. Unless otherwise authorized by the Engineering Division, the temperature of the mixed concrete shall not be less than fifty degrees Fahrenheit (50° F) and not more than eighty degrees Fahrenheit (80° F) at the time of placing it in the forms.

If the air temperature is thirty-five degrees Fahrenheit (35°F) or less at the time of placing concrete, it will be required that the water and/or the aggregate be heated to not less than seventy degree Fahrenheit (70o F) nor more than one-hundred-fifty degrees Fahrenheit (150° F). Concrete shall not be placed on frozen subgrade nor shall frozen aggregates be used in the concrete. In concreting operations during the summer months, maximum temperature of the mixed concrete shall not exceed ninety degrees Fahrenheit (90° F).

In cold weather, aggregates and water may be heated as part of the batching operation but they shall not be heated beyond a temperature of one-hundred-fifty degrees Fahrenheit (150°F). Aggregates shall not be heated directly by gas or oil flame or on sheet metal over direct flame. Materials containing frost or lumps of frozen material shall not be used in the mix and their presence in the concrete shall be cause for rejection of that batch.

15.17 Concrete for Sidewalk & Crosspans

15.17.1 General

This specification enumerates the requirements for the materials, storage, transportation, measuring, mixing, placing and curing of Portland cement concrete. This specification applies to all Portland cement concrete used in sidewalks, driveways, approaches, patches, manholes, inlets and other structures constructed in the City of Northglenn.

Specifications for Portland cement concrete pavement are in this chapter of these STANDARDS AND SPECIFICATIONS. Engineering plans, licenses, permits, inspection, warranty and acceptance shall be as detailed in these STANDARDS AND SPECIFICATIONS for the applicable type of construction involved. Permits shall be obtained before work begins. The Contractor shall contact the Public Works Department twenty-four (24) hours in advance of concrete placement when the form work is ready to receive the concrete. Where required, compaction test results shall verify the adequacy of all ground upon which concrete is to be placed.

15.17.2 Design Standards

Design criteria for the various elements using concrete are specified in other chapters of this document. Design specifications for sidewalks, curb and gutter, driveways, inlets, sidewalk and concrete paved streets are in **Chapter 11- Roadways & Pavements**. Design specifications for concrete pipe, manholes, inlets and other drainage and wastewater concrete structures are in **Chapter 8 - Water System**, **Chapter 7 - Sanitary Sewer System** and **Chapter 9 - Storm Drainage & Other Concrete Facilities**. Design specification relative to traffic signals and traffic control items is in **Chapter 16- Temporary Traffic Control**.

15.17.3 Placing Concrete

Preparation

Before depositing concrete, debris shall be removed from the space to be occupied by the concrete and the forms. Concrete shall not be placed until all forms and reinforcing steel have been inspected and approved by the Engineering Division. The soil receiving the concrete shall be moist, but not wet, and shall not contain frost or frozen material. Specifications for subgrade preparation are in **Chapter 11- Roadways & Pavements**.

Timing

Concrete which has developed initial set or does not have workable consistency shall not be used. Concrete shall be continuously mixed or agitated from the time the water is added until the time of use and shall be completely discharged from the truck mixer or truck agitator within one-and-one-half (1-1/2) hours after it comes in contact with the mixing water or with the aggregates. Re-tempered concrete will not be allowed.

Concrete Temperature

At the time of concrete placement, the mix temperature shall be between fifty degrees Fahrenheit (50° F) and ninety degrees Fahrenheit (90° F). In cold weather, aggregates and water may be heated as part of the batching operation but they shall not be heated beyond a temperature of one-hundred-and-fifty degrees Fahrenheit (150° F). Aggregates shall not be heated directly by gas or oil flame or on sheet metal over direct flame. Materials containing frost or lumps of frozen material shall not be used in the mix and their presence in the concrete shall be cause for rejection of that batch.

Handling

Concrete shall be handled from the mixer to the place of final deposit as rapidly as possible by methods which prevent separation or loss of ingredient. The concrete shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling. Concrete shall be deposited in continuous layers, the thickness of which generally shall not exceed twelve inches (12"). Concrete shall be placed in one continuous operation, except where keyed construction joints are shown on the plans or as approved by the Engineering Division. Delays in excess of thirty (30) minutes may require removal and replacement of that pour, as determined by the Engineering Division.

Concrete shall be placed in a manner that will avoid segregation and shall not be dropped freely more than five feet (5'). If segregation occurs, the Engineering Division may require the concrete to be removed and replaced at the Contractor's expense. Necessary hand spreading shall be done with shovels and not with rakes.

Concrete shall be thoroughly compacted or vibrated. All concrete shall be compacted by internal vibration using mechanical vibrating equipment, except that concrete in floor slabs, sidewalks, or curb and gutter, not poured against form linings, shall be either tamped or vibrated. Care shall be taken in vibrating the concrete to vibrate only long enough to bring a continuous film of mortar to the surface. Vibration shall stop before any segregation of the concrete occurs. Mechanical vibrators shall be an approved type as specified in ACI Publication 309, Chapter 5 (Latest Edition). Vibrators shall not be used to move or spread the concrete. Any evidence of lack of consolidation or over consolidation will be regarded as sufficient reason to require the removal of the section involved and its replacement with new concrete at the Contractor's expense. The Contractor shall be responsible for any defects in the quality and appearance of the completed work. A 2nd vibrator must be onsite.

Workability

The consistency of concrete shall be kept uniform for each class of work and shall be checked by means of a slump test. The workability of the concrete will be varied as directed by the Engineering Division. At all times, concrete shall have a consistency such that it can be worked into corners and angles of the forms and around joints, dowels and tie bars by the construction methods which are being used without excessive spading, segregation or undue accumulation of water or laitance on the surface. If, through accident, intention or error in mixing, any concrete that fails to conform to the proportions of the approved mix design, such concrete shall not be incorporated in the work but shall be discarded off the project site as waste material at the Contractor's expense. NO WATER MAY BE ADDED AT THE JOB SITE WITHOUT PERMISSION OF THE ENGINEERING DIVISION or his representative. If approval is obtained and water is added at the job site, slump tests shall be run and test cylinders cast following the addition of the water. Any expense incurred in excess of ordinary tests will be borne by the Contractor.

Weather Restrictions

- **Hot Weather:** Except by written authorization, concrete will not be placed if the temperature of the plastic concrete cannot be maintained at ninety degrees Fahrenheit (90° F) or lower. The placement of concrete in hot weather shall comply with ACI 305 (Latest Edition).
- **Cold Weather:** During extreme weather conditions, placing of concrete will be permitted only when the temperature of the concrete placed in the forms will not be less than fifty degrees Fahrenheit (50° F), nor more than ninety degrees Fahrenheit (90° F). To maintain this temperature range, the Contractor shall provide acceptable heating apparatus for heating the aggregates and the water. Concrete slabs shall not be placed, regardless of temperature conditions, if the supporting ground is frozen or contains frost. Use of salt or other additives to prevent concrete from freezing will not be allowed. Concrete which has been frozen shall be completely removed and replaced as directed by and to the satisfaction of the Engineering Division.

Concrete may be placed when the air temperature in the shade is at least forty degrees Fahrenheit (40° F) and rising. No concrete shall be placed, regardless of the present temperature, when the weather forecast promises freezing weather before final set of the concrete unless special means of heating and protection are used. Protection against freezing is

the Contractor's responsibility regardless of the weather forecast or climatic conditions at the time of placing. During cold weather conditions, concrete less than seventy-two (72) hours old shall be protected as follows:

Table 15.17: Concrete Placement Temperature Protection Requirements

Forecast Low Temperatures (per National Weather Service)	Protection
Between 40 and 32 Degrees	One layer of plastic or burlap
Between 31 and 25 Degrees	One layer of plastic and one layer of burlap, or two layers of burlap
Below 25 Degrees	Six inches (6") of hay or straw and two layers of plastic or burlap in addition to regular curing method, or equivalent commercial insulating material in addition to regular curing method

These coverings must remain in place until the concrete is at least five (5) days old. When straw is required on concrete and the concrete is cured with only curing compound, the fresh concrete shall be covered with a layer of burlap or plastic before application of straw. Heated enclosures may be utilized in lieu of protection requirements cited above. If used, such enclosures shall be maintained for seven (7) days.

Jointing

EXPANSION JOINTS:

Expansion joint material shall be provided at the following locations and shall be in place prior to the placing of concrete:

- Between new concrete and existing masonry buildings
- As shown on the drawings
- As directed by the Engineering Division

CONTRACTION JOINTS:

Transverse joints shall be placed at maximum intervals of ten feet (10') to control random cracking. Joints shall be formed, sawed or tooled to a minimum depth of one-third (1/3) of the total thickness, but no less than 1.5 inches. Contraction joints shall be placed as follows:

- Not more than ten feet (10') nor less than six feet (6') apart in curb and gutter and combination curb-walk.
- Not more than the walk width in non-monolithic concrete sidewalk.
- At least two joints equally spaced at not greater than ten-foot (10') intervals as applicable in driveways.
- As accepted and shown on the plans for special concrete structures.

Finishing & Curing

In addition to the curing techniques unique to hot and cold weather placement, adequate attention shall be given to finishing and curing the fresh concrete. Exposed faces of curbs and sidewalks shall be finished to true line and grade, as shown on the plans. The surface shall be floated to a smooth, but not slippery finish. The addition of surface water to assist in the finishing process is prohibited. Sidewalk and curb shall be broomed or combed and edged, unless otherwise indicated by the Engineering Division. After completion of brooming and before concrete has taken its initial set, all edges in contact with the forms shall be tooled with an edger having a three-eighths inch (3/8") radius. No dusting or topping of the surface or sprinkling with water to facilitate finishing will be permitted.

Immediately following the removal of the forms, all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surface's cavities produced by form ties, honeycomb spots, broken corners or edges and other defects shall either be thoroughly cleaned, moistened with water, and carefully pointed and trued with a mortar consisting of cement and fine aggregate or removed and replaced at the direction of the Engineering Division. The surface shall be left sound, smooth, even and uniform in color. Mortar used in pointing shall not be more than thirty (30) minutes old. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

Fresh concrete shall be adequately protected from weather damage and mechanical injury during the curing periods. The selected curing process shall be started as soon as it can be done without injury to the concrete surface. The use of a membrane-curing compound is recommended. The following curing procedures may be used subject to the approval of the Engineering Division.

WET BURLAP CURING:

After completion of the finishing operations, the surface of the concrete shall be entirely covered with burlap mats. The mats used shall be in such length or width that as laid they will extend at least twice the thickness of the concrete beyond the edges of the slab or structure. They shall be placed so that the entire structure and all edges of the concrete, when forms are removed, are completely covered. This covering shall be placed as soon as the concrete has set sufficiently to prevent marring of the surface. After being placed, the mats shall be thoroughly saturated with water by spraying with a mist spray. The burlap shall be so placed and weighted down so it remains in contact with the surface covered, and the covering shall be maintained fully wetted and in position for seven (7) days after the concrete has been placed. If it becomes necessary to remove the burlap for any reason, the concrete shall not be exposed for a period of more than one-half (1/2) hour. This method of curing shall not be used when the outside air temperature is below thirty-two degrees Fahrenheit (32° F) unless heated enclosures are provided.

PLASTIC SHEET CURING:

As soon after the completion of the finishing operation as the concrete has set sufficiently to prevent marring of the surface, the top surface and sides shall be entirely covered with plastic sheet materials. The plastic sheet as prepared for use shall have such dimensions that each unit as laid will extend beyond the edges of the concrete at least twice the thickness of the concrete. The units as used shall be lapped at least twelve inches (12"), and the laps of plastic sheet shall be secure such that they do not open up or separate. The plastic shall be placed and weighted, so it remains in contact with the surface covered, curing the entire curing period of seven (7) days.

WATERPROOF PAPER CURING:

The procedures used for plastic sheet curing shall be used when waterproof paper is used in curing concrete.

LIQUID CURING MEMBRANE:

Immediately after the surface water has disappeared from the concrete surface, the liquid membrane curing compound (white pigmented) shall be sprayed under pressure to the concrete surface at a rate not less than one (1) gallon per one-hundred-fifty (150) square feet with a spray nozzle or nozzles, so it covers the entire pavement with a uniform water-impermeable film. If the forms are removed within seven (7) days, the exposed sides and edges shall be sprayed in the above-described manner or the backfill completed immediately.

INSULATION PAD:

Insulation pads or other thermal devices may be used to protect concrete in cold weather.

Wax base and resin base solutions shall not be used if linseed oil protection is to be applied to the concrete surface. If linseed oil protection is to be utilized, the method of curing shall be either linseed oil base curing compound, wet burlap, plastic sheet or waterproof paper curing.

Testing of Concrete

The requirements of this section shall apply to testing services for all concrete curb and gutter, sidewalk, slope paving, retaining walls, structures and for all miscellaneous concrete testing. Testing for concrete pavement shall be in accordance with this chapter of these STANDARDS AND SPECIFICATIONS.

The contractor shall furnish the concrete necessary for casting test cylinders. See Table 15.18 for the cylinders test requirements.

Table 15.18: Concrete Cylinder Test Requirement

Type of Test	Frequency
Gradation (aggregate)	1 per 2500 sq. yard or fraction thereof for each size aggregate
Moisture Content, fine aggregate	1 per day or as often as needed for quality control
Moisture Content, coarse aggregate	1 per day minimum where moisture content is +0.5 percent from SSD condition
Slump	1 per set of cylinders and as often as needed for quality control
Air Content	1 per set of cylinders and as often as needed for quality control
Yield and Cement Factor	1 per set of cylinders and as often as needed for quality control
Compressive Strength	1 set of four (4) cylinders per 50 cubic yards or major fraction thereof on each day pavement is placed, with two (2) cylinders to be field-cured and 1 additional set shall be made if the Contractor intends to open early for traffic
Thickness	1 per 1250 linear feet each traffic lane on freshly finished concrete and as often as needed for quality control

Repairs

After stripping of the forms, if any concrete is found to be not formed as shown on the drawings or is out of alignment or level or shows a defective surface, it shall be considered as not conforming with the intent of these STANDARDS AND SPECIFICATIONS and shall be removed and replaced by the Contractor at his expense unless the Engineering Division gives written permission to patch the defective area. In this case, patching shall be done as described in the following paragraphs. Defects that require replacement or repair are those that contain honeycomb, damage due to stripping of forms, loose pieces of concrete, bolt holes, tie-rod holes, uneven or excessive ridges at form joints and bulges due to movement of the forms and other deficiencies identified in the acceptance and warranty inspection. Ridges and bulges shall be removed by grinding. Honeycombed and other defective concrete that does not affect the integrity of the structure shall be chipped out and the vacated areas shall be filled in a manner acceptable to the Engineering Division. The repaired area shall be patched with a non-shrink, non-metallic grout with a minimum compressive strength of five thousand (5000) psi in twenty-eight (28) days. All repair areas treated with an epoxy bonding agent shall have the approval of the Engineering Division before the repair filling is placed.

Bolt holes, tie-rod holes and minor imperfections as accepted by the Engineering Division shall be filled with

dry-patching mortar composed of one (1) part Portland cement to two (2) parts of regular concrete sand (volume measurement) and only enough water so that after the ingredients are mixed thoroughly the mortar will stick together on being molded. Mortar repairs shall be placed in layers and thoroughly compacted by suitable tools. Care shall be taken in filling rod and bolt holes so that the entire depth of the hole is completely filled with compacted mortar. The mortar mix proportions described above are approximate.

An approved mix shall be prepared by a commercial testing laboratory to ensure that grout has a twenty-eight (28) day compressive strength equal to that of the area on which it is placed. All costs for mix design and testing shall be paid by the Contractor. Those areas with excessive deficiencies as determined by the Engineering Division shall be removed and replaced at the Contractor's expense. Where repairs are made in existing sidewalks, all edges of the old sidewalk allowed to remain shall be saw-cut to a minimum depth of two inches (2"). No rough edges will be permitted where new construction joins the old section. Unless directed by the Engineering Division, no section less than five feet (5') in length shall be placed or left in place. Where new sidewalk construction abuts existing sidewalks, the work shall be accomplished so that there is no abrupt change in grade between the old section and the new work.

15.18 Underground Facilities for Traffic Signals

15.18.1 Foundations

- **Concrete Foundations.** All foundations shall be Portland cement concrete conforming to the applicable requirements of construction specifications of the City of Northglenn, except as herein provided.
- **Stable Subgrade.** The bottom of concrete foundations shall rest on firm ground. Cast-in-place foundations shall be poured monolithically where practicable. The exposed portions shall be formed to present a neat appearance.
- **Foundation Grades.** Forms shall be true to line and grade. Tops of foundations, except as noted on plans, shall be finished to curb or sidewalk grade or as ordered by the Engineering Division. Forms shall be rigid and securely braced in place and inspected prior to the pouring of concrete. Conduit ends and anchor bolts shall be placed in proper position and in a template until the concrete sets.
- **Anchor Bolts.** Anchor bolts shall conform to the specifications and each individual bolt shall have two (2) flat washers, one (1) lock washer and two (2) nuts. Shims or other similar devices for plumbing or raking will not be permitted.
- **Moistened Ground.** Both forms and ground which will be in contact with the concrete shall be moistened before placing concrete. Forms shall not be removed until the concrete has thoroughly set.
- **Abandoned Foundations.** All abandoned foundations shall be removed and disposed of by the contractor. All conduit runs associated with an abandoned foundation shall be extended or abandoned as called for on the plans. When a foundation is removed, the hole shall be backfilled in accordance with State of Colorado and City of Northglenn standard practices.

15.18.2 Conduit

- **PVC Conduit.** All cables and conductors not shown on the plans as aerial cable shall be installed in conduit unless installed in poles, pedestals, or mast arms. All metal conduit referred to in the specifications and shown on the plans shall be rigid and adequately galvanized. All PVC conduit will be of Schedule 80 or greater.
- **Tracer wire.** Tracer wire shall be installed on all conduits.
- **Ream Conduits.** The end of all metal conduit, existing or new, shall be well reamed to remove burrs and rough edges. Field cuts of existing or new conduit shall be made square and true, and the ends shall butt together for the full circumference thereof. Slip joints of running thread will not be permitted for coupling metal conduit. When a standard coupling cannot be used, an approved threaded union coupling shall be used. All couplings shall be screwed up until the ends of the metal conduits are brought together.

- **Stub Out.** Where a "stub out" is called for on the plans, a sweeping ell shall be installed in the direction indicated and properly capped. The locations of ends of all conduits in structures or terminating at curbs shall be marked by a "Y" at least three inches (3") high cut into the face of the curb, gutter, or wall directly above the conduit.
- **Conduit Bends.** Conduit bends, except factory bends, shall have a radius of not less than six (6) times the inside diameter of the conduit. Where factory bends are not used, conduit shall be bent without crimping or flattening, using the longest radius practicable.
- **Depth.** Conduit shall be laid at a depth of not less than twenty-four inches (24") below the top of curb grade in sidewalk or grass areas and to a depth of not less than thirty inches (30") below the finished grade in all other areas. Conduit under railroad tracks shall be not less than forty-eight inches (48") below the bottom of the tie.
- **Trench Size.** Trench excavations for conduit shall be two inches (2") wider than the outside diameter of the conduit. Backfilling of conduit trenches shall be accomplished by placing concrete or approved flow-fill up on the bottom surface of the existing or new roadway surface material. The remaining portion of the excavation shall be backfilled with the same type of material used to construct the existing roadway surface.
- **Conduit Run.** Conduit shall always enter a foundation, pull box or any other type structure from the direction of the run only.
- **Termination.** Conduits terminating in a pole shall extend approximately two inches (2") vertically above the foundation.
- **Nylon Line.** All conduit runs that exceed ten feet (10') in length shall have a continuous nylon line pulled into the conduit along with the specified electrical cables. The line shall be firmly secured at each end of the conduit run with a minimum slack of three feet (3'). The purpose of this line is to be able to pull future electrical cable through the existing conduit runs.
- **Clean Conduit.** Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel or blown out with compressed air.
- **Locate Wire.** Install a #12 locate wire inside the conduit throughout the length of the installation.
- **Spare Conduits.** New conduit runs shown on the plans are for bidding purposes only and may be changed with approval of the Engineering Division. The City may request the installation of spare conduits.

15.18.3 Pull Boxes

- Pull box shall always be installed in combination with a steel strain pole and at all other locations shown on the plans and at such additional points as ordered by the Engineering Division. The Contractor may install, at his own expense, any additional pull box that he may desire to facilitate the work.
- **Special Pull Boxes.** Special pull boxes which are required shall be fabricated and installed in general conformance with the size and details shown on standard drawings.
- **Design.** Pull boxes installed in concrete or similar finished areas shall be designed for such installations and shall be stackable and manufactured of a Precast polymer concrete material such as Quazite or an approved equal. Unless otherwise noted, pull box lids shall have the word "Traffic" cast into them. Pull boxes shall be installed so that the covers are level with curb or sidewalk grade or level with the surrounding ground when no grade is established. The bottoms of all pull boxes shall be bedded in crushed rock.
- **Conduit.** When a new conduit run enters an existing pull box, the contractor shall remove the pull box or tunnel under the side at no less than eighteen inches (18") and enter from the direction of the run. No new conduit will be allowed to enter a new or existing pull box in any other manner than that shown on standard drawings.

- **Loop Detector.** Loop detector pull boxes installed in the street shall be placed according to the plans or as directed by the Engineering Division. The lids shall have the word "Traffic" cast into them.

15.18.4 Detector Loop Wire Installation

The use of detector loops instead of cameras must be approved by the Engineering Division. If approved, each individual detector loop is to be terminated within a water valve housing as specified on the construction drawing, and each loop shall consist of one continuous wire, without splicing to this termination point. Any required series or parallel connections are to be at the termination point.

All loops shall have a tag attached to the leading clockwise lead of the loop. This tag shall be marked to indicate the relative location of the loop. This marking shall correspond directly to the loop designations on the intersection drawing provided in the contract.

Detector loop roadway slots shall be cut in asphalt that has a 6-inch minimum depth and sealed one-fourth inch (1/4") below the surface level of the roadway with 3M or approved equal. This sealer is to be used whether or not the roadway is to be overlaid.

The contractor shall include cost for loop wire, saw cutting, sealant, splice and test for a complete installation of the loop to the termination point for the pay item price.

15.18.5 Conductor & Cable

Wiring shall conform to appropriate articles of the National Electric Code. Wiring within cabinets, junction boxes, etc., shall be neatly arranged.

Powdered soap stone, talc or other approved lubricant shall be used in placing conductors in conduit.

A common neutral conductor, separate from the signal light circuit neutral, shall be used for all low-voltage circuits, including the detectors and pedestrian push-button circuits.

Splicing of cable will not be permitted in conduit or pull boxes or outside of signal heads, standards, or foundations.

In no case shall any shellac compounds be used. Wire nut type connectors shall be used on all splices made above ground level. Detector loop lead-in splices in underground systems shall be waterproofed with 3M splice kits or City approved equivalent. A minimum of twelve inches (12") of slack shall be left at each splice except within hand-holes where twenty-four inches (24") shall be left.

When conductors and cables are pulled into the conduit, all ends of conductors and cables shall be taped to exclude moisture and shall be so kept until the splices are made or terminal appliances attached. Ends of spare conductors shall be taped and marked.

Cable shall be stranded. For span wire type installations, cable shall be installed where specified on the plans and secured to messenger cable with cable rings in accordance with standard practices. Aerial cable shall be supported by strand vices of proper size and strength as well as insulators used where necessary.

A small permanent tag on which the direction and phase is printed, in the order named, using the codes given in "Cable Schedule," shall be securely attached near the end of each conductor at each controller, standard, or pull box where conductors are separated. Where direction and phase are not clearly indicated by conductor insulation, additional tags shall be used.

Inboard and outboard heads, mounted on mast arms, are to be wired separately from head to base of pole. Seven conductors for outbound and side-of-pole signal heads required.

15.18.6 Bonding & Grounding

Metallic cable sheaths, conduit, metal poles and foundations shall be made mechanically and electrically secure to form a continuous system and shall be effectively grounded. Bonding and grounding jumpers shall be copper wire, No. 8 AWG, for all systems. Beldon cable sheath for loop detectors to be grounded in control cabinet only. The other end of the sheath to be left ungrounded.

Bonding of standards shall be by means of a bonding wire attached to a bolt or a three-sixteenths inch (3/16") or larger bolt installed in the lower portion of the shaft.

At each pull box the ground electrode shall be a one-piece copper ground rod of five-eighths inch (5/8") diameter and eight feet (8') in length, driven into the ground so that the top is two inches (2") above the bottom of the pull box. The ground rod connector will be placed so that the bare copper wire, No. 8, can be pulled into a pole, foundation, or attached to the control cabinet ground buss.

15.18.7 Maintenance

Contractor Responsibility

The Contractor shall have full maintenance responsibility of the traffic signal from the date of the written notification by the Engineering Division to the final inspection and date of written approval of the work performed. Continuous maintenance and emergency service shall be provided by the Contractor 24 hours each day during the time frame outlined above. The Contractor shall provide and maintain a 24-hour a day continuous one number telephone answering service.

Emergency

All malfunctions of a controller and its accessory equipment shall be considered an emergency unless otherwise identified by the City. Equipment malfunctions and/or damage, which in the opinion of Northglenn's Engineering Division or other authorized person, constitutes a serious hazard or inconvenience to the public shall be considered an emergency. Such malfunctions or damage may include, but not necessarily be limited to, situations where:

- all indications are out including bulbs and lenses, for any one traffic movement;
- signal heads give conflicting indications to any intersection approach;
- a signal has been knocked down;
- an overhead red indication is out.

Response Time

Contractor shall undertake each such emergency repair no later than one hour after Northglenn notifies Contractor of the emergency.

Reimbursement

In instances of repairs that are not of an emergency nature, such repairs shall be undertaken at the site within one working day after Northglenn notifies Contractor of the needed repair. Northglenn shall pay the Contractor for the materials, parts and/or supplies actually used by the Contractor in making any such repair in the amount of the Contractor's cost-plus five percent (5%). Labor and equipment rates associated with work performed due to vandalism or vehicle accident damage will be reimbursed at the rate set forth in the City's Traffic Signal Maintenance Contract.

Failure to Work

Should the Contractor fail to perform any maintenance responsibilities within the prescribed time periods, the Engineering Division or other authorized person shall employ the services of the City's designated Traffic Signal Maintenance Contractor to perform said maintenance work. The Contractor shall reimburse the City for labor and equipment charges associated with the utilization of the City's designated Traffic Signal Maintenance Contractor plus a fifteen percent (15%) administration fee.

Field Testing

Prior to completion of the work, the Contractor shall cause the following tests to be made on all traffic signals in the presence of the Engineering Division.

Each circuit shall be tested for continuity. Each circuit shall be tested for grounds.

A functional test shall be made in which it is demonstrated that each and every part of the system functions as specified or intended herein. The functional test for each traffic signal system shall consist of not less than fourteen (14) days of continuous, satisfactory operation commencing with full operation of all electrical facilities. During the fourteen-day period, the contractor will maintain the system or systems. The cost of any maintenance necessary, except electrical energy and maintenance due to damage by public traffic, shall be borne by the contractor and will be considered as included in the price paid for the contract item involved and no additional compensation will be allowed.

Chapter 16. TEMPORARY TRAFFIC CONTROL

16.1 Construction Traffic Control

16.1.1 General

Traffic control devices shall be maintained in a safe operating condition at all times. The contractor shall provide for approval by the City Engineering Division, a traffic control plan, and shall comply with **Chapter 16 – Temporary Traffic Control** of these STANDARDS AND SPECIFICATIONS and the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD). If the Engineering Division finds the construction area to be inadequately barricaded, they have the authority to stop work and direct that corrective measures be taken prior to proceeding with work.

- Temporary Traffic Control is required for any work in the City's Right of Way. A submittal of a traffic control plan as well as a right of way permit with the Permit Application is necessary as per **Chapter 3- Permits**.
- All Traffic Control shall be provided for the reasonably safe and effective movement of road users through or around Temporary Traffic Control zones while reasonably protecting road users, workers, responders to traffic incidents, and equipment.

16.1.2 Pedestrian Traffic

Every precaution shall be taken to ensure that construction work does not interfere with the movement of pedestrian traffic, which shall be maintained on the sidewalk at all times. Flagger shall be provided for guidance, as necessary.

- Where an excavation interrupts the continuity of the sidewalk, the contractor shall provide suitable bridge or deck facilities to be supplemented by the use of such proper devices and measures as prescribed in the Manual on Uniform Traffic Control Devices, most recent edition, for the safe and uninterrupted movement of pedestrian traffic. The edges or ends of the pedestrian bridge or decking shall be beveled or chamfered to a thin edge to prevent tripping.
- Temporary diversion walkways shall be hard surfaced and electric lighting shall be provided and kept continuously burning during hours of darkness, when required by the Engineering Division.
- Unless otherwise authorized by the Engineering Division, pedestrians shall not be channeled to walk on the traveled portion of the roadway.
- Under certain conditions, it may be necessary to divert pedestrians to the sidewalk on the opposite side of the street. Such crossings shall only be made at intersections or marked pedestrian crossovers.
- Facilities satisfactory to the Engineering Division shall be provided for pedestrian crossing at corners, pedestrian crossovers, and public transportation stops.
- Temporary facilities, including pedestrian routes around worksites, are also covered by the accessibility requirements of the Americans with Disabilities Act of 1990.

16.1.3 Vehicular Traffic

Construction work zone traffic shall be controlled by signs, barricades, detours, etc., which are designed and installed in accordance with the Manual on Uniform Traffic Control Devices, most recent edition, and applicable City of Northglenn traffic standards. Traffic control plan shall be submitted and approved by the Engineering Division or his designee prior to start of any construction.

During construction of new facilities, traffic control should strive to keep the motorist from entering the facility. The primary means to accomplish this is by use of temporary barricades, located in advance of the point where new

construction joins existing and by appropriate signing. New construction shall not be opened to traffic without approval from the Engineering Division.

In general terms, a construction traffic control plan must be drawn on a map. For minor projects or local roadways, a neat sketch of the roadways and the proposed control devices will suffice. For major projects or major roadways, the traffic control plan should be superimposed on as-builts, construction plan drawings or another detailed map.

The Manual on Uniform Traffic Control Devices shall be the basis upon which the construction traffic control plan is designed in concern with proper, prudent, and safe engineering practice. All necessary signing, striping, coning, barricading, flagging, etc. shall be shown on the plan.

Directional access on roadways may be restricted [minimum travel lane width in construction area is ten feet (10')], but proper controls including flagging must be indicated. Removal of on-street parking should be considered and noted where applicable.

The temporary traffic control shall be properly maintained and cleaned throughout the temporary traffic control's use.

The temporary traffic control shall manage bicycle traffic through work zones.

16.1.4 Public Notice for Temporary Traffic Control

The City may require the Contractor to notify the public through signs, social media, newspaper, or individually about the adjacent construction and traffic interruption. This notice shall be completed a week in advance for large projects. The Engineering Division will notify the Contractor of this requirement through the Right of Way permit.

16.1.5 Complete Work Efficiently

All Temporary Traffic Control devices shall be removed as soon as practical when they are no longer needed.

Chapter 17. REVEGETATION & SEEDING

17.1 General

This chapter consists of the work of revegetation with seeded grasses and the specifications to establish, maintain and warranting the reseeded areas. “Formal” landscaping requirements are specified in the Municipal Code. Final drawings, specifications and details shall be submitted to the City for review and approval prior to construction. All work shall be completed in accordance with these STANDARDS and SPECIFICATIONS in a manner consistent with accepted horticultural practices.

17.1.1 Soil Preparation

Materials

Soil preparation shall be provided on all areas to be seeded, sodded, or otherwise planted. Organic matter for soil amendment shall be well aged dairy cattle manure, thoroughly composted organic material and other organic matter as approved by the City and shall contain a minimum of 60-percent organic matter. The mixture shall be free from clay subsoil, stones, lumps, plants or their roots, sticks, weed stolons and seeds, high salt content and other materials harmful to plant life. The materials shall be coarsely ground and thoroughly mixed together to ensure an even composition. The mix shall have an acidity no greater than pH 7.5 and shall meet the following mechanical analysis:

Table 17.1: Classification Table for Amended Soil

Sieve Size	% Passing	% Retained
1-1/2 Inch Screen	100	0
1-Inch Screen	90-100	0-10
1/2 Inch Screen	50-80	20-50
#100 Mesh Sieve	0-15	85-100

Note: If testing is required, it shall be done by a Professional Engineer registered in the State of Colorado and practicing in the field of soil mechanics. Testing shall be at the developer’s/contractor’s expense.

Placement

Upon establishment of approved grades, the soil surface shall be loosened by rototilling to a minimum of 8 inches, and all materials over two inches (2”) in diameter shall be removed. The organic matter shall be evenly spread over the entire surface at the rate of five (5) cubic yards per 1,000 square feet and shall be mixed thoroughly into the soil surface to a depth of eight inches (8”) by means of a rototiller, soil mixer or similar equipment. The surface shall then be finish-graded and compacted to the approved elevations. Prior to seeding or sodding, D1-ammonium phosphate (18-46-0) shall be spread evenly over the entire surface at the rate of 15 pounds per 1,000 square feet.

17.1.2 Topsoiling

Topsoiling is not considered a portion of the ordinary soil preparation operations as described in these STANDARDS AND SPECIFICATIONS. However, the use of good topsoil is desirable, and may help in reducing water consumption and encouraging plant growth. When topsoil exists on the project site, the Developer/Contractor shall strip and stockpile the topsoil and redistribute the topsoil over the open space areas after the overlot grading is complete. The City has the prerogative of deleting all or a portion of the soil preparation requirements when topsoil is provided, depending on topsoil quality and quantity.

Material

Topsoil shall be fertile sandy loam topsoil, taken from a well-drained site and free from clay subsoil, stones, lumps, plants or their roots, sticks, weed stolons and seeds, high salt content and other materials harmful to plant life. The topsoil shall have an acidity in the range of pH 5.5 to pH 8.5 and shall be screened and meet the following mechanical analysis:

Table 17.2: Classification Table for Topsoil

Sieve Size	% Passing	% Retained
1-Inch Screen	100	0
1/2 Inch Screen	97-100	0-3
#100 Mesh Sieve	60-40	40-60

Note: If soil testing is required, it shall be by a Professional Engineer registered in the State of Colorado and practicing in the field of soil mechanics and in accordance with "Methods of Soils Analysis -- Agronomy No. 9" as published by the American Society of Agronomy. Testing shall be at the developer's/contractor's expense.

Placement

Upon establishment of the approved grade, the subsoil surface shall be loosened to a minimum depth of eight inches (8") by tilling and all objects over two inches (2") in diameter shall be removed. The topsoil shall be spread over the area to a minimum of six inches (6") compacted depth and mixed lightly into the subsoil by means of a rototiller, soil mixer or similar equipment. The surface layer shall then be finish graded and compacted to the approved elevations.

17.1.3 Fertilization

A booster fertilizer with the chemical analysis of Nitrogen-12, Potash-12, Phosphorous-4 with 4 percent iron and 8 percent sulfur shall be applied on the prepared soil at the rate of 5 pounds per 1,000 square feet immediately prior to seeding. If a soil analysis indicates sufficient amounts of the above elements the City may, at its discretion, waive the requirement to fertilize.

17.1.4 Mulching

Mulch may be needed to conserve moisture, prevent crusting, reduce runoff and erosion, and help establish a plant cover. The need for mulch will be at the sole discretion of the City. Mulching material shall be applied immediately before or immediately after seeding. One of the mulching methods listed below will be acceptable:

- Application of hydro-mulch (wood fibers in a water slurry) -- minimum rate of 2,000 lbs/acre. Tackifier, fertilizer, etc. will be included in the hydro-mulch.
- Grain straw shall be used at an application rate of 4,000 lbs/acre of air-dried material. At least 50-percent of the mulch by weight shall be 10 inches or more in length. Mulch shall be anchored immediately after distributing with a mulch crimper, and tackifier.
- Mulch netting shall be firmly held in place with pins spaced not more than ten (10') linear feet apart. In sandy or extremely loose soil, the pins shall be located not more than five (5') linear feet apart.
- Jute netting, enkamat, and similar approved materials shall be installed according to the manufacturer's recommendations.
- Excelsior mat shall be installed according to the manufacturer's recommendations.

17.1.5 Seeding - General

Seeding of grasses or ground cover plants is required for either of two purposes:

- Temporary erosion control.
- Permanent seeding for erosion control and appearance

Temporary seeding for erosion control shall be placed within thirty (30) days of grading or construction and disruption of the soils.

17.1.6 Dry Land Seeding

Prior to any seeding, a depth of tillage sufficient to establish a seed bed will be done based on specific site conditions. Project scheduling should take advantage of spring or fall planting seasons for natural germination, but seeded areas shall be irrigated, if conditions so merit.

17.1.7 Germination Standard

The minimum standard for any dryland grass is five (5) seedlings of the seeded species per square foot. This count/inspection shall be taken four (4) weeks after germination by a qualified botanist. Any area not meeting the specifications on germination will be touch up seeded in one of the following methods:

- Hand Broadcast and Incorporation
- Mechanical Broadcast and Incorporation
- Interseeding with Seed Drilling Equipment

Dry land seeding, sometimes referred to as “native” seeding, shall be accomplished with mechanical power-drawn drills which have depth bands set to maintain a planting depth of at least 1/4-inch and shall be set to space the rows not more than seven inches (7”) apart. Seed that is extremely small shall be sowed from a separate hopper adjusted to the proper rate of application. When requested by the developer/contractor and approved by the City, seeding may be accomplished by means of approved broadcast or hydraulic-type seeders. Seed shall not be drilled or sown during windy weather or when the ground is frozen or otherwise untillable.

All seed sown by broadcast-type seeders shall be “raked in” or otherwise covered with soil to a depth of at least 1/4-inch. Hand method of broadcasting seed will be permitted only on small areas not accessible to machine methods. Water shall be applied as necessary to establish the cover crop. If inspections indicate that strips wider than the specified space between the rows planted have been left or other areas skipped, the City may require immediate re-sowing of seed in such areas at the developer’s expense. A Dry land seed mix shall be proposed by the developer/contractor and approved by the City.

17.2 Erosion Control - General

All materials shall conform to applicable requirements of "Erosion Control", listed as follows and meeting the requirements of ABAG Manual of Standards for Erosion and Sediment Control Measures.

17.3 Topsoil

The soil on the site shall meet the following criteria:

- The soil shall contain no more than seventy percent (70%) sand (as defined by USDA, Soil Conservation Service). This is to provide enough available water- holding capacity to support plant growth.

- The soil shall have sufficient porous base (greater than thirty percent (30%)) to permit adequate root penetration and provide for exchange of gases and water.
- The soil shall be free from any material harmful to plant growth.
- Topsoil that has been graded from the site shall be stockpiled, whenever possible, for reapplication on exposed graded slopes during the final grading stage. The soil shall be disked into the existing soil to provide for a good bond.

17.4 Seed

A seed mix similar to the native plants and grasses or the following seed mix shall be applied at above the minimum rate specified below: Seed Type Minimum Application Rate (Pounds per Acre) Blando Brome 30 Annual Ryegrass 20.

All seed shall be certified live and delivered to the site tagged and labeled in accordance with the California Agricultural Code and shall be acceptable to the County Agricultural Commissioner.

17.5 Fertilizer

Fertilizer shall contain a minimum of sixteen percent (16%) nitrogen, twenty percent (20%) available phosphoric acid, zero percent (0%) water soluble potash, and fifteen percent (15%) sulfur. It shall be uniform in composition, dry and free flowing, pellet or granular.

All fertilizer shall be delivered in unbroken or unopened containers, labeled in accordance with the applicable State regulations, and bearing the warranty of the producer for the grade furnished.

The Contractor is responsible for ensuring that all fertilizer and other chemicals are contained and do not run into the Storm Drainage System.

17.6 Straw Mulch

Straw mulch shall be of un-rotted small grain straw and shall be applied at the rate of four thousand pounds (4,000#) per acre. Mulch materials shall be relatively free of all noxious weeds. If the straw is applied with a blower, it shall be chopped in lengths not shorter than six inches (6").

17.7 Straw Bales

Straw shall be derived from wheat, oats, or barley, as required by law, before straw obtained from outside the County in which it is to be used is delivered to the site of the work. Straw that has been used for stable bedding shall not be used.

17.8 Temporary & Permanent Planting of Exposed Soils

Before seeding, necessary drainage controls such as dikes at tops of slopes and swales on slope benches shall be installed to prevent runoff from eroding slopes before grass is established. Temporary drainage controls shall remain in place until permanent drainage facilities are installed or until slopes are stabilized and temporary controls are no longer necessary for continued slope stability.

The area to be seeded shall have a firm seed bed that has previously been roughened by scarifying, disking, harrowing, chiseling, or track-walking, or otherwise worked to a depth of two inches (2") to four inches (4") unless a roughed condition already exists. No implement shall be used that will create an excessive amount of downward movement of soil or clods on sloping areas. The seedbeds may be prepared at the time of completion of earth-moving work.

Seeding, fertilizing, and mulching shall be done by October 1st of any year.

Slopes above critical areas, such as a water supply reservoir or an existing residence, shall be stabilized by October 1st of any year. Irrigation shall be used if rainfall is insufficient to establish protection by this date.

Seed shall be distributed uniformly over the seedbed by hand broadcasting, hydro-seeding or other approved method. Seed shall be covered to a depth of one-quarter to one-half inch (1/4"-1/2"), except when seed is hydraulically applied with a mulch. Seed shall not have a soil cover greater than one inch (1").

Fertilizer shall be distributed uniformly over the seedbed at a rate of not less than five hundred pounds (500#) per acre. Fertilizer shall be applied in any way that will result in uniform distribution. Fertilizer shall be incorporated into the soil if possible. Incorporation may be as part of the seedbed preparation or as part of the seeding operation. Fertilizer may also be applied as a mix with seed and fiber in a slurry (see Paragraph H below).

A mulch cover shall be distributed uniformly over the surface of the seeded area. Mulching shall follow immediately after the seeding. 1. For slopes flatter than 2:1 and within a fifty-foot (50') access of a straw blower, the following procedure shall be used: Straw mulch shall be applied at the rate of four thousand pounds (4,000#) per acre. The mulch shall be applied by hand, blower, or other suitable equipment. The mulch shall be anchored in place using hand tools, mulching rollers, disks, nets, chemical tackifiers or other suitable means. 2. For slopes steeper than two to one (2:1), mulch shall be applied hydraulically as specified in Item H, below.

- Hydro-seeding is defined as the simultaneous application of seed, fertilizer, and mulch in a slurry. The hydro-seeder shall be equipped with a built-in continuous agitation system of sufficient operating capacity to produce a homogeneous slurry and with a discharge system that applies the slurry to the slopes at a continuous and uniform rate. Seed shall not remain in the slurry longer than thirty (30) minutes. The slurry shall contain the required fertilizer (see preceding Item F) and shall also contain wood fiber to be applied at the rate of one thousand five hundred pounds (1,500#) of wood fiber per acre.
- The water used shall be potable water or Class 1 or 2 agricultural irrigation water.
- The slurry shall be continuously mixed and shall be mixed for at least five (5) minutes after the last addition before application starts. The slurry shall be applied at a rate that is non-erosive and minimizes runoff. The slurry must have fibrous and/or chemical adhesives to ensure retention of seed mix on soil slopes.

GLOSSARY

AASHTO -- American Association of State Highway and Transportation Officials

ACCELERATION LANE -- A speed change lane, including tapered areas, for the purpose of enabling a vehicle entering a roadway to increase its speed to a rate at which it can more safely merge with through traffic.

ACCESS -- Driveway or other point of access such as a street, road or highway that connects to the general street system. Where two public roadways intersect, the secondary roadway shall be the access.

APPROACH -- The portion of an intersection leg which is used by traffic approaching the intersection.

AVERAGE DAILY TRAFFIC (ADT) -- The total bi-directional volume of traffic passing through a given point during a given time period, divided by the number of days in that time period.

BAND WIDTH -- The time in seconds or the percent of cycle between a pair of parallel lines which delineate progressive movement on a time-space diagram. It is a quantitative measurement of through traffic capacity provided by signal progression.

CAPACITY -- The maximum number of vehicles that have a reasonable expectation of passing over a given roadway or section of roadway in one direction during a given time period under prevailing roadway and traffic conditions.

CITY -- shall mean the City of Northglenn, in the State of Colorado, acting by and through the City Manager, Mayor and City Council.

CITY REPRESENTATIVE -- shall mean the Director of Public Works or the Director of Public Works' authorized representative acting on behalf of the City.

CONTRACTOR -- shall mean a person, partnership, company, firm or corporation licensed and bonded in the City in accordance with the Municipal Code, responsible to provide all materials and labor to complete in place all components associated with a specific project.

CRITICAL VOLUME -- A volume (or combination of volumes) for a given street which produces the greatest utilization of capacity for that street in terms of passenger cars or mixed vehicles per hour.

COMMERCIAL -- Establishments where the buying and selling of commodities, entertainment or services is carried on, excluding service stations. Included are such as uses as office buildings, restaurants, hotels, motels, banks, grocery stores, theaters, parking lots, trailer courts and public buildings.

CORNER CLEARANCE (C) -- At an intersecting street, the distance measured along the curb line from the projection of the intersection street Right of Way line to the nearest edge of the curb openings.

CYCLE TIME -- The time period in seconds required for one complete sequence of signal indications.

DECELERATION LANE -- A speed change lane, including tapered areas, for the purpose of enabling a vehicle that is to make an exit turn from a roadway to slow to a safe turning speed after it has left the mainstream of faster-moving traffic.

DELAY -- Stopped time per approach vehicle in seconds per vehicle.

DESIGN HOUR VOLUME (DHV) -- Hourly traffic volume used for street design and capacity analysis, usually one or more peak hours during a twenty-four (24) hour period.

DESIGN SPEED -- Five to ten miles per hour (5-10 mph) above the proposed or desired speed limit of the facility under design.

DESIGN VEHICLE -- Developments intended for public use must be designed for the following types of vehicles:

Residential (excluding single-family or duplex)	SU30
Commercial Uses	WB40
Industrial Uses	WB50

For public streets, the following design vehicles must be used:

Commercial/Multi-Family Locals & Minor Collectors	SU30
Major Collectors	WB40
Arterials	WB50

Definitions for the above vehicle types are found in AASHTO Geometric Highway Design Standards.

DESIGNATED PRIVATE CONSTRUCTION WORK -- private sewer systems, water and sewer service lines to buildings, grading, drainage structures, retaining walls, parking lots, private streets and walks, fire lanes, driveways, and associated construction.

DESIGNER -- shall mean the City contracted Colorado Professional Engineer or the Developer contracted Colorado Professional Engineer who is designing the public infrastructure for a City of Northglenn CIP or development project.

DEVELOPER -- shall mean a person, partnership, company, firm, or corporation that is seeking to develop a property within the City.

DISTANCE BETWEEN DOUBLE DRIVES (D) -- The distance measured along the curb line between the inside edges of the two adjacent curb openings.

DISTRIBUTION SYSTEM -- mains of twelve-inch (12") and smaller diameter, together with all appurtenant and necessary valves, fire hydrants, taps, meters, service pipes and associated materials, property and equipment receiving potable water from large conduits and distributing it to individual consumers.

DIVIDED HIGHWAY -- A highway with separated roadways for traffic in opposite directions, such separation being indicated by depressed dividing strips, raised curbing's, traffic islands, other physical separations or by standard pavement markings and other traffic control devices.

EDGE CLEARANCE (E) -- The distance measured along curb line from the nearest edge of the curb opening to a point where the property line extended intersects the curb line.

ENGINEERING DIVISION -- The Engineering staff of the City of Northglenn Public Works Department have the responsibility of ensuring that all aspects of the Standards and Specifications are enforced and implemented.

EXPRESSIONS -- wherever the words “as directed”, “as required”, “as permitted” or words of like meaning are used, it shall be understood that the direction, requirements, or permission of the City Representative is intended. Similarly, the words “approved”, “acceptable”, “satisfactory” shall refer to approval by the City Representative.

FIRE TRUCKS -- Must be considered as a WB40 truck with a minimum forty-five-foot (45') radius for design purposes and any other requirements as determined by local fire protection district.

FLOWLINE -- The transition point between the gutter and the face of the curb. For a cross or valley pan, it is the center of the pan.

FRONTAGE -- The distance along the street Right of Way line of a single property or development within the property lines. Corner property at an intersection would have a separate frontage along each street.

GUARANTEE -- This is the written financial mechanism required by the City from the Developer/Contractor to ensure that the committed or planned infrastructure is completed. This can take the form of cash, performance, or warranty bond, and/or letter or credit.

GRADE -- Rate or percent of slope, either ascending or descending from or along the roadway. It is usually measured along the centerline of the roadway.

GREEN TIME -- The length of a green phase plus its change interval, in seconds.

HOURLY VOLUME -- The number of (mixed) vehicles that pass over a given section of a lane or roadway during a time period of one (1) hour.

IMPROVEMENTS AGREEMENT -- A written contract between the Developer/Owner and the City of Northglenn for installation of all public improvements and/or private improvements in the areas of common ownership, related to a particular project.

INDUSTRIAL OR WAREHOUSE -- Any establishment that manufactures or stores an article or product.

INSPECTOR -- shall mean the authorized representative of the City of Northglenn Public Works Department and Engineering Division at the site of the work.

LEVEL OF SERVICE (LOS) -- A measure of the mobility characteristics of an intersection as determined by vehicle delay and a secondary factor, the volume/capacity ratio.

MAY -- will be interpreted as being permissive.

MILE HIGH FLOOD DISTRICT (MHFD) -- Formerly known as Urban Drainage and Flood Control District (UDFCD)

MUTCD -- Manual on Uniform Traffic Control Devices and the Colorado Supplement.

MUNICIPAL CODE -- shall mean the official adopted Municipal Code of Northglenn, Colorado.

OWNER -- shall mean a person, company, firm, or corporation holding title to land that is being developed or modified within the City.

PRE-APPLICATION MEETING -- A meeting for all development projects with Public Improvement Plans and reports. The meeting is scheduled and organized through the City of Northglenn Planning office.

PUBLIC IMPROVEMENTS -- all work in the public Right of Way, City property, easements dedicated to the City, private property that will become City property or an easement to the City in the future and projects or utilities that will become the City's responsibility to maintain.

PUBLIC WORKS DIRECTOR -- The City of Northglenn Public Works Director shall designate the Engineering Division staff responsible for the review and implementation of these STANDARDS and SPECIFICATIONS.

RADIUS CURB RETURN -- The curved portion of a street curb at street intersections or the curved portion of a curb in the end slopes of a driveway approach.

RESIDENTIAL -- Property used primarily for residential purposes such as single-family, two-family, and multi-family units.

Single-Family (SF) Residential: Single, detached family dwelling units, double bungalows, or duplexes.

Multi-Family (MF) Residential: Three or more attached dwelling units including townhouses, condominiums, and apartments.

SERVICE AREA -- shall mean the area, whether inside or outside City limits, that receives water and sanitary sewer utility service from the City of Northglenn.

SERVICE LINE -- all pipe, fittings, and appurtenances of improvement for conveying water from distribution mains to the premises.

SERVICE STATION -- Any property where flammable liquids such as motor vehicle fuel are used, stored and/or dispensed from fixed equipment into fuel tanks of motor vehicles.

SETBACK (S) -- The lateral distance measured perpendicular to the street Right of Way line and extending from the Right of Way line to the closest point on a structure.

SIGHT DISTANCE -- The length of roadway ahead visible to the driver. The minimum sight distance available should be sufficiently long to enable a vehicle traveling at or near the design speed to stop before reaching a stationary object in its path.

SIGNAL PROGRESSION -- Progressive movement of traffic at a planned rate of speed through adjacent signalized locations within a traffic control system without stopping.

SPEED CHANGE LANE -- A separate lane for the purpose of enabling a vehicle entering or leaving a roadway to increase (acceleration lane) or decrease (deceleration lane) its speed to a rate at which it can more safely merge or diverge with through traffic.

STOPPING SIGHT DISTANCE -- The distance traveled by the vehicle from the instant the driver of a vehicle sights an object necessitating a stop to the instant the brakes are applied and the distance required to stop the vehicle from the instant brake application begins.

STORAGE LANE -- Additional lane footage added to a deceleration lane to store the maximum number of vehicles likely to accumulate during a critical period without interfering with the through lanes.

SHALL -- will be interpreted as being mandatory.

STANDARDS AND SPECIFICATIONS -- reference is made to the “City of Northglenn”, Standards and Specifications for the Design and Construction of Public Improvements.

SUBCONTRACTOR -- any person, partnership, company, firm, or corporation licensed and bonded in the City in accordance with the Municipal Code which has a direct or indirect contract with the Contractor or other Subcontractor and furnishes and/or performs on-site labor and/or furnishes materials in connection with the performance of the work.

SURETY -- shall mean the entity which is bound with and for the Contractor for the performance of the work as described in these specifications. Includes the capability to bond.

TAP -- shall mean the physical connection to the potable water or sanitary sewer system of the City of Northglenn.

TESTING AGENCY -- any individual, partnership or corporation which is qualified and licensed to perform the required sampling, analysis, testing and professional recommendation service.

TRAFFIC ENGINEER -- shall mean the Director of Public Works / Engineering Division authorized representative acting on behalf of the City.

TIME SPACE DIAGRAM -- A chart on which the distance between signals and signal timing is plotted against time. The chart, when completed, indicates signal progression band widths and speed of traffic.

URBAN DRAINAGE AND FLOOD CONTROL DISTRICT (UDFCD) -- Former name for Mile High Flood District (MHFD) **UTILITY SYSTEM** - shall include all water and sanitary sewer facilities owned by the City of Northglenn, including but not limited to, water and sewer mains, fire hydrants, service lines from tap through the meter pit or vault and pump stations.

WIDTH OF CURB OPENING (W) -- The width of curb opening measured at the curb line.

YOKE -- shall mean a metal pipe frame attached to the inlet and outlet sides of the meter providing support and conveying water to and from the meter.

RESOURCE STANDARDS FOR REFERENCES

1. Colorado Department of Transportation, Standard Specifications for Road and Bridge Construction.
2. Colorado Department of Transportation, Standard Plans (M & S Standards).
3. Colorado Department of Transportation, Roadway Design Manual.
4. American Public Works Association, Standard Plans.
5. American Association of State Highway and Transportation Officials, A Policy on Geometric Design of Highways and Streets.
6. Institute of Traffic Engineers (ITE), Trip Generation Volumes 1 through 3.
7. National Cooperative Highway Research Program (NCHRP) Report 279, Intersection Channelization Design Guide, 1985.
8. Institute of Traffic Engineering, Highway Capacity Manual.
9. ASTM, American Society for Testing and Materials.
10. The American with Disabilities Act, (A.D.A.) Regulations.
11. US Department of Transportation, Manual on Uniform Traffic Control Devices (M.U.T.C.D.)
12. Federal Highway Administration, Roundabouts: An Informational Guide.
13. American Association of State Highway and Transportation Officials, Guide for the Development of Bicycle Facilities.
14. Urban Drainage and Flood Control District, Standards.
15. EPA Drinking Water Standards
16. NSF Standards for Water Treatment Systems
17. ANSI Standard, Wastewater Treatment Systems
18. Clean Water Act
19. Denver Water Board, Engineering Standards of the Board of Water Commissioners



Appendix A Plan Development Checklist

APPENDIX A - CONSTRUCTION PLAN CHECKLIST

Civil Development Review

Project Name: _____

Project Location: _____

Review Date: _____

Reviewed By: _____

ITEMS REQUIRED	PLAN SET REQUIREMENT						ENGINEER RESPONSES
	30%	60%	90% and FINAL	YES	NO	N/A	
Submitted on 24" x 36" size drawings - electronically	x	x	x				COMMENTS
Each sheet title block includes correct project name	x	x	x				
Each sheet title block includes correct drawing number	x	x	x				
Each sheet title block includes correct Designed by, Drafted by and Checked by initials and dates	x	x	x				
Each sheet title block includes Colorado Professional Engineer seal			x				
Each sheet showing plan view includes north arrow and is shown with correct orientation	x	x	x				
Each sheet showing plan/elevation/details includes scale bar and is correct	x	x	x				
Each sheet showing horizontal and vertical control includes appropriate datum reference	x	x	x				
Order of precedence of plans is logical and sheet names/numbers are consistent with plans	x	x	x				
All legend symbols and abbreviations correspond with those shown in the plans	x	x	x				
All general notes correspond with the work of the plans	x	x	x				
Line weights are used properly to represent the work	x	x	x				
Scale is used properly to present the work.	x	x	x				
All details and section are correct for sheet reference numbers, limits, aspects, and orientation	x	x	x				
Project Location is accurately located and project limits are depicted on the plan	x	x	x				
Sheet order of precedence matches plan sequence	x	x	x				
Each plan sheet is included, and sheet number, drawing number and title are consistent with the plans		x	x				
Summary of quantities - all items are included, and quantities and units are consistent with estimate		x	x				
A key map plan, when necessary to identify areas when the plan is separated	x	x	x				
Sheet index included with titles of each sheet and sheet number consistent with actual sheet	x	x	x				
At a minimum, each submittal shall include the following plans (grading, erosion control, survey, street design, storm drainage, paving, utilities, traffic signage and striping, site lighting, landscape and irrigation)	x	x	x				

	PLAN SET REQUIREMENT						
ITEMS REQUIRED	PLAN SET REQUIREMENT			ENGINEER RESPONSES			
EXISTING CONDITIONS/DEMOLITION PLAN	30%	60%	90% and FINAL	YES	NO	N/A	COMMENTS
Topography is shown with appropriate line weight and accuracy	x	x	x				
Boring locations are shown, identified and accurate in their location.		x	x				
Right of Way, easements and other property lines are shown and consistent	x	x	x				
All existing features and elements are clearly identified	x	x	x				
Horizontal and vertical control is established	x	x	x				
Horizontal and vertical datum is identified	x	x	x				
Survey monument identification is correct	x	x	x				
Underground utilities are shown using appropriate symbols, line types and scale, and are complete	x	x	x				
All applicable site utility features and elements are clearly identified		x	x				
All demolition work of project is identified and appropriately referenced		x	x				
Demolition callouts accurately describe the nature and limits of the work		x	x				
All salvage and relocation items are clearly identified		x	x				
All utility demolition is identified by cross-hatching		x	x				
Pavement removal limits are clearly shown and dimensioned		x	x				

	PLAN SET REQUIREMENT						
ITEMS REQUIRED	PLAN SET REQUIREMENT			ENGINEER RESPONSES			
SITE PLAN	30%	60%	90% and FINAL	YES	NO	N/A	COMMENTS
Topography is consistent with existing conditions sheets	x	x	x				
Topography is consistent with proposed new contours shown	x	x	x				
Right of Way, easements, and other property lines are shown and consistent with existing conditions sheets	x	x	x				
Existing utilities consistent with existing utilities sheets	x	x	x				
All applicable features and elements are clearly identified	x	x	x				
Surveying information and applicable datum shown	x	x	x				
All new work on project is identified and appropriately referenced to discipline plan sheets (i.e. see Civil, Structural, Mechanical, Electrical sheets)		x	x				
All new work of project is coordinate between discipline plan sheets		x	x				
All new work is clearly delineated from existing conditions	x	x	x				
Only new work is shown (i.e. All existing work replaced by new work is removed from plan sheets)		x	x				
New work callouts accurately describe the nature and limits of the work		x	x				
Location of ADA ramps, curb and gutter, sidewalk is shown	x	x	x				
Typical street cross-sections are provided		x	x				
New Utilities are shown and complete		x	x				
Show all street names	x	x	x				

	PLAN SET REQUIREMENT						
ITEMS REQUIRED	PLAN SET REQUIREMENT			ENGINEER RESPONSES			
CIVIL PLANS/ROADWAY/TRANSPORTATION	30%	60%	90% and FINAL	YES	NO	N/A	COMMENTS
Topography is consistent with existing condition sheets	x	x	x				
Right of Way, easements, and other property lines are shown and consistent with existing conditions sheets	x	x	x				
All applicable features and elements are clearly identified		x	x				
Civil work clearly identified and dimensioned in appropriate units/coordinates		x	x				
Reference dimensions are indicated as appropriate		x	x				
ROW limits are clearly shown and dimensioned		x	x				
Construction phasing plans are included		x	x				
Construction staging area clearly identified			x				
Slopes for drainage are shown and clear		x	x				
Pavement sections are shown and detailed		x	x				
Signage and striping is shown and complete		x	x				
ADA parking and access are shown and have been coordinated with others		x	x				
Traffic control is shown and complete		x	x				

	PLAN SET REQUIREMENT						
ITEMS REQUIRED	PLAN SET REQUIREMENT			ENGINEER RESPONSES			
GRADING PLAN/STORM WATER MANAGEMENT PLAN	30%	60%	90% and FINAL	YES	NO	N/A	COMMENTS
Topography is consistent with existing condition sheets	x	x	x				
Topography is consistent with proposed new contours shown	x	x	x				
Grading limits are clearly shown and dimensioned		x	x				
Trenching and cut/fill limits are shown		x	x				
Drainage structures grate and invert elevations are shown		x	x				
City of Northglenn standard erosion control notes included	x	x	x				
Storm sewer utility to include plan and profile		x	x				
Storm sewer manholes and inlets include stationing		x	x				
Storm sewer profiles to include HGL		x	x				
BMPs to be selected based on appropriate use (refer to Mile High Flood District for use requirements)		x	x				
Side slopes greater than 3:1 may require terracing or structural retaining walls. Retaining walls greater than 3 feet must have structural design		x	x				
All existing curb, gutter, and sidewalk and proposed curb, gutter, sidewalk	x	x	x				
Shows that adjoining property will not be affected and grading is compatible	x	x	x				
Detention pond details including outlet structure shown		x	x				

	PLAN SET REQUIREMENT						
ITEMS REQUIRED				ENGINEER RESPONSES			
WATER UTILITY PLAN	30%	60%	90% and FINAL	YES	NO	N/A	COMMENTS
Site map with north arrow and scale	x	x	x				
Vicinity map with north arrow and scale	x	x	x				
Title of project (list phases as applicable)	x	x	x				
Label whether town homes, apartments, duplexes or condominiums	x	x	x				
Typical street cross sections showing all existing and proposed utilities with required separation		x	x				
Standard water plan notes		x	x				
Signature blocks	x	x	x				
Fire flow information (max static pressure, residual pressure)		x	x				
Bar scale (1" = 50' of sufficient size to properly show detail)	x	x	x				
Valves must be installed a maximum of every 600 feet or no more than 18 residential units out of services and 1 hydrant		x	x				
System must be looped if more than 12 single family services on a single feed water line		x	x				
Permanent and temporary dead end mains require a hydrant	x	x	x				
Show public water mains, stubouts and hydrants in public ROW or utility easements	x	x	x				
Ensure easements are adequate	x	x	x				
Outage modeling required for shut down of water mains greater than 12 inch diameter			x				
30" minimum pup between fittings		x	x				
Minimum of 5' of cover to top of pipe	x	x	x				
Water lines located on 5 feet north or west of street centerline or 5 feet north of west curb median	x	x	x				
Provide calculations for all concrete thrust blocks for water mains greater than 16 inches and label volume		x	x				
Show and label all existing and proposed utilities including gas and electric. Size and material must be shown.	x	x	x				
Label all existing and proposed water lines as public or private	x	x	x				
Label phase lines with stations		x	x				
Label match lines with stations and corresponding sheet numbers		x	x				
Label all horizontal and vertical bends and size (45 degree max bend, use standard sizes)		x	x				
Label street names (note if private)	x	x	x				
Label all existing valve and fire hydrants		x	x				
Shown anode size, test station, and location on DIP/steel mains		x	x				
Label property lines	x	x	x				
Label subdivision boundaries and adjacent filings	x	x	x				
Label curb and gutter	x	x	x				
Label size of all reducers		x	x				
Label curve data including PC's and PT's with stations and label radius number and widths		x	x				
Provide addresses and lot numbers for all lots/buildings		x	x				

Show stations for all fittings		x	x				
Show stations for all crossings		x	x				
Show stations for all service connections (4" and larger)		x	x				
Label all concrete thrust blocks and show volumes		x	x				
Label pipe as abandoned or removed per Northglenn standards		x	x				
Label length of main to be abandoned		x	x				
Stub-outs must have temporary blow-offs assemblies with thrust blocks		x	x				
Label horizontal distance from proposed waterline to other utilities where it deviates from typical cross section		x	x				
Verify that the water main is located in roadways, in drive aisles of parking areas, or at a minimum 5 feet from edge of easement within that easement		x	x				
Verify that the water main is located 15 feet away from any tree, structure or building		x	x				
Crossings underneath utilities shall have plan and profile and maintain a minimum of 24" separation		x	x				
Show pipe elevations and vertical separations for all wastewater, storm sewer, electrical duct banks and high		x	x				
If vertical separaton is not met flow-fill shall be used to achieve compaction		x	x				
Show secondary containment (casing pipe, encased in flow-fill or HDPE/welded steel) whcihc is required for water		x	x				
Add concrete restraints at top and bottom of slope on grades greater than 10%		x	x				
Install MJ restrained pipe on grade greater than 10%		x	x				
Steel casing should not be more than 5% slope on proposed water line		x	x				
Steel casing needs to be approximately 2 times the diameter of the proposed water line		x	x				
Ensure no taps or tees are proposed at casing locations or within lowering		x	x				
Show casing pipe if water main under another utility greater than 30" in diameter		x	x				
If crossing pressure zones, a pressure regulator station is required		x	x				
Show detail for all pressure regulator stations on construction drawings. Show vents on plan view		x	x				
Profile all pressure regulator stations		x	x				
Profile all air and vacuum valve stations. Show vents on plan view.		x	x				
Hydrant design notes shall include station and offset, flange elevation, GPM, and thrust block sizes		x	x				
No horizontal or vertical bends on hydrant laterals		x	x				
Show bollards, if required.		x	x				
Show concrete reverse anchors for fire hydrant valve if hydrant installed at dead ends		x	x				
Show MJ restraints for pipe joints for PVC and DIP hydrant laterals greater than 20 feet		x	x				
Show and label fire department connections		x	x				
Profiles required for mains greater than 8 inches at scale of 1"-50' horizontal and 1"-5' vertical		x	x				
Profiles required for mains when slopes greater than 10%, at all water line lowering		x	x				
Stations on profile to match plan view		x	x				

Label existing and proposed grades		x	x				
Label all proposed horizontal and vertical bends with elevations		x	x				
Label percent grade on all profile pipes		x	x				
Label all valves and show butterfly valves on 16" water lines and larger		x	x				

	PLAN SET REQUIREMENT						
ITEMS REQUIRED	PLAN SET REQUIREMENT			ENGINEER RESPONSES			
WASTEWATER UTILITY PLAN	30%	60%	90% and FINAL	YES	NO	N/A	COMMENTS
Wastewater general notes	x	x	x				
Wastewater plan and profile to be at a scale of minimum 1"=50' hoizontal and 1"=5" vertical	x	x	x				
Wastewater lines to be located five feet south or east of street centerline	x	x	x				
Label street width FL-FL and horizontal separation between utiliteis	x	x	x				
When connecting to existing manoles or mains shown and label all design information for such facility including size, material, slope, etc.	x	x	x				
Label manholes with stations (offset as required)	x	x	x				
Provide reference stations and horizontal control for intersecting manholes		x	x				
Label interval stationing and distinguish between centerline or wastewater stationing	x	x	x				
Label curve data including PC's and PT's with stations and label radius number and widths		x	x				
Label access road to manholes		x	x				
Label services lines locations with stations (commercial projects)	x	x	x				
Label sleeves with begin and end station and include pipe size and material of sleeve	x	x	x				
Label length and slopes of pipes - must match stationing		x	x				
Label manholes with stations, diameter, rim elevations, and all inverts (existing and proposed)		x	x				
Label under drain including type (passive or active), material, clean outs, trench dams, and discharge points		x	x				
Label existing and proposed grades	x	x	x				
Label grid stations and elevations	x	x	x				
Verify diameter of manholes and pipes	x	x	x				
Label if manhole has locking lid and type		x	x				
Manhole assessment must be completed when modifications or connections to existing manholes are proposed	x	x	x				
Maximum spacing between manholes 400 feet		x	x				
No services allowed on stub for future main extensions	x	x	x				

Appendix B General Notes

Submission of Construction Plans shall include a General Notes sheet as part of the plan set. Include only the notes that apply to the project.

1. All materials, workmanship, and construction of public improvements shall meet or exceed the standards and specifications set forth in the City of Northglenn Standards and Specifications and applicable district, state and federal regulations. Whenever there is conflict between these plans and the specifications, or any applicable standards, the most restrictive standard shall apply. All work shall be inspected and accepted by the Engineering Division.
2. The Developer/Contractor is specifically cautioned that the location and/or elevation of existing utilities, as shown on these plans, is based on records of the various utility companies and, where possible, measurement taken in the field. The information is not to be relied upon as being exact or complete. The Designer shall contact the Utility Notification Center of Colorado (UNCC) at 1-800-922-1987, at least 3 working days prior to beginning excavation or grading, to have all registered utility locations marked. Other unregistered utility entities (i.e. ditch/irrigation companies) are to be located by contacting each agency. It shall be the responsibility of the Developer/Contractor to relocate all existing utilities that conflict with the proposed improvements shown on these plans.
3. No work may commence within any improved public Right of Way until a Right of Way Permit and/or Grading Permit is obtained, if applicable. The Developer shall submit a Construction Traffic Control Plan, in accordance with MUTCD, to the Engineering Division prior to any construction activities within, or affecting, the Right of Way. The Developer shall be responsible for providing any and all traffic devices as may be required for the construction activities.
4. The Developer/Contractor shall be responsible for obtaining all necessary permits for all applicable agencies. The Developer/Contractor shall notify the Engineering Division at least 2 working days prior to the start of any earth disturbing activity, or construction on any and all public improvements.
5. The Designer who has prepared these plans, by execution and/or seal hereof, does hereby affirm responsibility to the City of Northglenn, as the beneficiary of said designer's work, for any errors and omissions contained in these plans, and acceptance of these plans by the City Engineering Division shall not relieve the Designer who has prepared these plans of all such responsibility. Further, to the extent permitted by law, the Designer hereby agrees to hold harmless and indemnify the City, and its officers and employees, from and against all liabilities, claims and demands which may arise from any errors and omissions contained in these plans.
6. All utility installations within or across the roadbed of new residential roads must be completed prior to the final stages of road construction. All service lines must be stubbed to the property lines and marked so as to reduce the excavation necessary for building connections.
7. The Developer/Contractor shall coordinate and cooperate with the City Engineering Division, and all utility companies involved, regarding relocations, adjustments, extensions, and rearrangements of existing utilities during construction, and to assure that the work is accomplished in a timely fashion and with minimum disruption of service. The Developer/Contractor shall be responsible for contacting, in advance, all parties affected by any disruption of any utility service.
8. When applicable, the Developer/Contractor shall have onsite each of the following:



9. The Developer/Contractor shall be responsible for all aspects of safety including, but not limited to, excavation, trenching, shoring, traffic control and security. Refer to OSHA Publication 2226, Excavating and Trenching.
10. If, during the construction process, conditions are encountered which could indicate a situation that is not identified in the plans or specifications, the Developer/Contractor shall contact the Designer and the Engineering Division immediately.
11. All references to any published standards shall refer to the latest revision of said standard.
12. The Developer/Contractor is responsible for providing all labor and materials necessary for the completion of the intended improvements, shown on these drawings.
13. The Developer/Contractor shall be responsible for ensuring that no mud or debris shall be tracked onto the existing public street system. Mud and debris must be removed by the end of each working day by an appropriate mechanical method (i.e., machine broom sweep, light duty front end loader, etc.).
14. The Developer/Designer shall be responsible for recording as-built information on a set of record drawings kept on the construction site, and available to the Engineering Division at all times.
15. Dimensions for layout and construction are not to be a scaled form of any drawing. If pertinent dimensions are not shown, contract the Designer for clarification, and annotate the dimension on the as-built record drawings.
16. The Developer/Contractor shall comply with all terms and conditions of the Colorado Permit for Storm Water Discharge, the Storm Water Management Plan (SWMP) and the Erosion Control Plan.
17. All structural erosion control measures shall be installed, at the limits of construction and at areas with disturbed soil, on- and off-site, prior to any other ground-disturbing activity. All erosion control measures shall be maintained in good repair by the Developer/Contractor, until such time as the entire disturbed areas is stabilized with hard surface or landscaping. To mitigate erosion, the Developer/Contractor shall use standard erosion control techniques described in the Mile High Flood District's Urban Storm Drainage Criteria manual, Volume 3 – Best Management Practices.
18. The Developer/Contractor shall sequence installation of utilities in such a manner as to minimize potential utility conflicts. In general, storm drainage and sanitary sewer should be constructed prior to installation of the water lines and dry utilities.
19. There shall be no site construction activities on Saturdays or Sunday or after 3:30 pm on weekdays unless approved otherwise on the Right of Way permit.
20. The Designer shall provide, in this location on the plans, the location and descriptions of the nearest survey benchmark for the project as well as the basis of bearings. The information shall be as follows:

BM Number: _____ Elevation: _____

Description: _____

21. Upon completion of construction, the site shall be cleaned and restored to a condition equal to, or better than, that which existed before construction, or to the grades and condition as required by these plans.

22. Existing fences, trees, streets, sidewalks, curb and gutter, landscaping, structures, and improvements destroyed, damaged, or removed due to construction of this project shall be replaced or restored in like kind at the Developer's/Contractor's expense.
23. Overlot grading construction must comply with the State of Colorado permitting process for "stormwater discharges associated with the construction activity" and City Grading Permit.
24. After Initial Acceptance by the City Engineering Division, public improvements depicted in these plans shall be guaranteed to be free from material and workmanship defects for a period of two years from the date of Initial Acceptance.
25. These public improvement construction plans shall be valid for a period of one year from the date of acceptance by the City Engineering Division. Use of these plans after the expiration date will require a new review and approval process by the City prior to commencement of any work shown in these plans.

Appendix C Construction Notes

C.1 Standard Grading and Erosion and Sediment Control Construction Plan Notes

1. The Engineering Division must be notified at least forty-eight (48) hours in advance of any construction on this site.
2. There shall be no earth-disturbing activity outside the limits designated on the accepted plans.
3. All required perimeter silt and construction fencing shall be installed prior to any land disturbing activity (stockpiling, stripping, grading, etc.). All other required erosion control measures shall be installed at the appropriate time in the construction sequence as indicated in the accepted construction schedule and construction plans including erosion control.
4. At all times during construction, the Developer/Contractor shall be responsible for preventing and controlling on-site erosion including keeping the property sufficiently watered so as to minimize wind-blown sediment. The Developer/Contractor shall also be responsible for installing and maintaining all erosion control facilities shown herein.
5. Pre-disturbance vegetation shall be protected and retained wherever possible. Removal or disturbance of existing vegetation shall be limited to the area(s) required for immediate construction operations, and for the shortest practical period of time.
6. All soils exposed during land disturbing activity (stripping, grading, utility installations, stockpiling, filling) shall be kept in a roughened condition by ripping or disking along land contours until mulch, vegetation, or other permanent erosion control BMPs are installed. No soils in areas outside project street Rights of Way shall remain exposed by land disturbing activity for more than thirty (30) days before required temporary or permanent erosion control (e.g. seed/mulch, landscaping) is installed.)
7. In order to minimize erosion potential, all temporary erosion control measures shall:
 - a. Be inspected at a minimum of once every two (2) weeks and after each significant storm event and repaired or reconstructed as necessary in order to ensure the continued performance of their intended function.
 - b. Remain in place and correctly established until such time as all the surrounding disturbed areas are sufficiently stabilized as determined by the City Engineering Division.
 - c. Be removed after the site has been sufficiently stabilized as determined by the Engineering Division.
8. When temporary erosion control measures are removed, the Developer/Contractor shall be responsible for the clean up and removal of all sediment and debris from all drainage infrastructure and other public facilities.
9. The Contractor shall clean up any inadvertent deposited material immediately and make sure streets are free of all materials by the end of each working day.
10. All retained sediments shall be removed and disposed of in a manner and location so as not to cause their release into any waters of the United States.
11. All soil stockpiles shall be protected from sediment transport by surface roughening, watering and perimeter silt fencing. Any soil stockpile remaining after thirty (30) days shall be seeded and mulched.

12. The stormwater volume capacity of detention ponds will be restored, and storm drainage lines will be cleaned upon the completion of the project.
13. Colorado Discharge Permit System (CDPS) requirements make it unlawful to discharge or allow the discharge of any pollutant or contaminated water from construction sites.
14. A designated area shall be provided on site for concrete truck chute washout. The area shall be constructed to contain washout material and located at least fifty (50) feet away from any waterway during construction. Upon completion of construction activities, the concrete washout material will be removed and properly disposed of prior to the area being restored.
15. If conditions in the field change from the plans anticipated, additional erosion control measures may be required by the Engineering Division.
16. A vehicle tracking control pad shall be installed when needed for construction equipment, including but not limited to personal vehicles exiting existing roadways.
17. Add notes to reflect the storm water runoff control plan of the project.

C.2 Sanitary Sewer Construction Notes

Chapter 1 All design standards, materials and workmanship for public sanitary sewers shall be in accordance with the City of Northglenn standards and specifications.

Chapter 2 Benchmark elevations are based on _____ datum. (similar language that includes description and elevation of an acceptable benchmark may be used. Use navd 88 datum).

Chapter 3 Basis and record of bearing (horizontal control) defined in accordance to Colorado boundary survey minimum standard.

Chapter 4 The Contractor shall call for locates a minimum of two (2) business days prior to commencing construction activities. The Contractor shall keep all locate requests up-to-date and comply with applicable Colorado revised statutes (C.R.S.), pertaining to "blue stake". Errors in locates shall be immediately reported to the Engineering Division.

Chapter 5 The Contractor shall field verify existing sewer elevations and alignments prior to construction and implementation; verification may require potholing.

Chapter 6 Any activity that might affect the sanitary sewer system (materials entering the system, conveyance and treatment) requires approval and/or permit by the Engineering Division prior to any activity.

Chapter 7 Sewer construction shall not commence until a Right of Way permit is issued on accepted construction plans and a pre-construction meeting.

Chapter 8 Immediately report any of the following to the Engineering Division: any release of sewage, any damage to the public sanitary sewage system, or the dropping of debris into the public sanitary sewage system. Take immediate action to contain the sanitary sewage overflow from the sewer system. The Contractor shall be responsible for all costs to repair the system. The contractor shall repair all damage as directed and approved by Engineering Division.

Chapter 9 The inspection of the Contractor's work by an agency shall in no way relieve the Contractor of the responsibility for compliance with the requirements of the contract documents, construction plans and/or specifications. If the engineer of record or Engineering Division fail to point out a defect, deficiency or error in the work

from lack of discovery or for any other reason, it shall in no way prevent later rejection or relieve the contractor of performing corrections to the unsatisfactory work when discovered.

Chapter 10 The Contractor shall comply with applicable occupational safety and health administration (OSHA) regulations at all times and any manhole entry guidelines.

Chapter 11 Sanitary sewer construction shall start at the lowest downstream point and progress upstream, regardless of the stationing shown on the plans.

Chapter 12 The horizontal and vertical separation between public water mains and public sewer lines shall comply with the City of Northglenn STANDARDS AND SPECIFICATIONS.

Chapter 13 New public sewer facilities must be tested, inspected and authorized for discharge by the Engineering Division prior to discharging into the existing public sanitary sewer.

Chapter 14 Only plans accepted by Northglenn Engineering Division shall be used for the installation of sanitary sewer facilities. Plans accepted by the City requiring revisions shall be resubmitted for review and re- acceptance by the Engineering Division prior to start of the revised work.

Chapter 15 Sewer construction will not be accepted by Engineering Division if it includes additional work not provided in the approved set of plans.

Chapter 16 Contractor shall maintain access to all sanitary sewer manhole structures at all times.

Chapter 17 All storm water pollution prevention plan (swppp) measures shall be installed so as to prevent all storm water, construction water, fuels, chemicals, or liquids to be directed into or onto any sanitary sewer facilities. Protection of sanitary sewer facilities shall be a part of the approved construction swppp and best management practices. Protection devices shall be installed and maintained around all potentially affected sanitary sewer facilities within the project limits.

Chapter 18 Survey layout and survey control shall be performed by, or under the direct supervision of, a Registered Land Surveyor (RLS) registered in the state of Colorado.

C.3 Additional general sewer notes; any of the following notes may be omitted when not applicable:

1. The contractor shall furnish, operate, and maintain all equipment and labor necessary to provide continuous 24 hr/day sanitary sewer service to all parties tributary to a live sanitary sewer to which a connection is to be made. The Engineering Division shall be notified a minimum of two (2) business days prior to commencing any construction activities that could either adversely impact the flow within a live sanitary sewer system or involve connection to any public sanitary sewer.
2. Where connections to existing manholes are to be made, the Contractor shall construct new inverts in the existing base to smoothly direct the flow in the proper direction.
3. Ductile iron pipe shall be installed with an approved exterior polyethylene wrapping.
4. Manhole surfaces shall be caulked, sealed, and coated.

5. [length] linear feet of existing [diameter] public sewer from manhole # [manhole #] to manhole # [manhole #] is to be abandoned. Remove sewer completely. Sewer shall not be abandoned in place without prior approval from the Engineering Division.
6. It is the sewer contractor's responsibility to adjust or reconstruct all sanitary sewer manholes to finished grade. All frames and cover adjustments are to be in accordance with the City of Northglenn STANDARDS AND SPECIFICATIONS. While adjusting the manhole to finished grade, it is the contractor's responsibility to ensure that frames and covers are cleaned of any and all attached materials (asphalt, concrete, etc.) And that any vent holes are open and clear of obstructions. If the frame and cover are damaged or cannot be completely cleaned, a new frame and cover are to be put into place. Costs associated with these actions are the responsibility of the Contractor.
7. This public sewer is designed at minimum allowable pipe slope. Special care should be taken to assure design slope is maintained. Sewers found to be constructed at insufficient slopes will not be accepted by the Engineering Division. Corrective action, including re-construction of the sewer(s) at the sole expense of the project owner/contractor would be required.
8. All testing required by the city shall be paid for by the Contractor / Developer.

C.4 Water Construction Notes

1. The minimum cover over water lines is five (5) feet and the maximum cover is six (6) feet.
2. Water mains will be installed according to the latest City of Northglenn Standards and Specifications.
3. Contractor to have on the job site and a copy of the latest Standard Specifications at all times.
4. Contractor shall schedule inspections a minimum of 24 hours in advance and in accordance with the Inspection Checklist requirements. To schedule the inspections, call City of Northglenn Engineering Division.
5. Separation between sanitary sewer and water mains shall be a minimum of 10' HORIZONTAL, 2' VERTICAL (above sewer).
6. Service laterals will be set to grade by Contractor prior to the installation of water meters and boxes.
7. Water meter will not be installed, nor water turned on until the backflow devices required for the building and irrigation systems have been installed, tested, approved, and certified.
8. Protect existing utilities in place.
9. Water mains shall have 60" minimum cover to finish grade.
10. Raise existing water valve covers to grade.
11. Chip 2" 'W' in curb face to identify water service location. 20. Install thrust or gravity blocks per requirements of this documents.
12. Contractor to verify depth and location of all utilities prior to trenching.
13. Contractor to install temporary taps for testing and chlorination prior to connecting to existing mains.
14. Design: Marking tape shall have the following properties

15. Color – Blue per APWA color code
16. Width – 3 inches minimum
17. Text – “CAUTION RESTRAINED JOINT BURIED BELOW”
18. Text shall continually repeat every 2 feet
19. Text color – Black
20. Text Size – 1 inch minimum
21. Thickness – 4mil minimum
22. Installation: Marking tape shall be placed along (longitudinally) the top of the water main following the installation of the required poly wrap for pipe and fittings, and taped to the poly wrap (around the water main) at 4 ft intervals for the limits of the installed joint restraint. The tape shall identify the complete restrained length.
23. No work shall begin until the water plans have been accepted for construction by the Engineering Division. When requesting inspections, please refer to the Project # identified on the plans.
24. All work shall conform to City of Northglenn STANDARDS AND SPECIFICATIONS, and to the latest edition of UDACS shall supersede any conflicts contained in the approved drawings and/or specifications.
25. All water meter boxes shall be located outside of driveway areas.
26. All valves shall be located outside of driveways, valley and curb gutters.
27. All water and storm drain or sanitary sewer crossings shall conform to the City of Northglenn STANDARDS AND SPECIFICATIONS.
28. All water facilities shall be filled, disinfected, pressure tested, flushed, filled, and an acceptable water sample obtained, prior to connection to the City of Northglenn distribution system.
29. Any interruption of service must be performed in accordance with The City of Northglenn STANDARDS AND SPECIFICATIONS. Proper written notification must be given to all affected customers.

C.5 Storm Drainage Construction Notes

1. The City shall not be responsible for the maintenance of storm drainage facilities located on private property.

C.6 Street Improvements Construction Notes

1. All street construction is subject to the General Notes on the cover sheet of these plans as well as the Street Improvements Notes listed here.
2. A paving section design, signed and stamped by a Colorado licensed Engineer, must be submitted to the Engineering Division for approval, prior to any street construction activity, (full depth asphalt sections are not permitted at a depth greater than 8 inches of asphalt). The job mix shall be submitted for approval prior to placement of any asphalt.

3. Where proposed paving adjoins existing asphalt, the existing asphalt shall be saw cut, a minimum distance of 12 inches from the existing edge, to create a clean construction joint. The Developer/Contractor shall be required to remove existing pavement to a distance where a clean construction joint can be made. Wheel cuts shall not be allowed unless approved by the Engineering Division.
4. Street subgrades shall be scarified the top 12 inches and re-compacted prior to subbase installation. No base material shall be laid until the subgrade has been inspected and approved by the Engineering Division.
5. Valve boxes and manholes are to be brought up to grade at the time of pavement placement or overlay. Valve box adjusting rings are not allowed.
6. When an existing asphalt street must be cut, the street must be restored to a condition equal to or better than its original condition. The existing street condition shall be documented by the Inspector before any cuts are made. The finished patch shall blend smoothly into the existing surface. The determination of need for a complete overlay shall be made by the Engineering Division.
7. All traffic control devices shall be in conformance with these plans or as otherwise specified in M.U.T.C.D. (including Colorado supplement) and as per the Right of Way Work Permit traffic control plan.
8. The Developer/Contractor is required to perform a gutter water flow test in the presence of the Engineering Division representative and prior to installation of asphalt. Gutters that hold more than ¼ inch deep or 5 feet longitudinally, of water, shall be completely removed and reconstructed to drain properly.
9. Prior to placement of H.B.P. or concrete within the street *and* after moisture/density tests have been taken on the subgrade material (full depth asphalt) or on the subgrade and base material (when a composite section is proposed), a mechanical 'proof roll' will be required. The entire subgrade and/or base material shall be rolled with a heavily loaded vehicle having a total GVW of not less than 50,000 lbs. and a single axle weight of at least 18,000 lbs. with pneumatic tires inflated to not less than 90 p.s.i.g. "Proof roll" vehicles shall not travel at speeds greater than 3 mph. Any portion of the subgrade or base material which exhibits excessive pumping or deformation, as determined by the Engineering Division, shall be reworked, replaced, or otherwise modified to form a smooth, non-yielding surface. The Engineering Division shall be notified at least 24 hours in advance of the "proof roll". All 'proof rolls' shall be performed in the presence of the Engineering Division staff.

C.7 Traffic Signing and Pavement Marking Construction Notes

1. All signage and marking are subject to the General Notes on the cover sheet of these plans, as well as the Traffic Signing and Marking Construction Notes listed here.
2. All symbols, including arrows, ONLYS, crosswalks, stop bars, etc. shall be pre-formed thermoplastic.
3. All signage shall be per the City STANDARDS AND SPECIFICATIONS, these Construction Plans or MUTCD.
4. All lane lines for asphalt and concrete pavement shall receive epoxy applications. The epoxy lines shall be specified in CDOT Standard Specifications for Road and Bridge Construction.
5. Pre-formed thermoplastic applications shall be as specified in these Plans and/or these STANDARDS AND SPECIFICATIONS.



6. Prior to permanent installation of traffic striping and symbols, the Developer/Contractor shall place temporary tabs or tape depicting alignment and placement of the same. Their placement shall be approved by the Engineering Division prior to permanent installation of striping and symbols.
7. All surfaces shall be thoroughly cleaned prior to installation of striping or markings.
8. All sign posts shall utilize breakaway assemblies and fasteners per the STANDARDS AND SPECIFICATIONS.



Appendix D Certification of As-Builts

SAMPLE CERTIFICATION FORM

ENGINEER OF RECORD CERTIFICATION OF AS-BUILTS

<DATE>

City of Northglenn

Public Works Department

11701 Community Center Drive

Northglenn, CO 80233

RE: Certification of Substantial Conformance - <project name>

I hereby certify that I am a licensed civil engineer in the State of Colorado. To the best of my knowledge, information, and belief, the site improvements and infrastructure at <project name> were constructed in general conformance to the Construction Drawings issued by <Firm Name> and approved by the City of Northglenn. In my professional opinion, this project is in compliance with all applicable laws, codes and ordinances. This includes the <list of improvements> as shown on the approved plans <Sheets _ through inclusive>.

<Firm Name> bases this opinion on site visits and visual observations of the site improvements, as well as information provided by the Owner and the Contractor.

Respectfully,

<Firm Name>

<engineer of record> P.E. <number>



Appendix E Checklist for Right-of-Way Permits

NORTHGLENN PUBLIC WORKS DEPARTMENT

CONTRACTOR CHECKLIST

FOR RIGHT OF WAY PERMIT APPLICATION SUBMITTAL

All contractors conducting any work in the City of Northglenn Right of Way shall obtain a Right of Way Permit prior to any work. The Contractor should use this checklist to expedite the issuance of the permit. Questions may be directed to 303-450-8984.

_____ Infrastructure Construction Plans

_____ Construction Schedule

Please include a detailed construction schedule which includes time frame for traffic control, construction, inspections, testing, and restoration work.

_____ Performance, Payment, Maintenance and Warranty Bond

100% of the total cost of the project (as submitted by the Contractor and accepted by the City), or minimum \$5,000.00 shall be required for job-specific guarantee and an estimated cost for the year for an Annual guarantee. Bonds need to be written on city bond form. Bonds shall be the original document; photocopies or faxes shall not be acceptable.

_____ Certificate of Insurance

An original Certificate of Insurance listing the City of Northglenn as additional insured* shall be provided to the City, and shall be completed by the Applicant's insurance agent as evidence that policies providing the minimum required coverage, conditions, and minimum limits are in full force and effect, and shall be reviewed and approved by the City of Northglenn prior to issuance of a permit.

*Per the Northglenn Municipal Code relating to Public Rights of Way, Chapter 16, Article 2, the policy shall be endorsed to include: **"The City of Northglenn and the City of Northglenn's officers, volunteers and employees as additional insured."**

Workmen's Compensation Insurance to cover obligations imposed by applicable laws for any employee engaged in the performance of work under this permit, and Employer's liability insurance with minimum limits of one hundred thousand dollars (\$100,000) each accident, one hundred thousand dollars (\$100,000) disease – each employee, and five hundred thousand dollars (\$500,000) disease – policy limit. Evidence of qualified self-insured status may be substituted for the workmen's compensation insurance requirements of this paragraph.

General Liability Insurance with minimum combined single limits of one million dollars (\$1,000,000) each occurrence and one million dollars (\$1,000,000) aggregate. The policy shall be applicable to all premises and operations. The policy shall include coverage for bodily injury, broad form property damage (including completed operations), personal injury (including independent contractors), products, and completed operations. The policy shall include coverage for explosion, collapse, and underground hazards. The policy shall contain a severability of interest provision.



Comprehensive Automobile Liability Insurance with minimum combined single limits for bodily injury and property damage of not less than one million (\$1,000,000) each occurrence and one million dollars (\$1,000,000) aggregate with respect to each of permittee's owned, hired or non-owned vehicles assigned to or used in performance of the services. The policy shall contain a 'severability of interests' provision.

Traffic and Pedestrian Control Plan

A detailed traffic and pedestrian control plan that complies with the requirements of the Manual of Uniform Traffic Control Devices (MUTCD), latest revised edition, shall be submitted to the Engineering Division for review and approval. Traffic control plans shall be site specific and show signs, barricades, cones, tapers, spacing, driveways, paths and walks along with any other pertinent information. Include the number of workdays as well as specific hours of the proposed work. Pedestrian control shall comply with the requirements of the Americans with Disabilities Act. Generic traffic control plans cannot be accepted.

Standards and Specification Books

A current City Standards and Specifications book (\$50.00) or CD (\$5.00) or downloaded copy from the City's website is required to obtain a Right of Way permit. A Specifications book or the print pages applicable to the project must be maintained on site.

Permit Fee

Permit Fee shall be based on the City of Northglenn Fee Schedule. Permit fee shall include plan review fees, grading permit fees, inspection fees, restoration fees, and other fees as required by Chapter 16, Article 2 of the Northglenn Municipal Code.

Outstanding Fees

Starting work without a permit = \$500.00 plus 2 times the permit fee. Stop Work Order = \$250.00 per day per violation.

Mix Design

Submit mix designs for any concrete, asphalt, flow fill, and Class 6 Recycled Concrete Roadbase that will be used on the project. Concrete Mix Designs should be CDOT 4500 PSI Class B and Asphalt Mix Designs should be CDOT SX PG 64-22 No RAPP

Submittals

Any products or materials used on the project will require submittals. Provide two (2) copies of each for review and approval. (Example: pipe, fittings, tapping saddle, valve, hydrant, polywrap, etc.)

Contractor Registration

Contractors working in the City of Northglenn will be required to complete an application form annually (calendar year), complete with references, and submit to the City for review. A fee based on the City of Northglenn Fee Schedule will be assessed if the application is approved.

Construction Water Permit



Contractors needing to utilize City water for construction purposes may apply for a construction water permit. A refundable deposit of \$1,000.00 will be required. In addition, the first month's use fee of \$150.00 will need to be paid at the time of application for a construction water permit.

_____ Grading Permit

If the applicant's project involves working on slopes in excess of 6%, encompasses more than 1 acre of land, or exceeds 200 cubic yards of earthwork, then you will need to obtain this permit. If applicable, it may require additional bond and fees. Detailed information may be obtained by speaking with the Engineering Division.

_____ Stormwater Discharge Permit

Contact Northglenn's Stormwater Coordinator at 303-450-8792 for information regarding new City, State, and Federal regulations which may be required for the project.



Appendix F Design Forms



Grease Interceptors for Non-Domestic Facilities

Protecting public health and safety is the primary responsibility of the City's Public Works. Sewer blockages and spills pose a threat to public health and safety, and is prevented with proper FOG management. FOG includes animal fat products, dairy, cooking oil, shortening, and grease. FOG is often used in the preparation of food and beverages, so water used to wash equipment, dishes and floors in food service and preparation facilities contain FOG.

When FOG, or food and wastewater containing FOG, are poured down the drain, it cools and usually solidifies in the sewer pipes of buildings and the City's sewer collection system, which restricts and eventually clogs wastewater flow. Wastewater back-up into homes, businesses and the environment is known as sanitary sewer overflow and causes serious water quality problems, property damage and threat to public health. The most effective way to prevent sanitary sewer overflow and minimize FOG accumulation in sewer pipes is to prevent the introduction of FOG into the sanitary sewer system with Best Management Practices (BMPs).

All non-domestic facilities that prepare, serve, or otherwise make any type of food or beverages available for consumption (Food Service Establishment) are required to install and maintain a gravity grease interceptor. Interceptors prevent FOG from entering the City's sewers in the event of BMP failure. Full gravity grease interceptor criteria are given in the City's Grease Interceptor Design Form, but see page 2 of this document to estimate the required volume. Interceptors shall be maintained by regularly scheduled cleaning (pump-out) at a minimum every 90 days, or more often if required by the City.

Food Service Establishments are required to have a plan review approved by the City of Northglenn's Public Works. As part of this review, facilities submit to the City the following:

1. Industrial Waste Questionnaire
2. Grease Interceptor Design Form, completed and stamped by a Professional Engineer, or otherwise approved by City of Northglenn Public Works
3. List of fixtures and appurtenances that discharge to the sanitary waste system with manufacturer and model number.
4. Building/Kitchen floor plan with fixtures noted
5. Anticipated Best Management Practices (BMPs) used to limit FOG entering sanitary system
6. Anticipated maintenance (pump-out) schedule for grease interceptor.

The Industrial Waste Questionnaire and Grease Interceptor Design Form are found online at:

<http://www.northglenn.org/IndustrialPretreatment>

To submit plan review documents, and for questions about the City's FOG control program, please contact:

Alex Gan, Industrial Pretreatment Specialist
(303) 450-4026

ipprogram@northglenn.org



Gravity Grease Interceptor Volume Estimate

The following is provided as a guide to estimate the volume required for a gravity grease interceptor. Volume calculated using this document is **not** accepted as a replacement for the completed Gravity Grease Design Form when submitting documents for a food service establishment plan review. Structurally, the interceptor must also be equipped with a particular design of inlet, baffle wall and outlet tee. This guide is only intended to allow a food service professional to quickly estimate the approximate volume of gravity grease interceptor required for their establishment. The estimate may vary high or low by up to 33% of actual depending on kitchen design factors.

Gravity grease interceptors are sized based on the expected flow rate of different categories of kitchen fixtures in gallons per minute (gpm) with criteria of a hydraulic residence time of 30 minutes and a 25% FOG and solids storage factor. The design flow rate is one-third the maximum flow rate because of the bulk hydraulic compensation of short-term peak flow events. Refer to Water Research Foundation project reports 03-CTS-16Ta & b for design justification.

$$\text{Volume} = [\text{Maximum Flow Rate (gpm)}] \times 30 \text{ min} \times 1.25 \text{ storage factor} \div 3$$

To calculate the Maximum Flow Rate, select the appropriate fixture flow rate from the table below. Fixture flows are displayed for different drainage pipe diameters. Sum together the flow rates of all fixtures and insert into the Volume equation above.

		Fixture Flows (gpm)		
		1.5"	2.0"	2.5"
A	Ware Washing (3-comp sinks)	15	30	60
B	Food Preparation		2.2	
C	Pre-Rinse		2.2	
D	Dishwashing Machine		5	
E	Cooking Equipment	15	30	60
F	Mop Sink / Service Fixture		5	
G	Waste Food Disposal		2.2	
H	Floor Drains (one or many)		5	

Consider the following example for a kitchen with:

Two 3-comp wash sinks, 2" diameter drain pipe	A = 2 × 30	= 60
Two 2-comp prep sinks	B = 2 × 2.2	= 4.4
One pre-rinse sink	C = 1 × 2.2	= 2.2
One dishwashing machine	D = 1 × 5	= 5
One wok range, 1.5" diameter drain pipe	E = 1 × 15	= 15
One mop sink	F = 1 × 5	= 5
No waste food disposals	G = 0	= 0
Several floor drains	H = 5	= 5
A + B + C + D + E + F + G + H = 96.6		

$$\begin{aligned}\text{Volume} &= [\text{Maximum Flow Rate (gpm)}] \times 30 \text{ min} \times 1.25 \text{ storage factor} \div 3 \\ &= 96.6 \times 30 \times 1.25 \div 3 = 1207.5 \approx \mathbf{1200 \text{ gallons}}\end{aligned}$$



Gravity Grease Interceptor Design Form

Project Name:	
Project Address:	
Date Grease Interceptor Sized:	
Company Sizing Grease Interceptor:	
Engineer Name:	
Engineer Phone:	
Engineer E-mail:	

Instructions

This form must be completed and stamped by a licensed Professional Engineer, or otherwise approved by City of Northglenn Public Works. Return the completed form and the following attachments to the Industrial Pretreatment division:

1. Completed Industrial Waste Questionnaire
2. List of fixtures with manufacturer and model
3. Building or kitchen floor plan with fixtures noted
4. Anticipated Best Management Practices used to limit FOG entering system
5. Anticipated grease interceptor maintenance and pump-out schedule

Gravity grease interceptors are sized based on the expected flow rate of three categories of kitchen fixtures (listed below) in gallons per minute (gpm) with criteria of a hydraulic residence time of 30 minutes and a 25% FOG and solids storage factor. The design flow rate is one-third the maximum flow rate because of the bulk hydraulic compensation of short-term peak flow events. Refer to Water Research Foundation project reports 03-CTS-16Ta & b for design justification.

$$\text{Volume} = [\text{Maximum Flow Rate (gpm)}] \times 30 \text{ min} \times 1.25 \text{ Storage Factor} \div 3$$

- **Drainage** fixtures are filled and completely drained at the end of their use and includes the 3-compartment sink and cooking equipment like tilt skillets, braising pans, rotisserie ovens and wok ranges. Flow is calculated using the Manning Formula (see page 2), which accounts for sink pipe drain size, pipe material types and pipe slope to determine the maximum flow rate from the fixture. Most Drainage fixtures connect to a single drain pipe; if the fixture connects to separate drain pipes, list it as multiple fixtures.
- **Faucet** fixtures are not filled, but instead drain at their faucet's flow rate and includes sinks for food preparation, pre-rinse, equipment cleaning and waste food disposal units. If floor drains are present, their combined flow equals the fixture(s) supplying the spray. Sinks with two faucets count as two fixtures. Ignore hand-wash-only fixtures for sizing.
- **Cleaning** fixtures have specific peak discharge rates that exceed faucet flow but are less than the maximum rate the drain pipe permits and includes dishwashers, clothes washers used for cleaning of food service-associated linens, and automatic hood cleaning systems. Enter the manufacturer-specified flow rate per discharge cycle.

Structurally, the gravity grease interceptor must be equipped a particular design of inlet, baffle wall and outlet tee. Refer to pages 3-4 for details.



Drainage Fixtures

$$\text{Flow Rate (gpm)} = 669 \times A \times R^{2/3} \times S^{1/3} \div n$$

$$A = 0.7254 \times [\text{Pipe Diameter (inches)} \div 12]^2$$

$$R = 0.0251 \times \text{Pipe Diameter (inches)}$$

S = Pipe slope, n = Roughness coefficient

Drainage Pipe Diameter	Minimum Slope
2 ½ inches or smaller	0.0208
3 to 6 inches	0.0104
8 inches or larger	0.0052

87.5% of horizontal drainage pipe depth is assumed wettable due to flow caused by gravity alone. Contact City if sewage ejector pumps are used.

Manning's roughness coefficient, n, depends on the material and age of the drainage pipe:

	PVC	Copper
Minimum (new)	0.008	0.010
Normal (used)	0.009	0.011
Maximum (old)	0.010	0.012

	Fixture Name	Diameter (in)	Slope	Roughness (n)	Flow Rate
1.					
2.					
3.					
4.					
Total Drainage Fixtures Flow Rate (DFQ) =					

Faucet Fixtures

International Plumbing Code requires most faucets discharge a maximum 2.2 gpm at 60 psi and service/mop sinks should discharge a minimum 3 gpm at 8 psi. Measure flow rate if uncertain.

	Fixture Name	Maximum Flow Rate
1.		
2.		
3.		
4.		
	If floor drains exist, use flow rate for spray-supplied fixture(s)	
Total Faucet Fixtures Flow Rate (FFQ) =		

Cleaning Fixtures

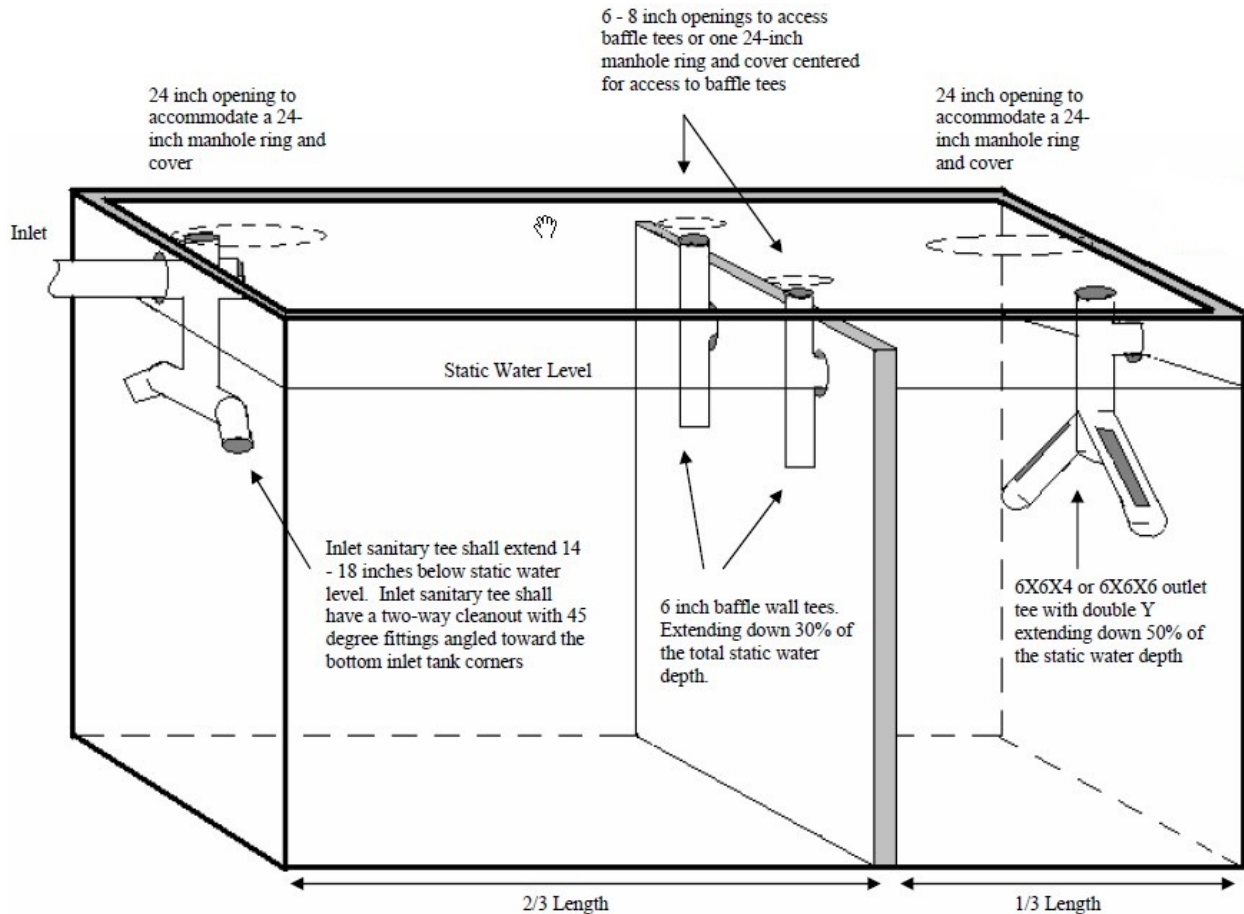
Provide manufacturer and model with list of fixtures that is provided with this form.

	Fixture Name	Mfg. Specified Flow Rate
1.		
2.		
3.		
4.		
Total Cleaning Fixtures Flow Rate (CFQ) =		

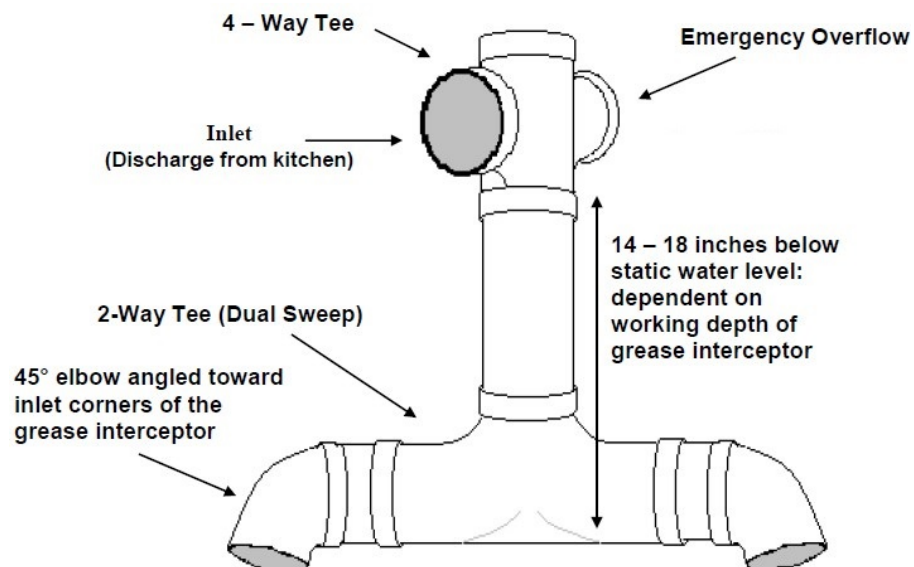
Grease Interceptor Volume

[DFQ + FFQ + CFQ] × 30 minutes × 1.25 ÷ 3 =				Volume in gallons
			× 12.5 =	

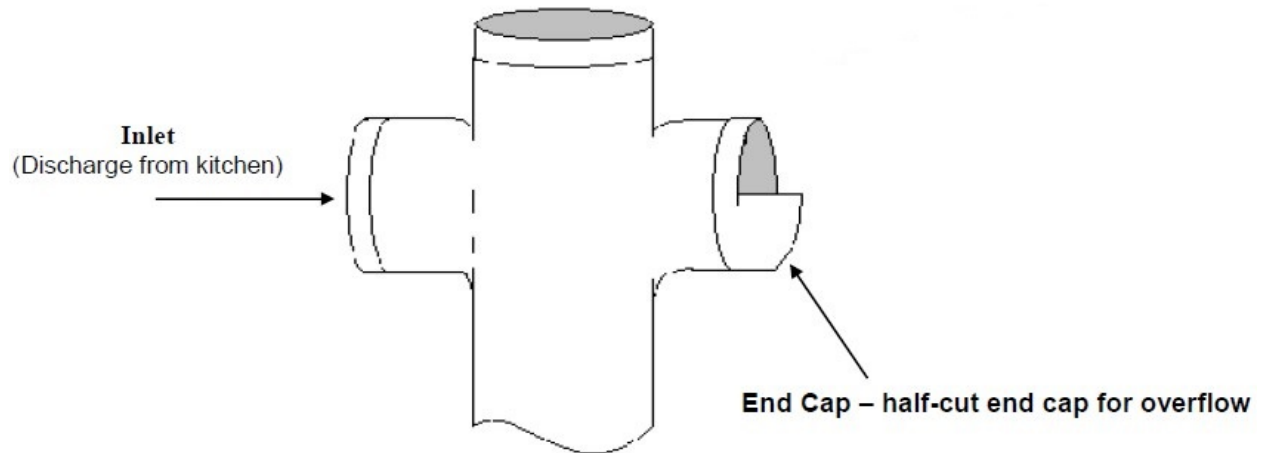
Inlet, Baffle Wall and Outlet Tee Design Overview



Inlet Tee Design

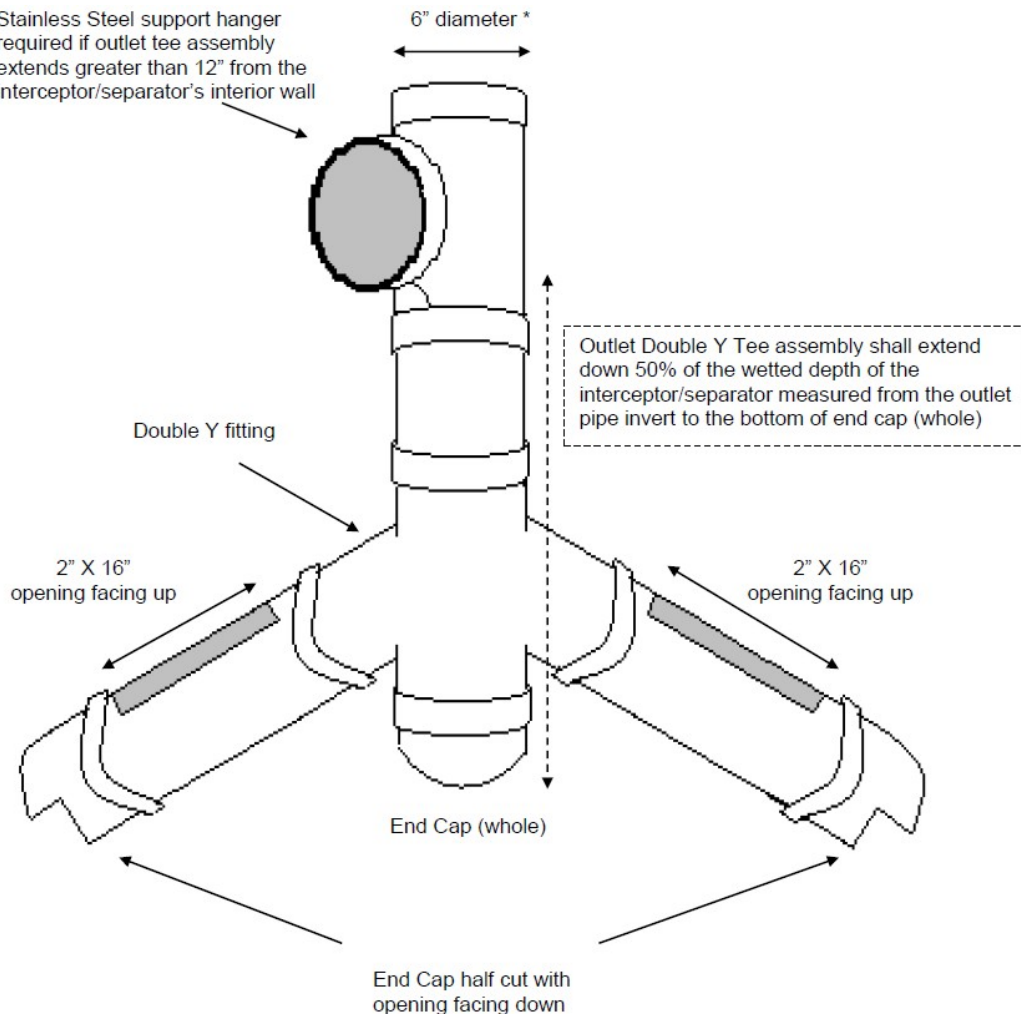


Emergency Overflow Close-up



Outlet Tee Design

Stainless Steel support hanger required if outlet tee assembly extends greater than 12" from the interceptor/separator's interior wall



Appendix G Standard Drawings

G.1 Erosion Control Standard Drawings

EC - 1 Concrete Washout

EC - 2 Vehicle Tracking Control

EC - 3 Sediment Control Log

EC - 4 Silt Fence Erosion Barrier

EC - 5a Sediment Basin

EC - 5b Sediment Basin

EC - 6a Inlet Protection

EC - 6b Inlet Protection

EC - 7 Curb Sock

G.2 Sanitary Sewer Standard Drawings

SS – 1 Standard Manhole Base

SS – 2 Manhole Barrels and Alternate Tops

SS – 3 Intermediate Platform for Manholes greater than 17' deep

SS – 4 Typical Trench Section for Pipe Protection

SS – 5 Typical House Service Location

SS – 6 Standard Clean Out

SS – 7 Jacking Detail

SS – 8 Typical Underdrain Clean Out

SS – 9 Encasement for Conduit Crossing

SS – 10 Sanitary Sewer Manhole Cover

SS – 11 Standard Sanitary Sewer Underdrain Clean Out

G.3 Storm Drainage Standard Drawings

ST – 1 Standard Manhole Base

ST – 2 Manhole Barrels and Alternative Tops



ST – 3 Intermediate Platform for Manholes greater than 17' deep

ST – 4 Typical Pipe Bedding

ST – 5a Curb Inlet – Type R

ST – 5b Curb Inlet – Type R

ST – 5c Curb Inlet – Type R

ST – 6 Storm Drainage Manhole Cover

ST – 7 Encasement for Conduit Crossings

G.4 Street Standard Drawings

R – 1 Local Typical Section

R – 2 Collector Typical Section

R – 3 Arterial Typical Section

R – 4 Vertical Curb and Gutter

R – 5 Combination Curb, Gutter and Sidewalk

R – 6 Curb Ramp Combination Curb, Gutter and Sidewalk

R – 7 Curb Ramp Vertical Curb and Walk

R – 8 Sidewalk Ramp with Cross pan, Vertical Curb

R – 9 Ramp Drive for Vertical Curb, Attached Walk

R – 10 Ramp Drive for Vertical Curb, Detached Walk

R – 11 Truncated Dome/Detectable Warning

R – 12a Standard Sidewalk Chase Drain

R – 12b Standard Sidewalk Chase Drain

R – 13 Median Cover Material – Patterned Concrete

R – 14 Median Edging – Patterned Concrete

R – 15 Sleeve Detail

R – 16 Trench Patch Back

G.5 Traffic Standard Drawings

T – 1 Typical Signpost Anchor Detail

T – 2 Loop Detector Details

T – 3 Loop Detector/Pull Box – Water Valve Stem Type

T – 4 Traffic Signal Pole Box

T – 5 Pedestrian Push Button Post and Sign

T – 6 School Flashing Beacon Assembly – Side of Road

T – 7a School Flashing Beacon Assembly – Overhead

T – 7b School Flashing Beacon Assembly – Overhead

G.6 Water Standard Drawings

W – 1 Typical Trench Section Pipe Protection

W – 2 Fire Hydrant Installation

W – 3 Concrete Thrust Blocks Bearing Surfaces and Installation

W – 4 Concrete Thrust Block Dimensions

W – 5 Concrete Thrust Blocking for Unbalanced Fittings

W – 6 Polyethylene Wrap for Ductile Iron Pipe

W – 7 Tracer Wire on Plastic Pipe

W – 8a Settings for 5/8" x 3/4" thru 1" Meters

W – 8b Settings for 5/8" x 3/4" thru 1" Meters

W – 9 Meter Settings for 1 1/2" and 2" Meter with Valve and Bypass

W – 10 Standard 3" and 4" Meter Setting

W – 11 Typical Meter Vault

W – 12 Standard Concrete Meter Support

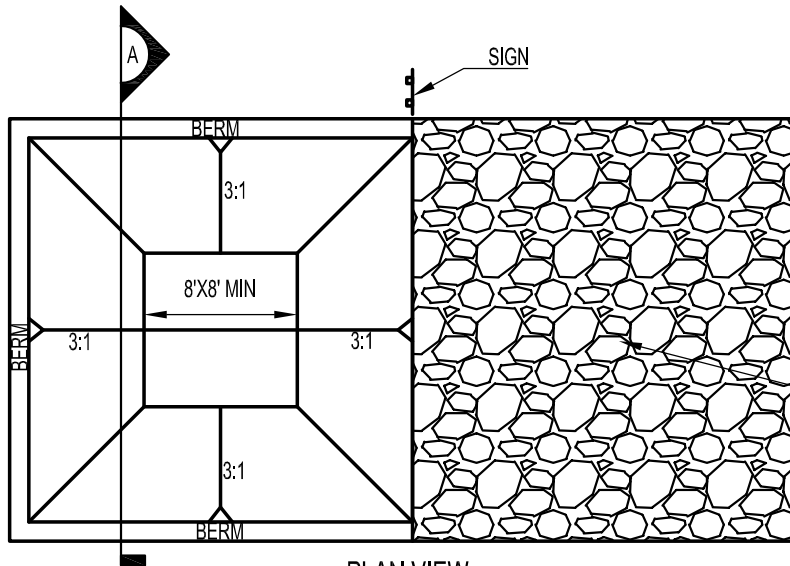
W – 13 Wall and Body Clamps 3" Meter

W – 14 Wall Clamps for 4" to 12" Meters

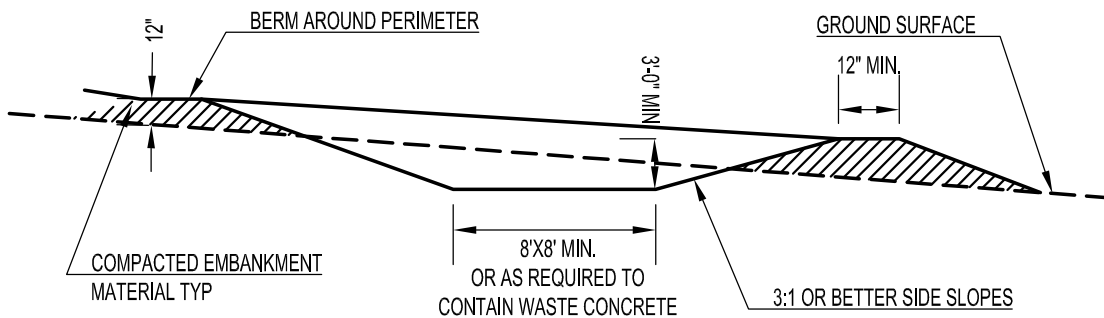
W – 15 Standard Blow-Off Installation



- W – 16 A.C. to D.I. Pipe Adaptor
- W – 17 Conduit Crossing
- W – 18 Standard Air Valve Installation
- W – 19 Butterfly Valve Installation in Mains 16” or Larger
- W – 20 Water Distribution System – Typical Plan for Cul-de-Sac
- W – 21 Boring Detail
- W – 22 Transmission Main Blow-Off Installation
- W – 23 Water Manhole Cover
- W – 24 Residential Service Tap



PLAN VIEW



SECTION A

CONCRETE WASHOUT AREA INSTALLATION NOTES:

1. SEE PLAN SET FOR LOCATIONS OF CONCRETE WASHOUT AREA.
2. THE CONCRETE WASHOUT SHALL BE INSTALLED PRIOR TO ANY CONCRETE PLACEMENT ON SITE.
3. VEHICLE TRACKING CONTROL IS REQUIRED AT THE ACCESS POINT.
4. SIGNS SHALL BE PLACED AT THE CONSTRUCTION ENTRANCE, AT THE WASHOUT AREA, AND ELSEWHERE AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CONCRETE WASHOUT AREA TO THE OPERATOR OF CONCRETE TRUCKS AND PUMP RIGS.
5. EXCAVATION MATERIAL SHALL BE UTILIZED IN PERIMETER BERM CONSTRUCTION.

CONCRETE WASHOUT AREA MAINTENANCE NOTES:

1. THE CONCRETE WASHOUT AREA SHALL BE REPAIRED AND ENLARGED OR CLEANED OUT AS NECESSARY TO MAINTAIN CAPACITY FOR WASTE CONCRETE.
2. AT THE END OF CONSTRUCTION ALL CONCRETE SHALL BE REMOVED FROM THE SITE AND DISPOSED OF AT AN APPROVED WASTE SITE.
3. WHEN THE CONCRETE WASHOUT AREA IS REMOVED, COVER THE DISTURBED AREA WITH TOP SOIL, DRILL SEED AND CRIMP MULCH OR OTHERWISE STABILIZE IN A MANNER APPROVED BY THE LOCAL JURISDICTION.
4. INSPECT AS REQUIRED UNDER ANY PERMITS.

REVISIONS

DATE	ITEM	BY
3/2020		ULTEIG

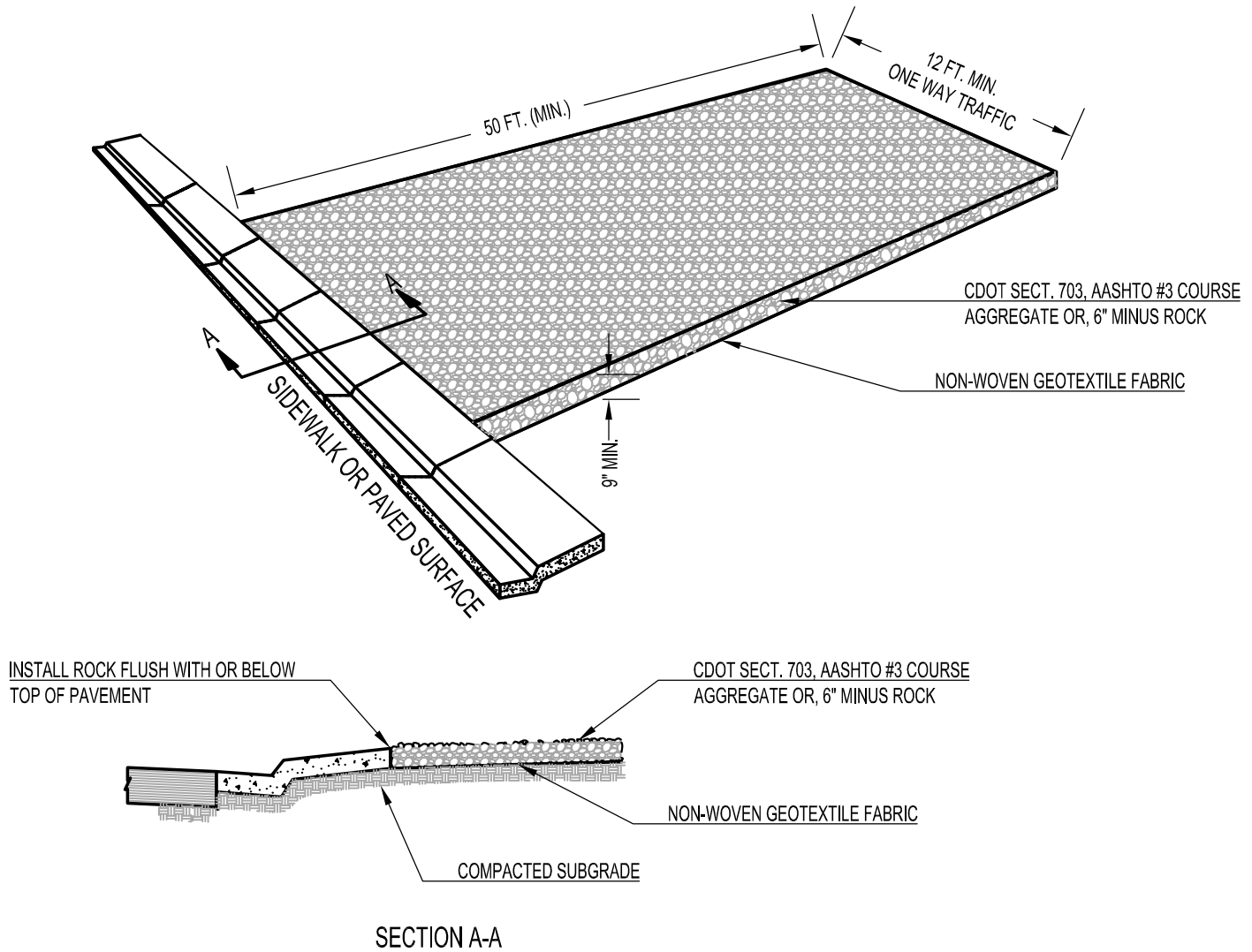


PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

CONCRETE WASHOUT


ISSUED

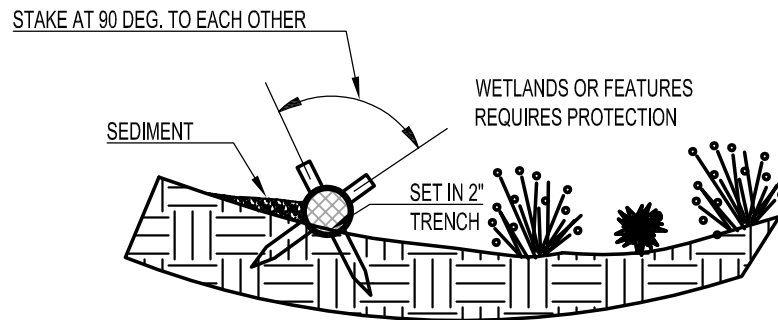
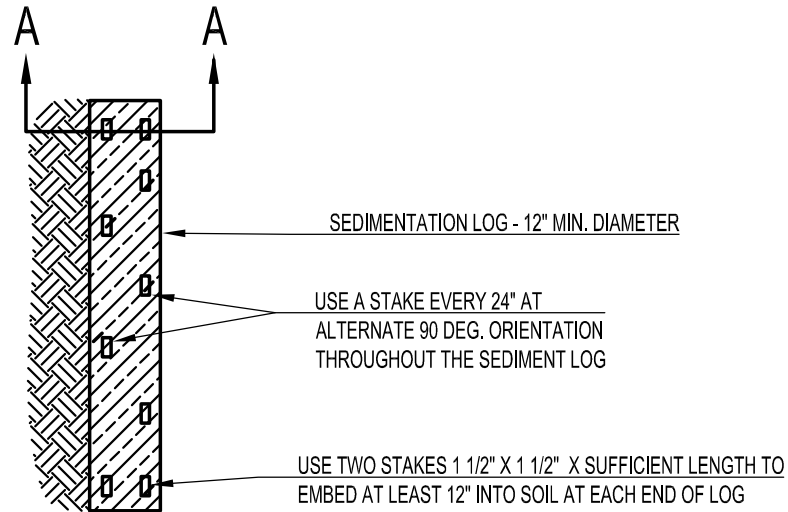
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	EC 1
SCALE	N.T.S.



NOTES

1. EROSION CONTROL MEASURES SHALL BE MAINTAINED AT ALL TIMES AS DIRECTED BY LOCAL JURISDICTION
2. ALL ROCK TO BE REMOVED UPON COMPLETION OF CONSTRUCTION.
2. PUBLIC ROADWAY TO BE KEPT CLEAN AND FREE OF MUD, DIRT AND DEBRIS AT ALL TIMES.

REVISIONS			 CITY OF Northglenn	PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
					DRAWING NO.	EC 2
					SCALE	N.T.S.
				VEHICLE TRACKING CONTROL		




SECTION A-A

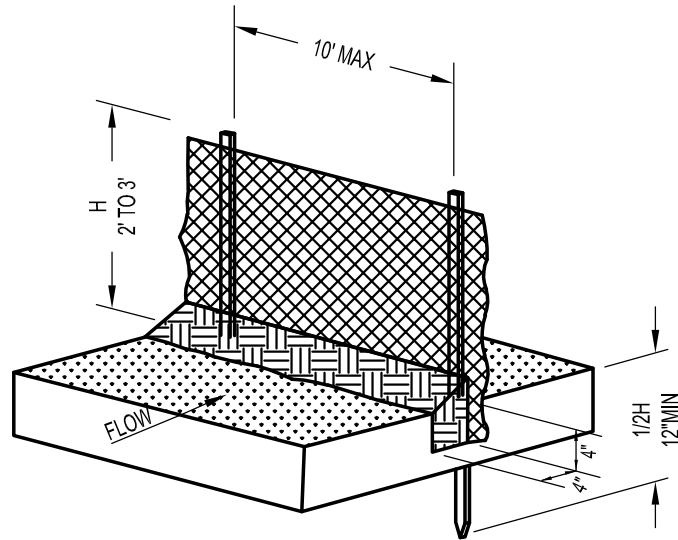
SEDIMENT CONTROL LOG INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
- LOCATION AND LENGTH OF SEDIMENT CONTROL LOG.
2. SEDIMENT CONTROL LOGS INDICATED ON INITIAL SWMP PLAN SHALL BE INSTALLED PRIOR TO ANY LAND DISTURBING ACTIVITIES.
3. SEDIMENT CONTROL LOGS SHALL CONSIST OF STRAW, COMPOST, EXCELSIOR, OR COCONUT FIBER.
4. NOT FOR USE IN CONCENTRATED FLOW AREAS
5. THE SEDIMENT CONTROL LOG SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 2".

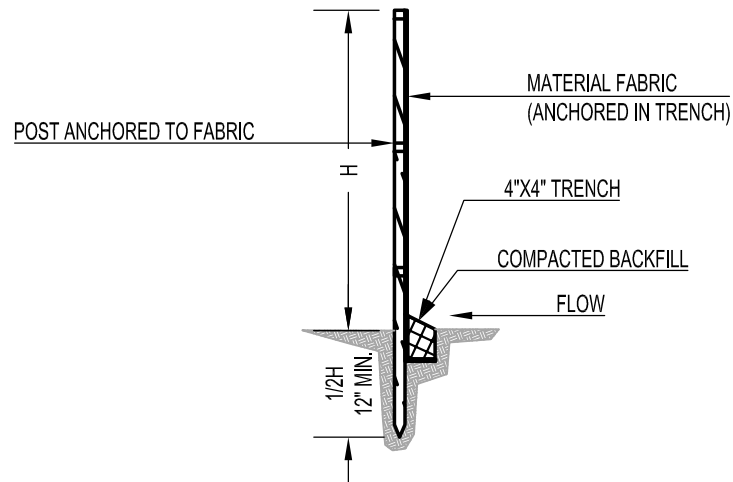
SEDIMENT CONTROL LOG MAINTENANCE NOTES

1. THE SWMP MANAGER SHALL INSPECT SEDIMENT CONTROL LOGS AS REQUIRED UNDER ANY PERMITS AND MAKE REPAIRS OR CLEAN OUT UPSTREAM SEDIMENT AS NECESSARY.
2. SEDIMENT ACCUMULATED UPSTREAM OF SEDIMENT CONTROL LOGS SHALL BE REMOVED WHEN THE UPSTREAM SEDIMENT DEPTH IS WITHIN $\frac{1}{2}$ THE HEIGHT OF THE CREST OF LOG.
3. SEDIMENT CONTROL LOG SHALL BE REMOVED AT THE END OF CONSTRUCTION, IF ANY DISTURBED AREA EXISTS AFTER REMOVAL, IT SHALL BE COVERED WITH TOP SOIL, DRILL SEEDED AND CRIMP MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

REVISIONS			 CITY OF Northglenn	PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
			SEDIMENT CONTROL LOG		DRAWING NO.	EC3
					SCALE	N.T.S.




SILT FENCE INSTALLATION



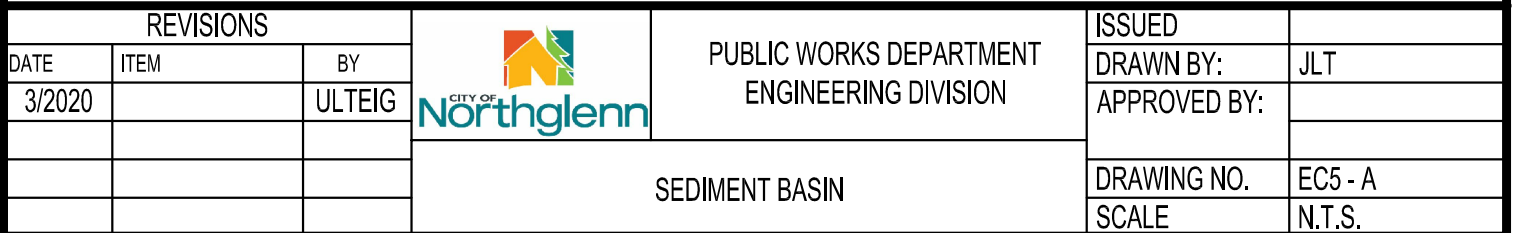
SECTION

NOTE:
EROSION CONTROL MEASURES SHALL BE
MAINTAINED UNTIL LANDSCAPING IS COMPLETED,
OR AS DIRECTED BY LOCAL JURISDICTION.

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
					DRAWING NO.	EC4
					SCALE	N.T.S.

SILT FENCE EROSION BARRIER

SB



SEDIMENT BASIN SHEET 2 OF 2



SIZING INFORMATION FOR STANDARD SEDIMENT BASIN			
UPSTREAM DRAINAGE AREA (ROUNDED TO NEAREST ACRE) (AC)	BASIN BOTTOM WIDTH (W) (FT)	SPILL CREST LENGTH (CL) (FT)	HOLE DIAMETER (HD) (IN)
1	12 1/2	2	9/32
2	21	3	13/16
3	28	5	1/2
4	33 1/2	6	9/16
5	38 1/2	8	21/32
6	43	9	21/32
7	47 1/4	11	25/32
8	51	12	27/32
9	55	13	7/8
10	58 1/4	15	15/16
11	61	16	31/32
12	64	18	1
13	67 1/2	19	1 1/16
14	70 1/2	21	1 1/8
15	73 1/4	22	1 3/16


MINIMUM BOTTOM WIDTH AND DIAMETER OF OUTLET PLATE HOLES BASED ON 2,700 CU. FT. / ACRE OF TRIBUTARY AREA AND 72 HOUR DRAIN TIME.

SEDIMENT BASIN INSTALLATION NOTES

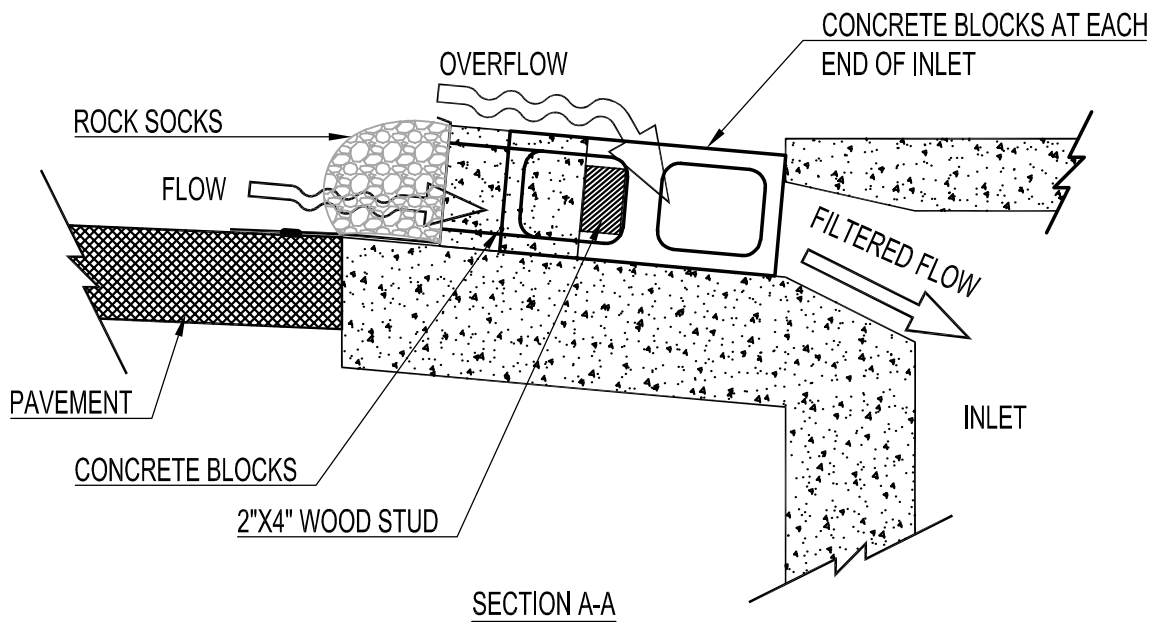
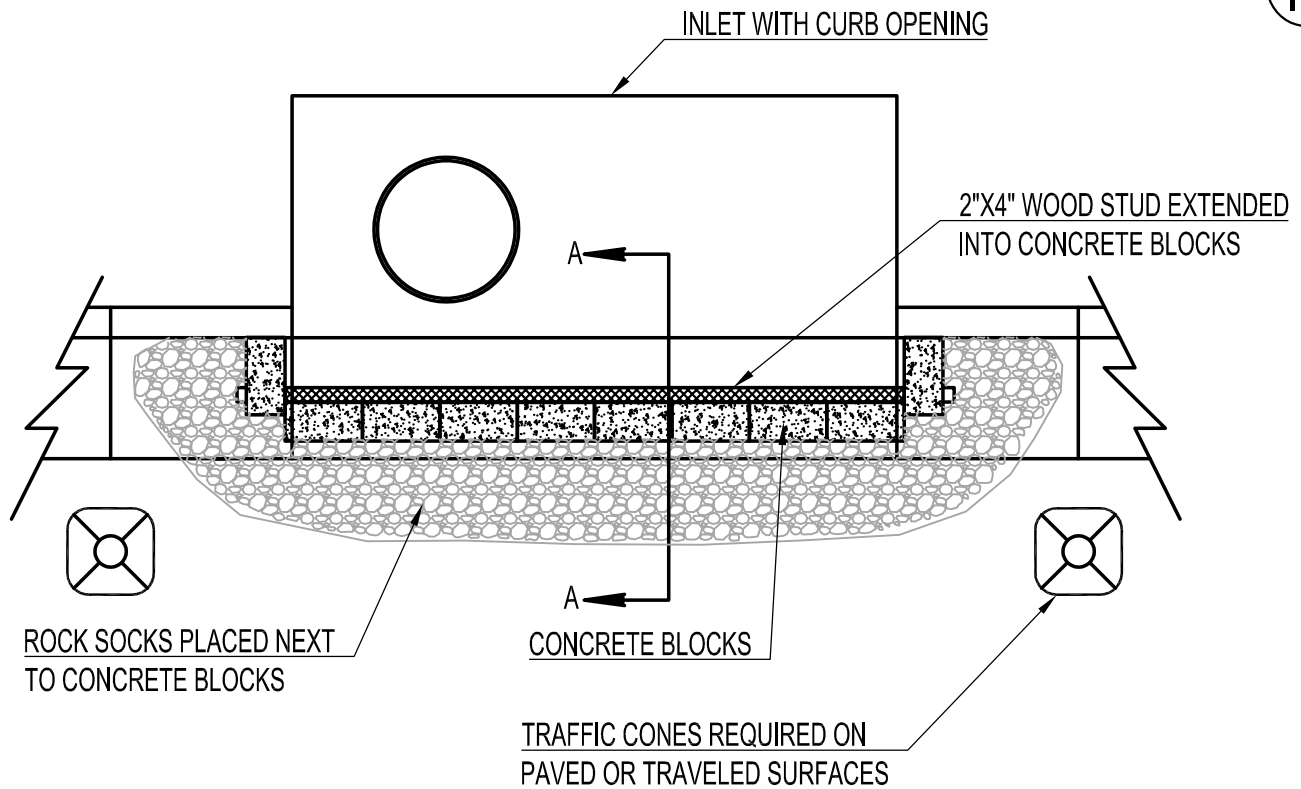
- SEE PLAN VIEW AND SECTIONS FOR
 - LOCATION OF SEDIMENT BASIN
 - TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN)
 - FOR STANDARD BASIN BOTTOM WIDTH "W", CREST LENGTH "CL", AND HOLE DIAMETER "HD"
 - FOR NONSTANDARD BASIN SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT "H", NUMBER OF COLUMNS "N", HOLE DIAMETER "HD", AND PIPE DIAMETER "D"
- FOR STANDARD BASIN, BOTTOM DIMENSIONS MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED
- SEDIMENT BASINS INDICATED ON INITIAL SWMP PLAN SHALL BE INSTALLED PRIOR TO ANY OTHER LAND DISTURBANCE ACTIVITY
- EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.
- EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D 698
- PIPE SCH. 40 OR GREATER SHALL BE USED
- THE DETAILS ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) IDENTIFIED ON THE SWMP PLAN VIEW DRAWINGS USED FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES

SEDIMENT BASIN MAINTENANCE NOTES

- THE SWMP MANAGER SHALL INSPECT SEDIMENT BASIN AS REQUIRED UNDER ANY PERMITS AND AFTER ANY STORM EVENT AND MAKE REPAIRS OR CLEAN OUT AS NECESSARY.
- SEDIMENT ACCUMULATED IN BASIN SHALL BE REMOVED WHEN SEDIMENT DEPTH IS ONE FOOT (I.E., 2-FEET BELOW THE SPILLWAY CREST).
- SEDIMENT BASINS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS ACCEPTED BY THE LOCAL JURISDICTION.
- WHEN SEDIMENT BASINS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.


REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
					DRAWING NO.	EC5 - B
					SCALE	N.T.S.

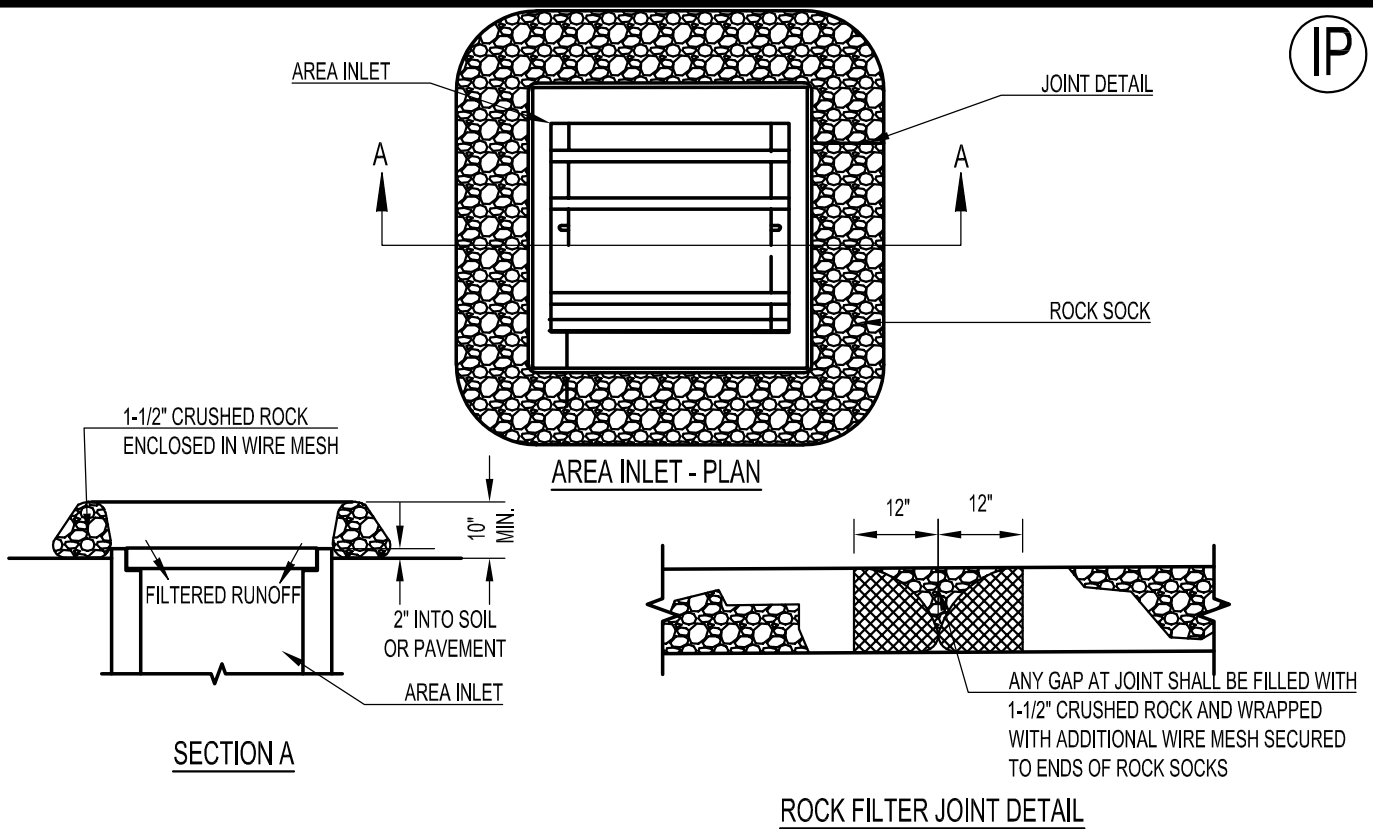
SEDIMENT BASIN



NOTE
EROSION CONTROL MEASURES SHALL BE MAINTAINED
AT ALL TIMES AS DIRECTED BY LOCAL JURISDICTION

DETAIL
CURB INLET GRAVEL FILTER

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
					DRAWING NO.	EC6 - A
					SCALE	N.T.S.
				INLET PROTECTION		




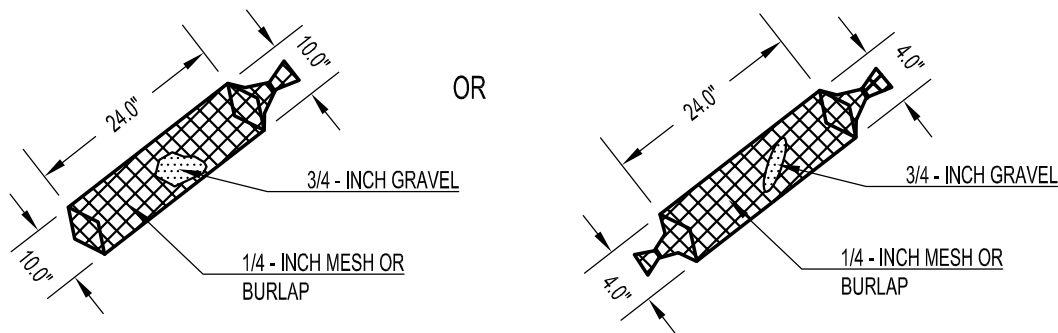
INLET PROTECTION INSTALLATION NOTES

1. INLET PROTECTION AFTER INLET CONSTRUCTION OR AFTER PAVEMENT SHALL BE INSTALLED WITHIN 48 HOURS AFTER NLET CONSTRUCTION OR PAVING IS COMPLETED
2. CRUSHED ROCK BE FRACTURED FACE (ALL SIDES) AND SHALL COMPLY WITH GRADATION SHOWN IN CDOT SECT. 703-2, #4 AGGREGATE (1-1/2" MINUS)
3. WIRE MESH SHALL BE FABRICATED OF 10 GAUGE WIRE TWISTED INTO A MESH WITH A MAXIMUM OPENING OF 1 INCH (COMPLY TERMED "CHICKEN WIRE"). ROLL WIDTH SHALL BE 48 INCHES
4. WIRE MESH SHALL BE SECURED USING "HOG RINGS" OR WIRE TIES AT 6 INCH CENTERS ALONG ALL JOINTS AND 2 INCH CENTERS ON ENDS OF BERM
5. ROCK SOCKS SHALL BE CONSTRUCTED IN ONE PIECE OR SHALL BE CONSTRUCTED USING JOINT DETAIL

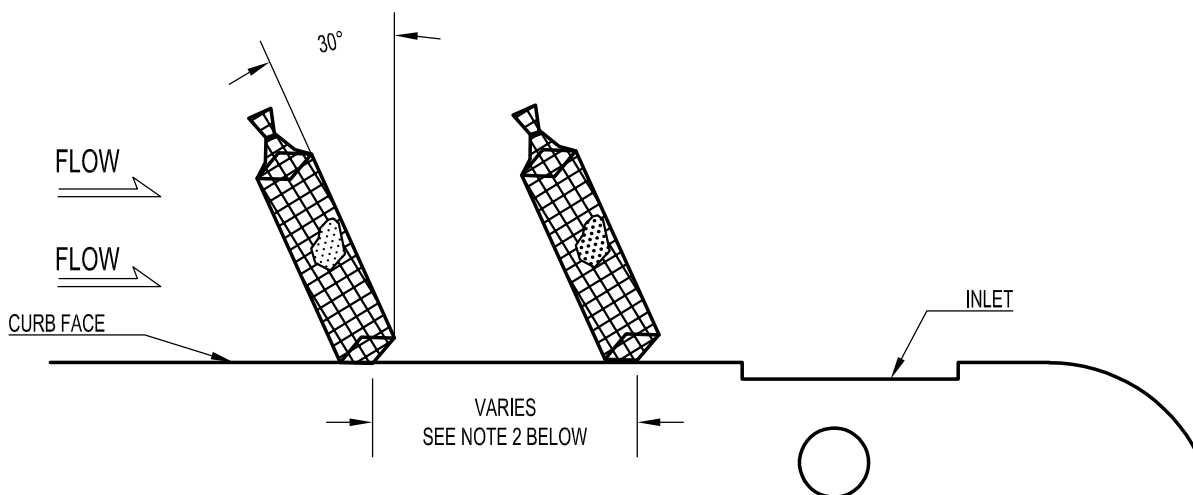
INLET PROTECTION MAINTENANCE NOTES

1. THE SWMP MANAGER SHALL INSPECT INLET PROTECTION AS REQUIRED UNDER ANY PERMITS AND AFTER ANY STORM EVENT AND MAKE REPAIRS OR CLEAN OUT AS NECESSARY. INSPECT MORE FREQUENTLY DURING WINTER CONDITIONS DUE TO FREEZE THAW PROBLEMS AND REPAIR AS NEEDED.
2. SEDIMENT ACCUMULATED UPSTREAM OF INLET PROTECTION SHALL BE REMOVED WHEN THE SEDIMENT DEPTH UPSTREAM OF ROCK SOCK IS WITHIN 2-1/2 INCHES OF CREST.
3. INLET PROTECTION IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS APPROVED, UNLESS THE LOCAL JURISDICTION APPROVES EARLIER REMOVAL OF INLET PROTECTION IN STREETS
4. WHEN INLET PROTECTION AT AREA INLETS IS REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOP SOIL, DRILL SEEDED AND CRIMP MULCHED, OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG	INLET PROTECTION		APPROVED BY:	
					DRAWING NO.	EC6 - B
					SCALE	N.T.S.




DETAIL 1

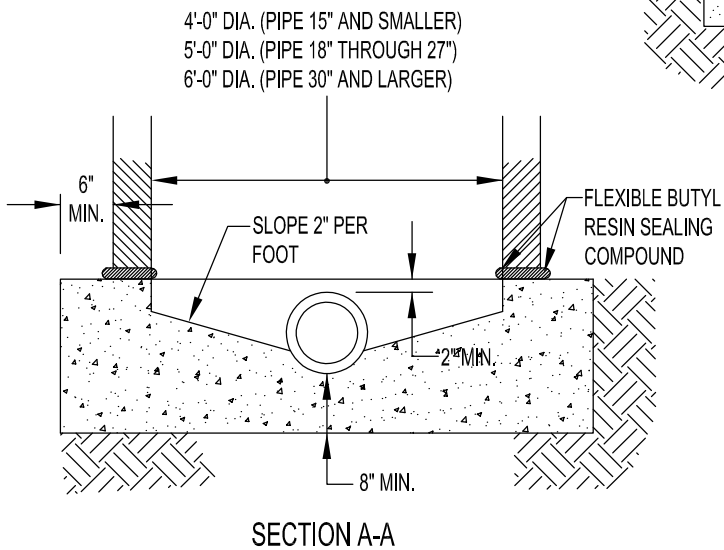
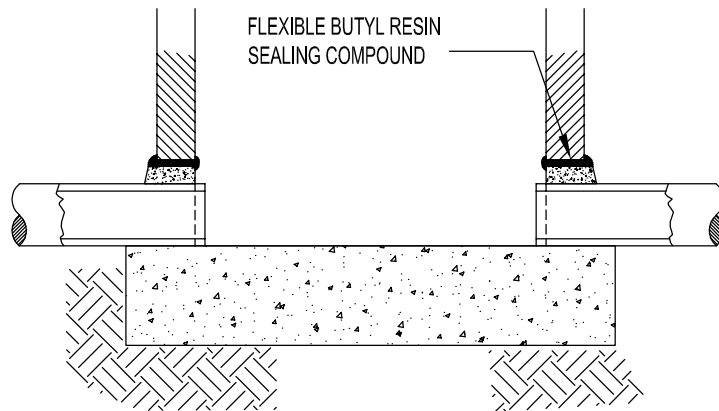
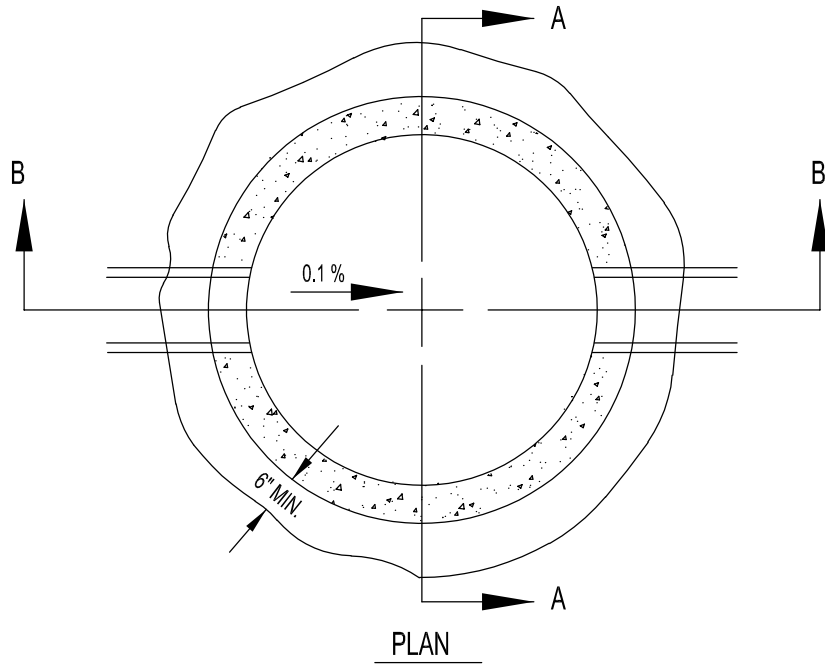


DETAIL 2

NOTES

1. SOCKS WILL BE USED UPGRADIENT OF INLET
2. NO LESS THAN TWO 10 INCH DIAMETER SOCKS MUST BE USED IN SEQUENCE, SPACED NO MORE THAN FIVE FEET APART UPGRADIENT OF INLET. NO LESS THAN SIX SOCKS SHALL BE USED IF THE 4 INCH SOCK IS USED AND SPACED AT NO MORE THAN 5 FEET APART
3. INCLINE AT 30 DEGREES FROM PERPENDICULAR, OPPOSITE THE DIRECTION OF FLOW (SEE DETAIL 2)
4. EROSION CONTROL MEASURES SHALL BE MAINTAINED AT ALL TIMES AS DIRECTED BY THE LOCAL JURISDICTION

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
					DRAWING NO.	EC7
					SCALE	N.T.S.
				CURB SOCK		



NOTES:

1. JOINTS TO BE SET IN FLEXIBLE COAL TAR OR EQUAL COMPOUND AND GROUTED WITH MORTAR INSIDE AND OUTSIDE.
2. ALL BASES SHALL BE REINFORCED AND TO BE APPROVED BY CITY ENGINEERING DIVISION.
3. ALL CONCRETE REINFORCEMENT TO BE PER CDOT STANDARD SPECIFICATIONS (LATEST REVISION).
4. MINIMUM 0.1% FALL THRU MH ON BASE.
5. THE CITY PREFERS PRE-CAST BASES.

REVISIONS

DATE	ITEM	BY
3/2020		ULTEIG



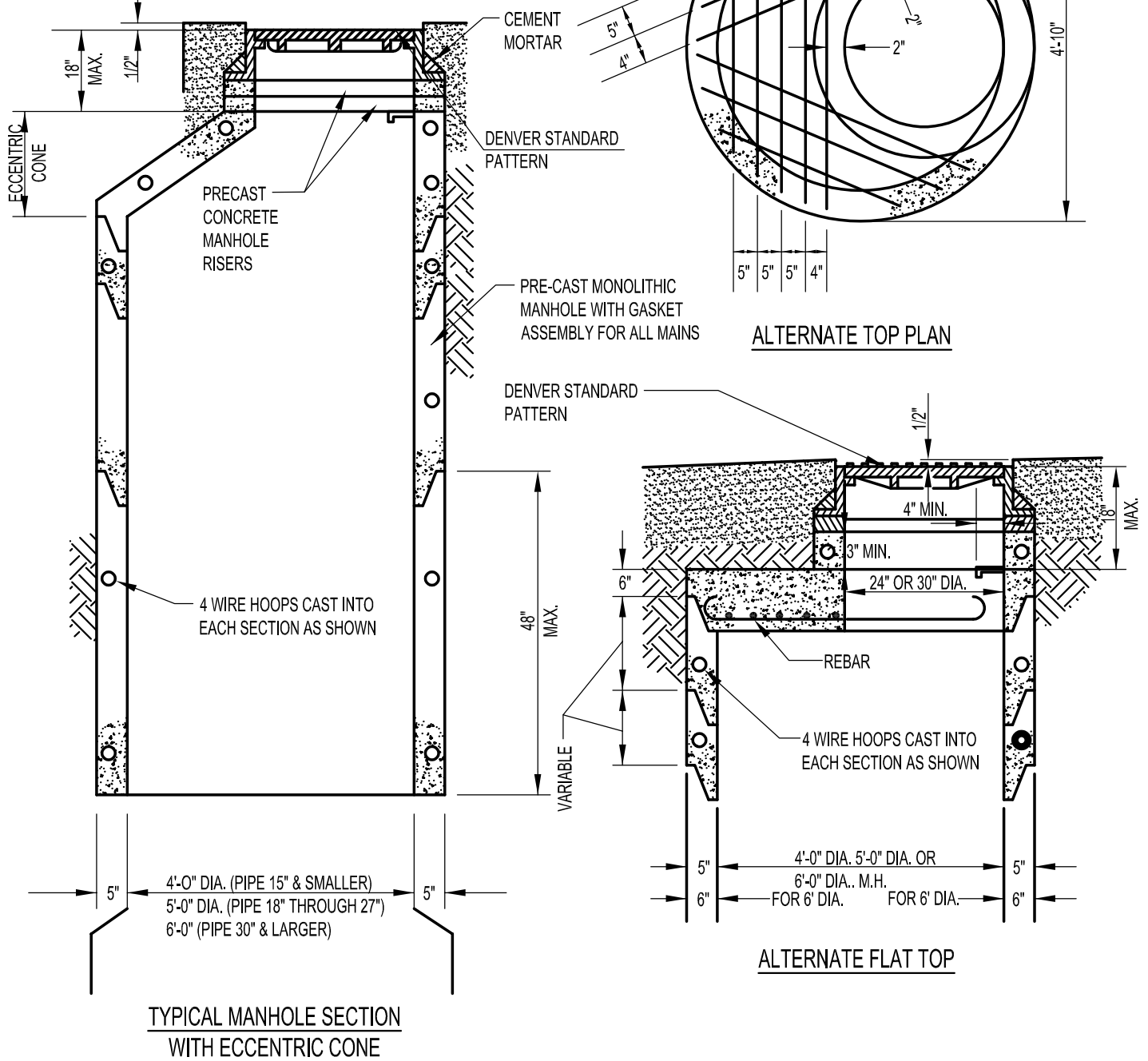
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION


STANDARD MANHOLE BASE

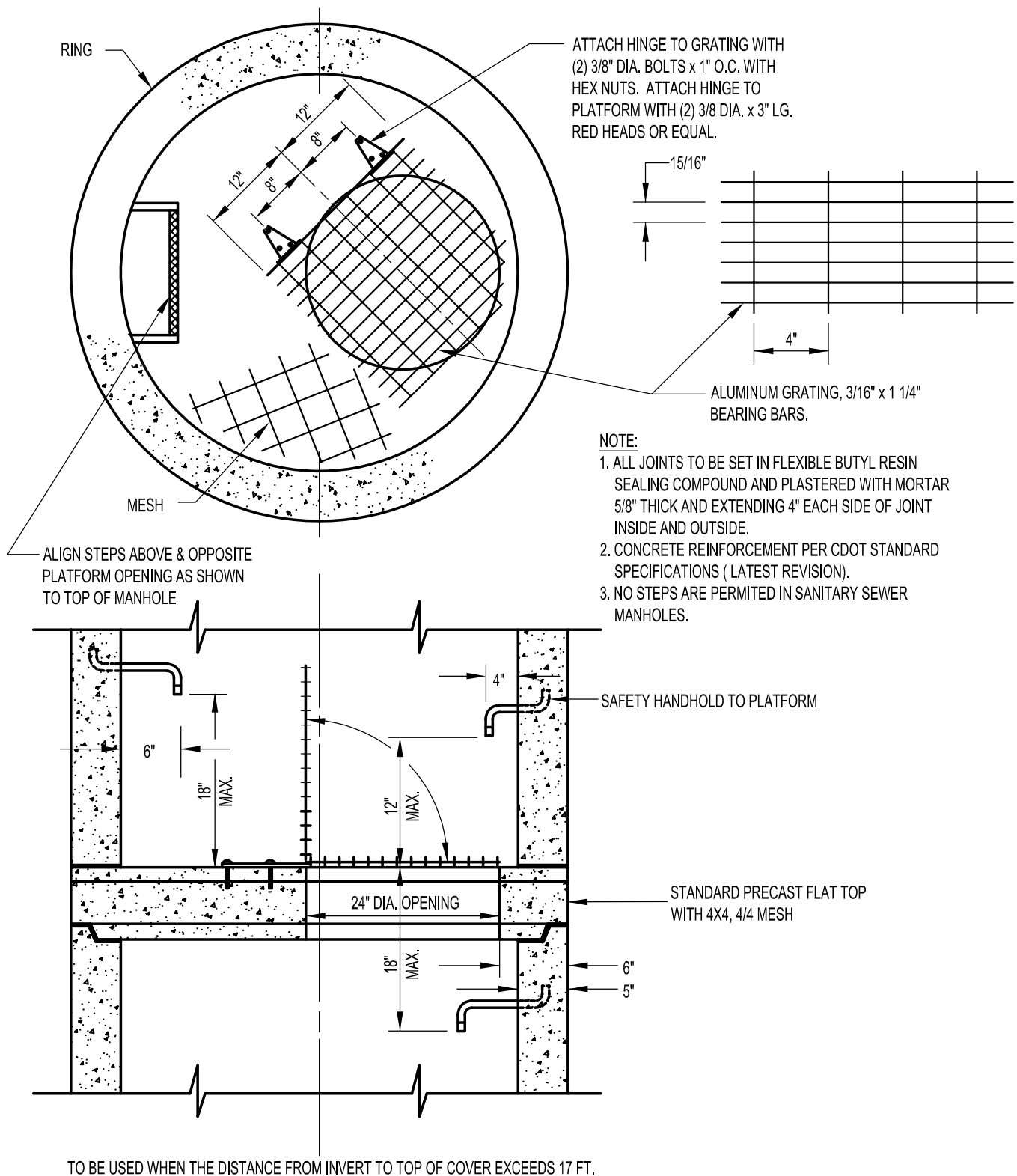
ISSUED	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	SS1
SCALE	N.T.S.


NOTES:

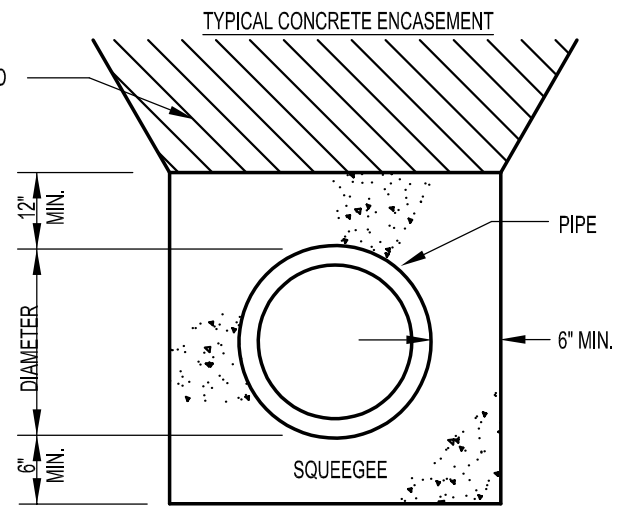
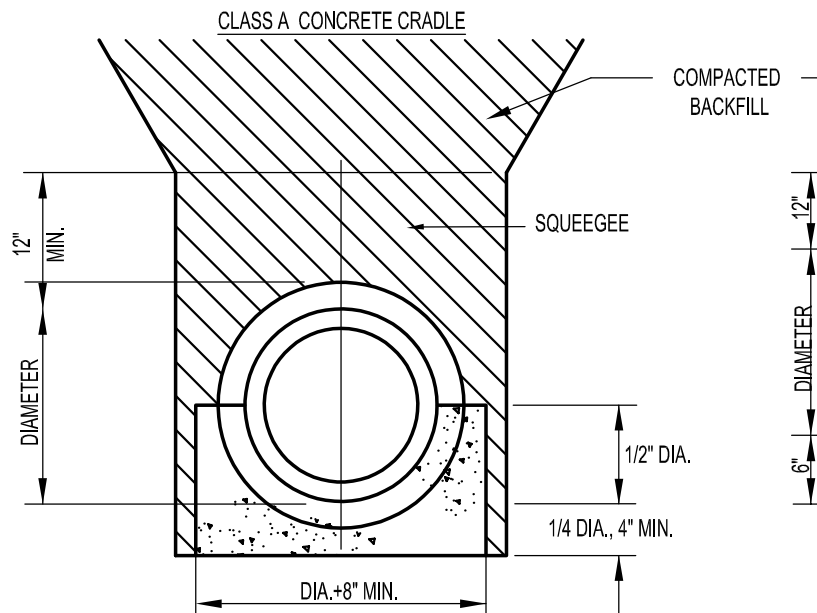
1. ALL JOINTS TO BE SET IN FLEXIBLE BUTYL RESIN SEALING OR EQUAL. SEALING COMPOUND AND PLASTERED WITH MORTAR $\frac{5}{8}$ " THICK AND EXTENDING 4" EACH SIDE OF JOINT INSIDE AND OUTSIDE, RUBBER GASKETS ON ALL JOINTS. JOINT TO MEET ALL ASTM 433 REQUIREMENTS.
2. MORTAR ON RISER RINGS IS ACCEPTABLE.
3. MANHOLES INSTALLED OUTSIDE OF STREET RIGHT-OF- WAY SHALL HAVE LOCKING COVERS.
4. "SEWER" TO BE IMPRINTED ON COVER.
5. CONCRETE REINFORCEMENT PER CDOT STANDARD SPECIFICATIONS (LATEST REVISION).
6. NO STEPS ARE PERMITTED IN SANITARY SEWER MANHOLES.
7. NO HOLES ARE TO BE CUT INTO MANHOLE ON SITE.
8. 14-20 MILS OF COAL TAR EPOXY OR EQUAL ON ALL EXTERNAL SURFACES OF MANHOLE.



REVISIONS			 PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION MANHOLE BARRELS AND ALTERNATE TOPS	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		UTLEIG		APPROVED BY:	
				DRAWING NO.	SS2
				SCALE	N.T.S.

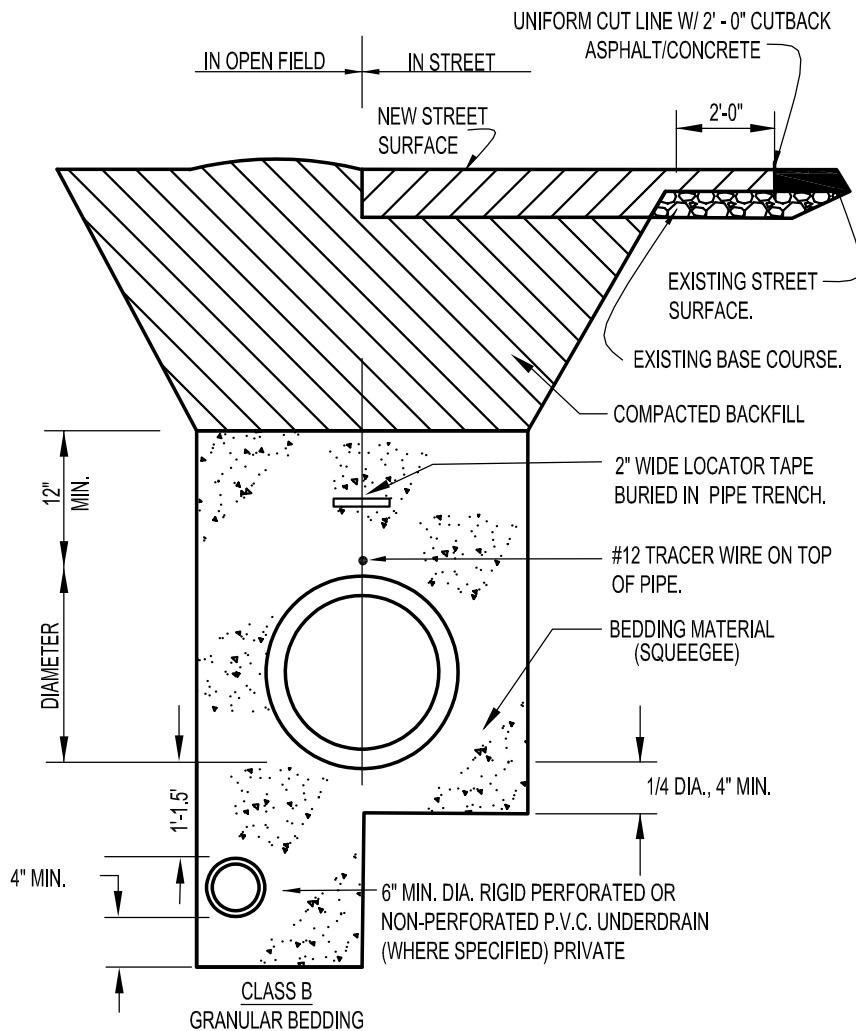


REVISIONS			 PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		UTLEIG		APPROVED BY:	
				DRAWING NO.	SS3
				SCALE	N.T.S.
			INTERMEDIATE PLATFORM FOR MANHOLES OVER 17' IN DEPTH		



NOTES:


1. THIS DETAIL IS TO BE USED UNDER NORMAL CONDITIONS. WHERE EXCESSIVE GROUND WATER IS PRESENT AN ALTERNATE DESIGN WILL BE REQUIRED.
2. GRANULAR BEDDING IS ALLOWED ONLY FOR LARGE PROJECTS. THE PROJECT DESIGNATED AS LARGE INCLUDES PROJECTS OVER 200' LENGTH ONLY.
3. ALL SMALL PROJECTS SHALL BE BACKFILLED WITH FLOWABLE FILL AS DESIGNATED IN CHAPTER 14.
4. CLASS VI BACKFILL FROM 1' ABOVE PIPE FOR LARGER PROJECTS. THE CITY WILL REQUIRE CONTRACTORS TO USE FLOW-FILL (SEE RIGHT OF WAY PERMIT).

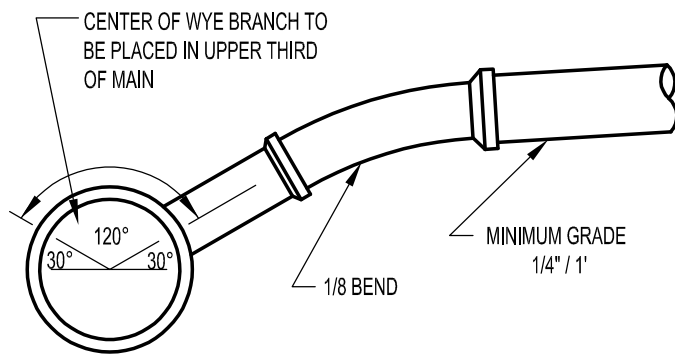


FOR PATCHING IN STREET SURFACE USE FULL DEPTH ASPHALT AS NOTED BELOW OR MATCH EXISTING PLUS ONE (1) INCH, WHICH EVER IS GREATER

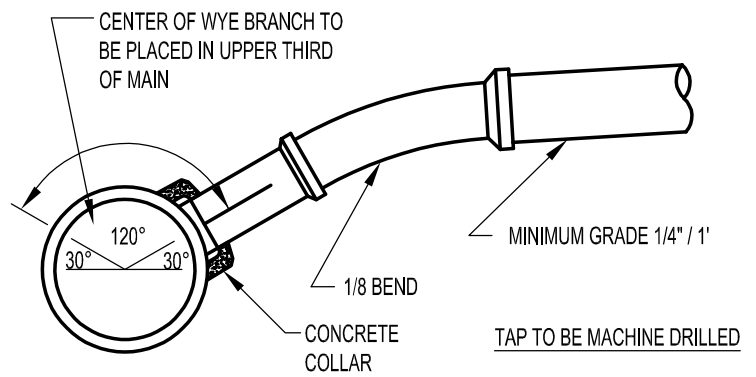
STREET CLASSIFICATION	DEPTH ASPHALT
ARTERIAL	10"
COLLECTOR	8"
LOCAL	6"

PIPE DIAMETER	MINIMUM WIDTH	MAXIMUM WIDTH
4"	1'-8"	2'-4"
6"	1'-10"	2'-6"
8"	2'-0"	2'-8"
12"	2'-4"	3'-0"

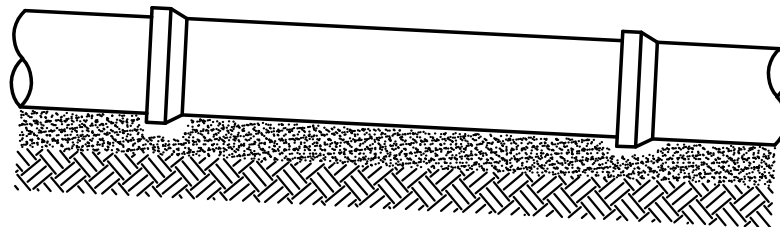
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
					DRAWING NO.	SS4
					SCALE	N.T.S.



1/8 BEND CONNECTION TO TEE



1/8 BEND & SADDLE CONNECTION

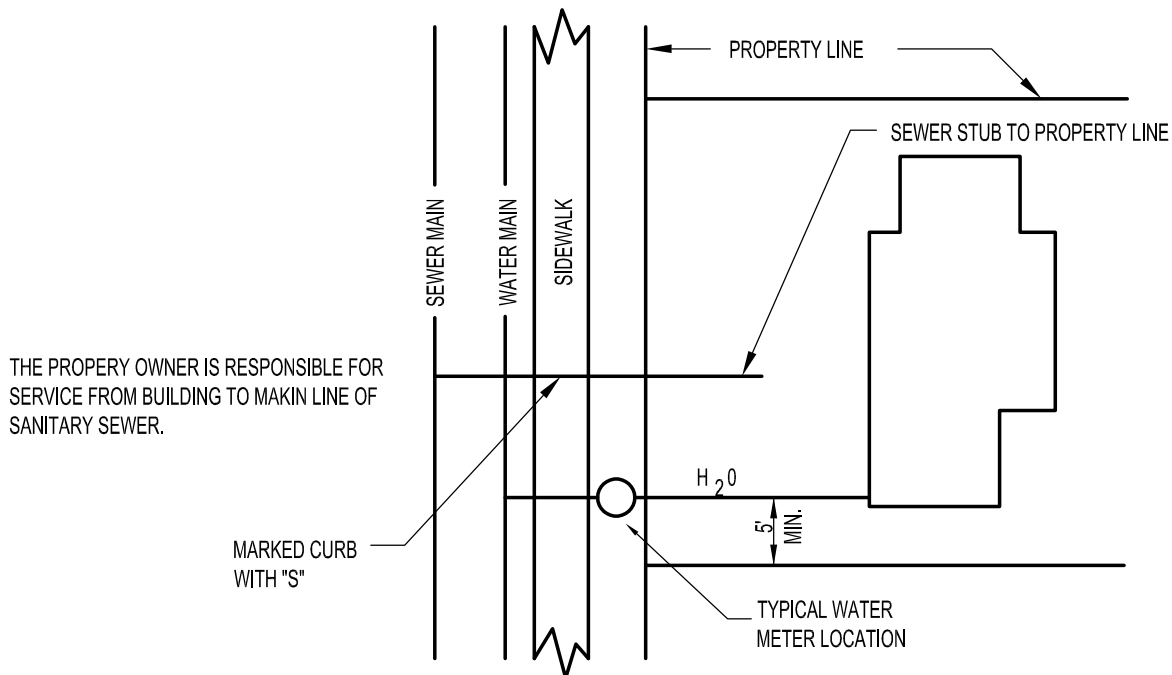


FACTORY PREPARED A.S.T.M. C-425
COMPRESSION TYPE JOINTS ONLY OR
APPROVED EQUIVALENT.

BELL SHOULD NOT TOUCH SIDES
OR BOTTOM OF BELL HOLE.

4" MINIMUM BEDDING
ABOVE AND BELOW PIPE.

ACCEPTABLE BEDDING



THE PROPERTY OWNER IS RESPONSIBLE FOR
SERVICE FROM BUILDING TO MAKIN LINE OF
SANITARY SEWER.

MARKED CURB
WITH "S"

H₂O

5"
MIN.

TYPICAL WATER
METER LOCATION

REVISIONS

DATE	ITEM	BY
3/2020		UTLEIG

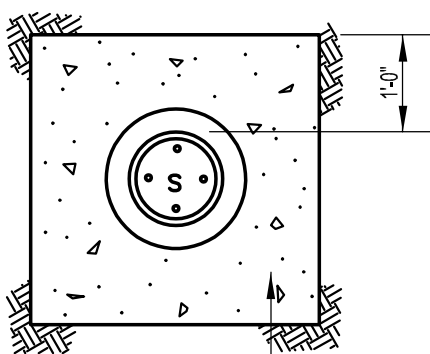


PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

TYPICAL HOUSE SERVICE LOCATION

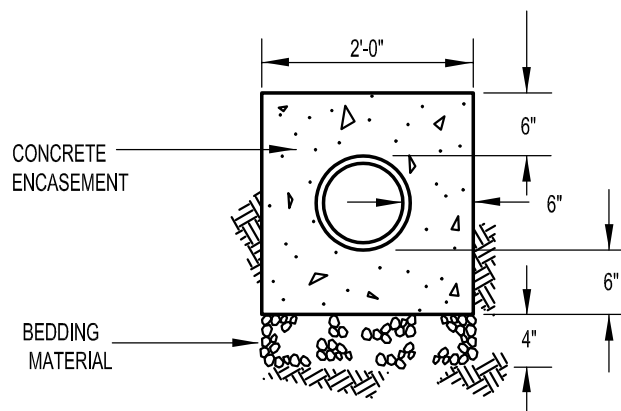
ISSUED

DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	SS5
SCALE	N.T.S.



CONCRETE COLLAR TO BE USED IN
UNPAVED AREAS ONLY

PLAN VIEW

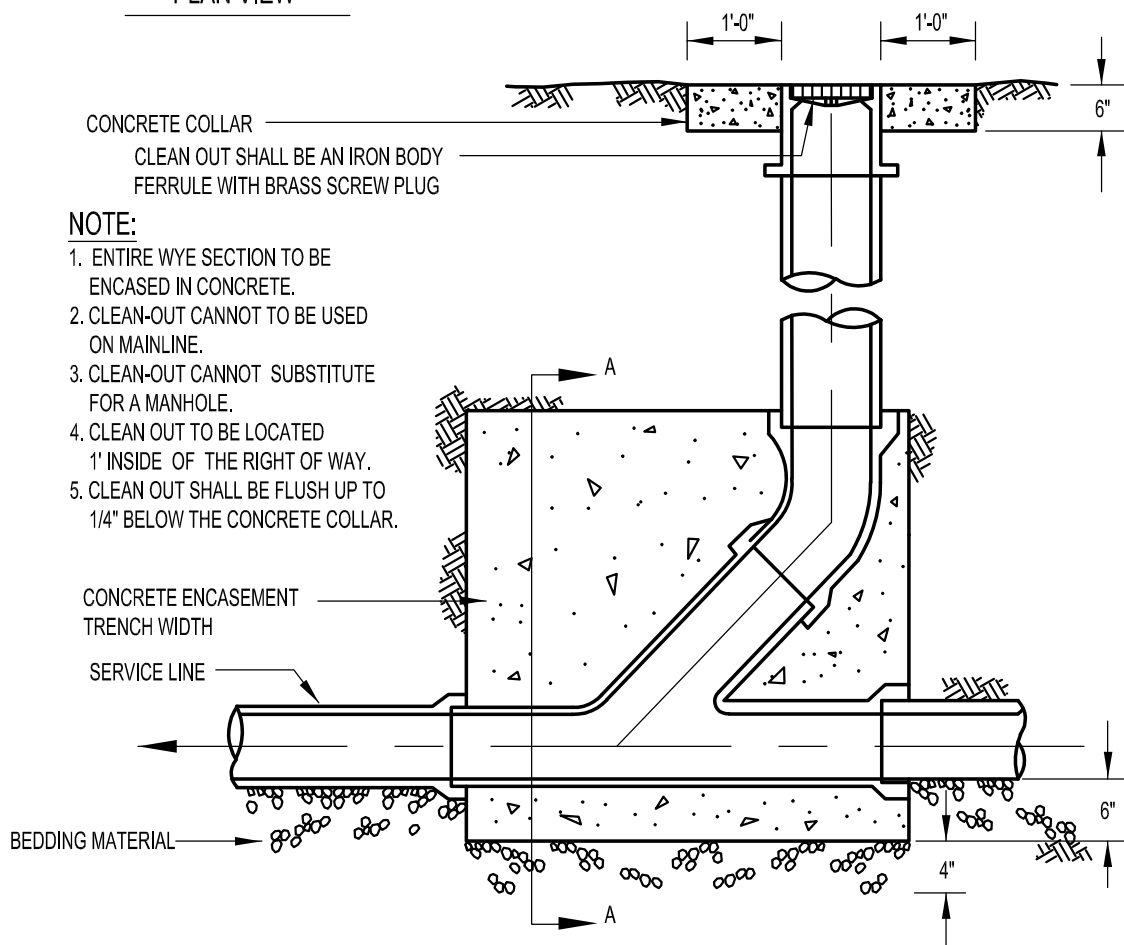


SECTION A-A

CONCRETE COLLAR
CLEAN OUT SHALL BE AN IRON BODY
FERRULE WITH BRASS SCREW PLUG

NOTE:

1. ENTIRE WYE SECTION TO BE ENCASED IN CONCRETE.
2. CLEAN-OUT CANNOT TO BE USED ON MAINLINE.
3. CLEAN-OUT CANNOT SUBSTITUTE FOR A MANHOLE.
4. CLEAN OUT TO BE LOCATED 1' INSIDE OF THE RIGHT OF WAY.
5. CLEAN OUT SHALL BE FLUSH UP TO 1/4" BELOW THE CONCRETE COLLAR.



ELEVATION

REVISIONS

DATE	ITEM	BY
3/2020		UTLEIG

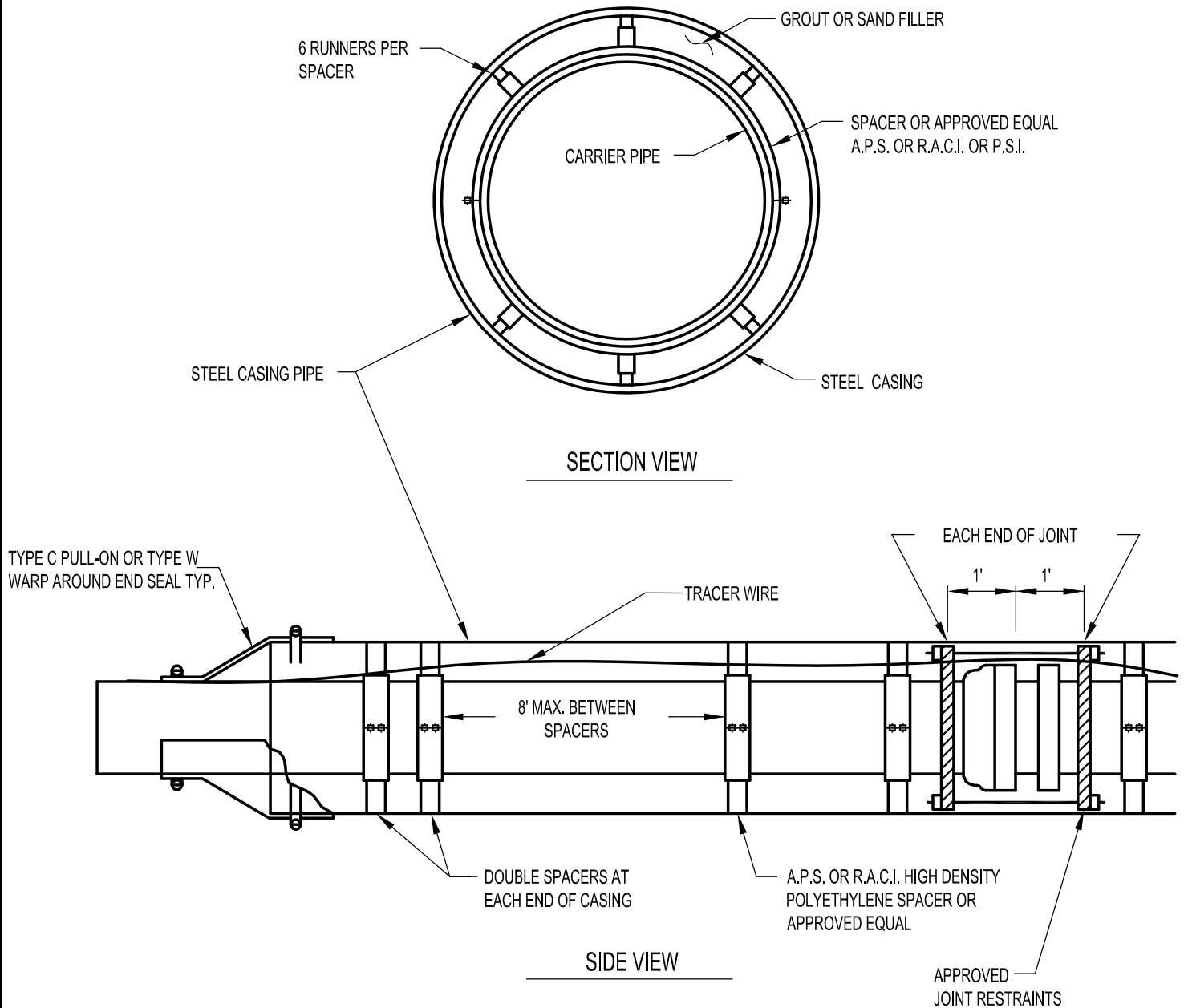



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

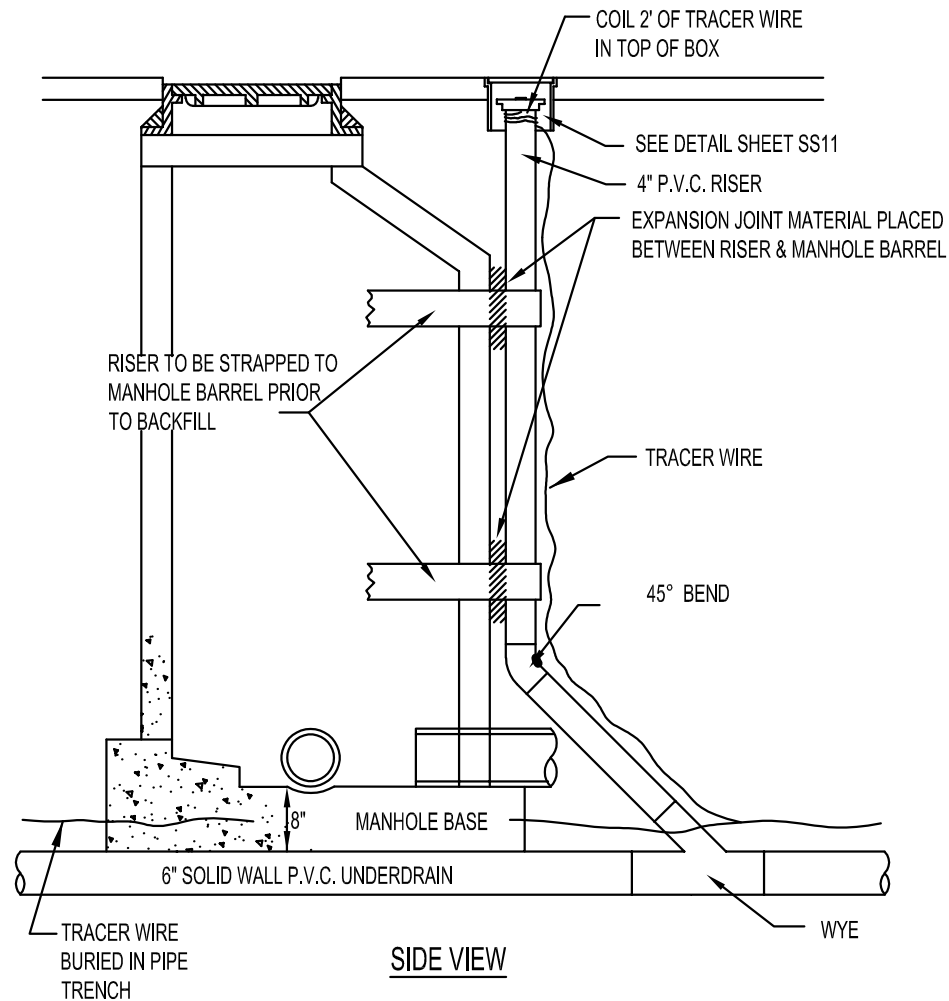
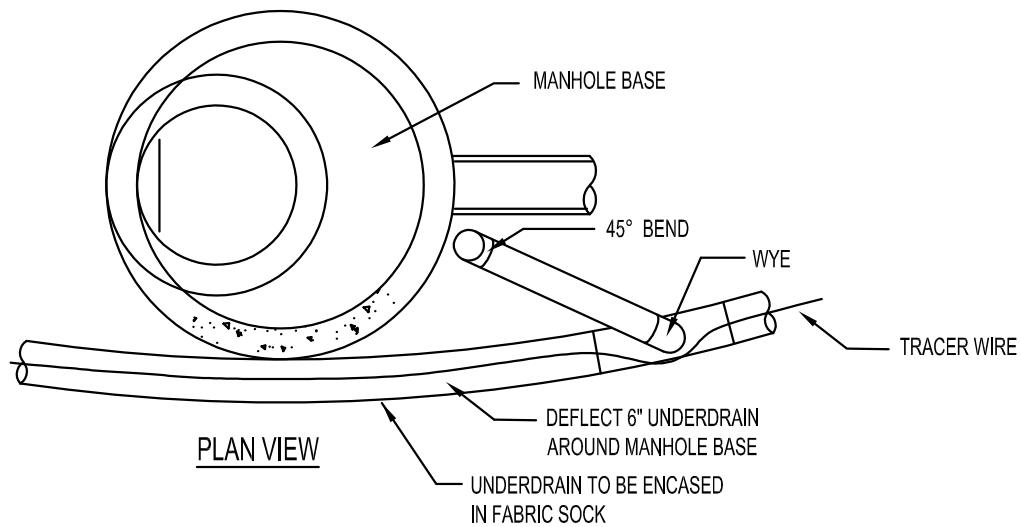
STANDARD CLEAN-OUT


ISSUED

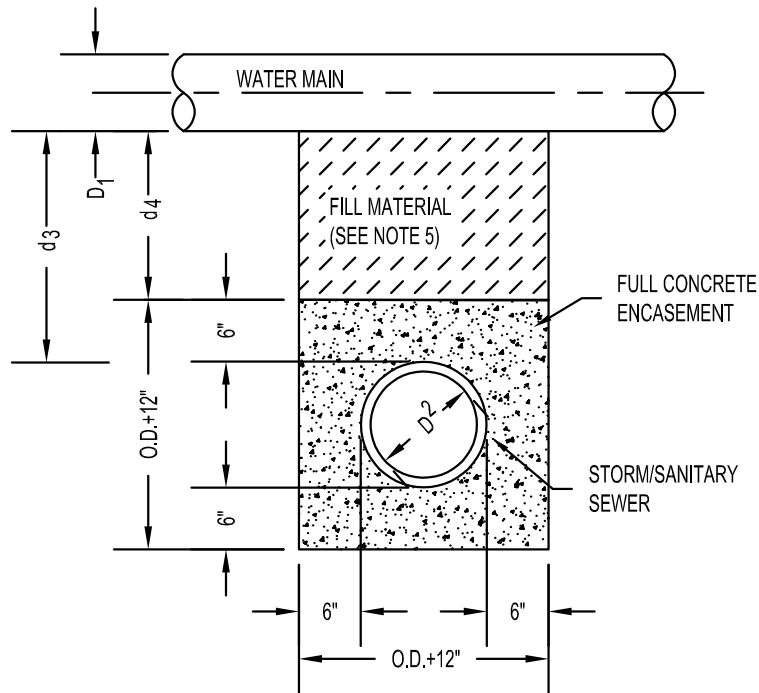
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	SS6
SCALE	N.T.S.



REVISIONS			 CITY OF Northglenn	PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION		ISSUED	
DATE	ITEM	BY				DRAWN BY:	JLT
3/2020		UTLEIG				APPROVED BY:	
						DRAWING NO.	SS7
						SCALE	N.T.S.
			JACKING DETAIL				

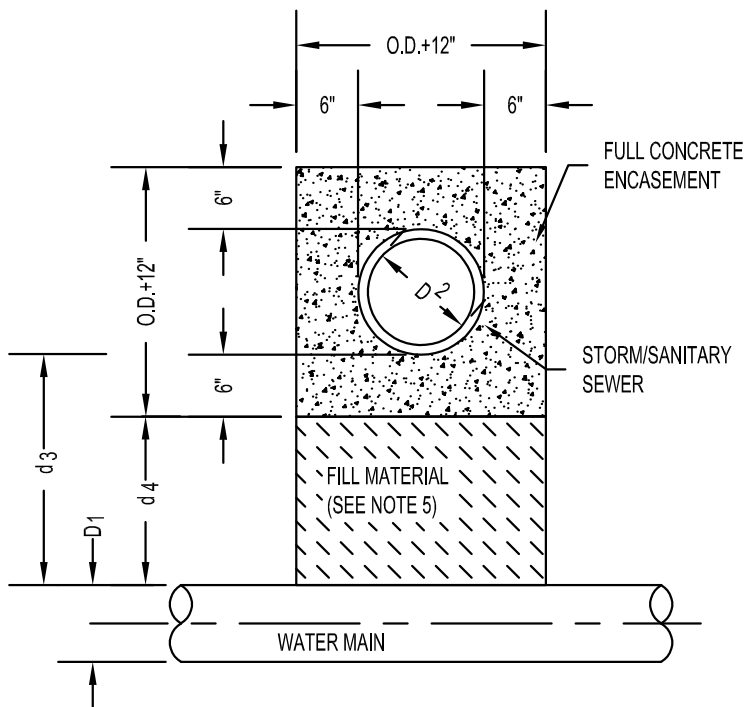


REVISIONS			 PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		UTLEIG		APPROVED BY:	
				DRAWING NO.	SS8
				SCALE	N.T.S.
			TYPICAL UNDERDRAIN CLEANOUT		



STORM OR SANITARY SEWER CROSSING UNDER WATER MAIN

IF $d_3 > 24"$, ENCASEMENT NOT REQUIRED



STORM OR SANITARY SEWER CROSSING OVER TOP OF WATER MAIN ENCASEMENT

REQUIRED REGARDLESS OF DIMENSION d_3

(SEE NOTE 1 FOR SPECIAL CASES)

NOTES:

1. CONCRETE COLLAR AROUND STORM SEWER JOINTS MAY BE ACCEPTED WITH WRITTEN APPROVAL BY THE CITY ENGINEERING DIVISION AND ONLY FOR PIPE 30" OR LARGER.
2. CONCRETE TO BE CAST AGAINST UNDISTURBED SOIL OR SHORING.
3. LENGTH OF ENCASEMENT SHALL EXTEND AT LEAST 10-FEET EACH SIDE OF WATER MAIN.
4. UNLESS OTHERWISE NOTED ON PLAN/PROFILE DRAWINGS, ENCASEMENTS NEED NOT BE REINFORCED.
5. FILLER MATERIAL BETWEEN CONDUITS TO BE:
 - a. APPROVED COMPRESSIBLE MATERIAL SUCH AS STYROFOAM, ETC. IF $d_i < 6"$.
 - b. COMPACTED BACKFILL, IF $d_i > 6"$.
6. SHORING OR SHEETING, IF USED, TO BE CUT OFF AT TOP OF ENCASEMENT

REVISIONS

DATE	ITEM	BY
3/2020		UTLEIG



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

ENCASEMENT FOR CONDUIT CROSSINGS

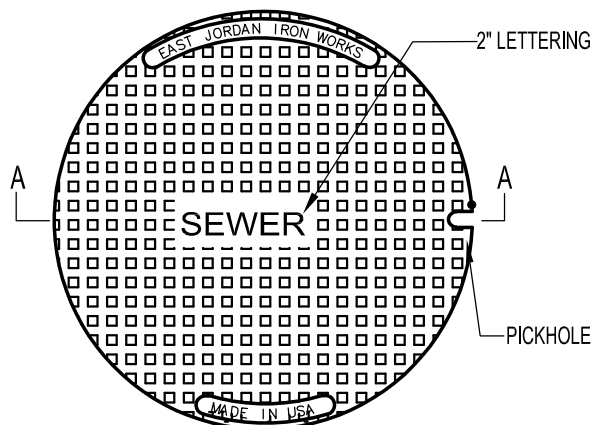
ISSUED

DRAWN BY: JLT

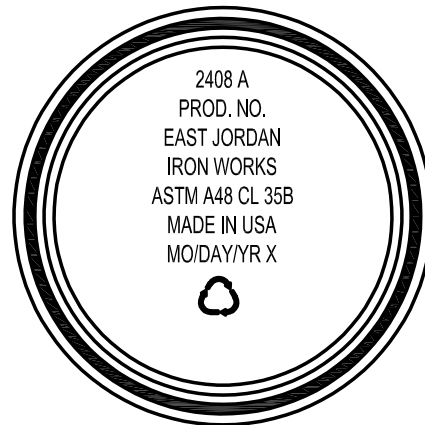
APPROVED BY:

DRAWING NO. SS9

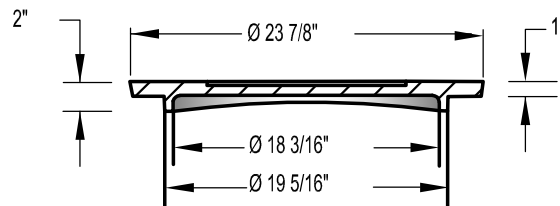
SCALE N.T.S.



TOP OF COVER



BOTTOM OF COVER



SECTION A-A

COVER: GRAY IRON ASTM A 48 CL35 B
 LOAD RATING: HEAVY DUTY
 WEIGHT: 135LBS. (61kg)
 MACHINED SURFACE
 EAST JORDAN IRON WORKS PRODUCT OR APPROVED
 EQUAL

REVISIONS

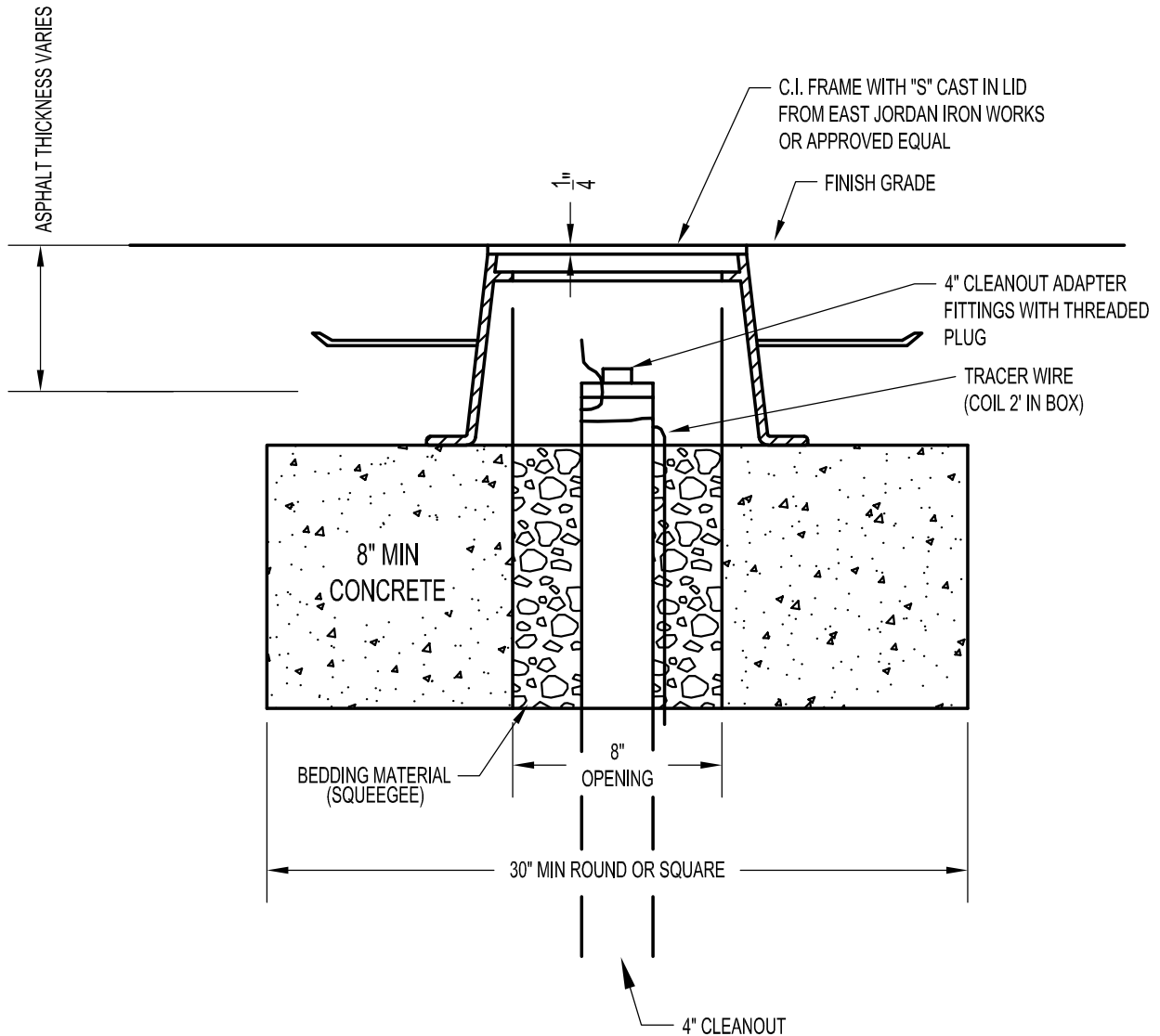
DATE	ITEM	BY
3/2020		UTLEIG




PUBLIC WORKS DEPARTMENT
 ENGINEERING DIVISION

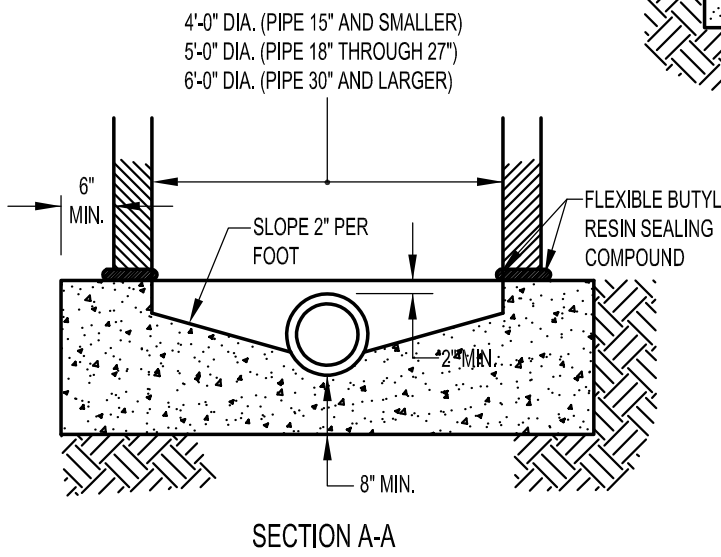
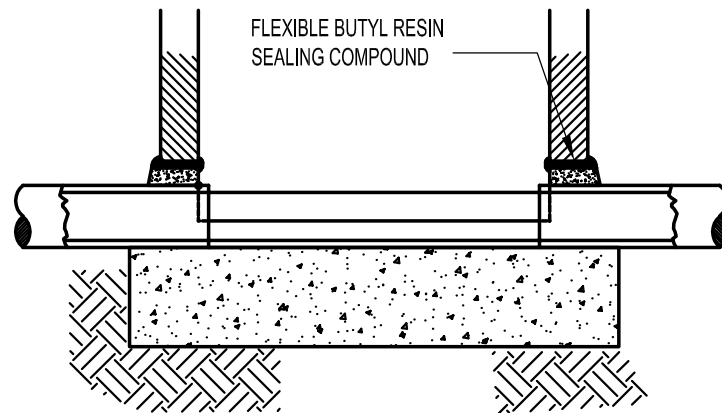
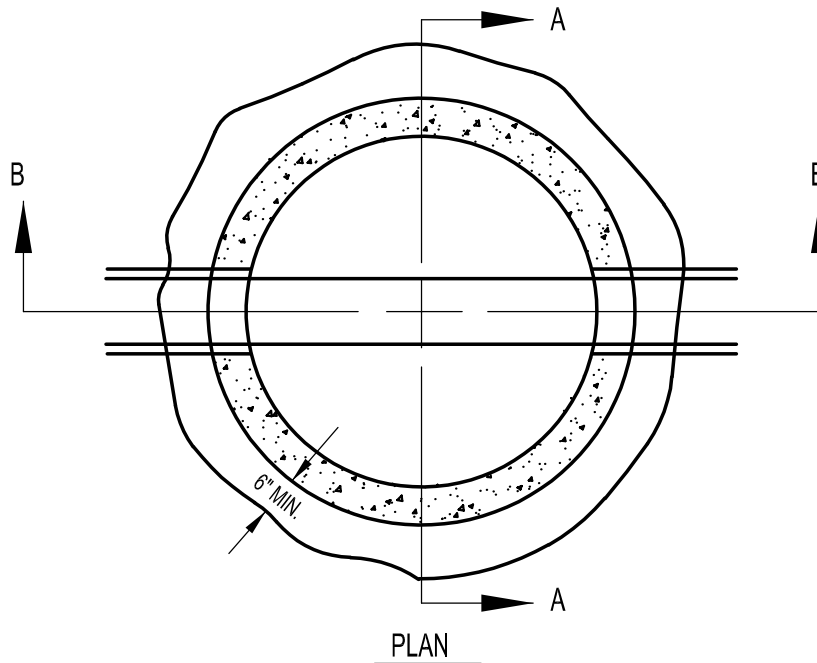
SANITARY SEWER MANHOLE COVER

ISSUED	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	SS10
SCALE	N.T.S.



REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
					DRAWING NO.	SS11
					SCALE	N.T.S.

STANDARD SANITARY SEWER
UNDERDRAIN CLEAN-OUT



NOTES:

1. JOINTS TO BE SET IN FLEXIBLE BUTYL RESIN SEALING COMPOUND AND GROUTED WITH MORTAR INSIDE AND OUTSIDE.
2. ALL BASES SHALL BE REINFORCED AND TO BE APPROVED BY CITY ENGINEER.
3. SQUARE BASES ARE ACCEPTABLE.
4. ALL CONCRETE REINFORCEMENT TO BE PER CDOT STANDARD SPECIFICATIONS (LATEST REVISION).
5. FOR PIPES 36" AND LARGER OR WHERE CONDITIONS SUCH AS MULTIPLE PIPES WARRANT A CONCRETE BOX BASE WILL BE REQUIRED (SEE CDOT STANDARD DRAWINGS)

REVISIONS

DATE	ITEM	BY
3/2020		ULTEIG



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

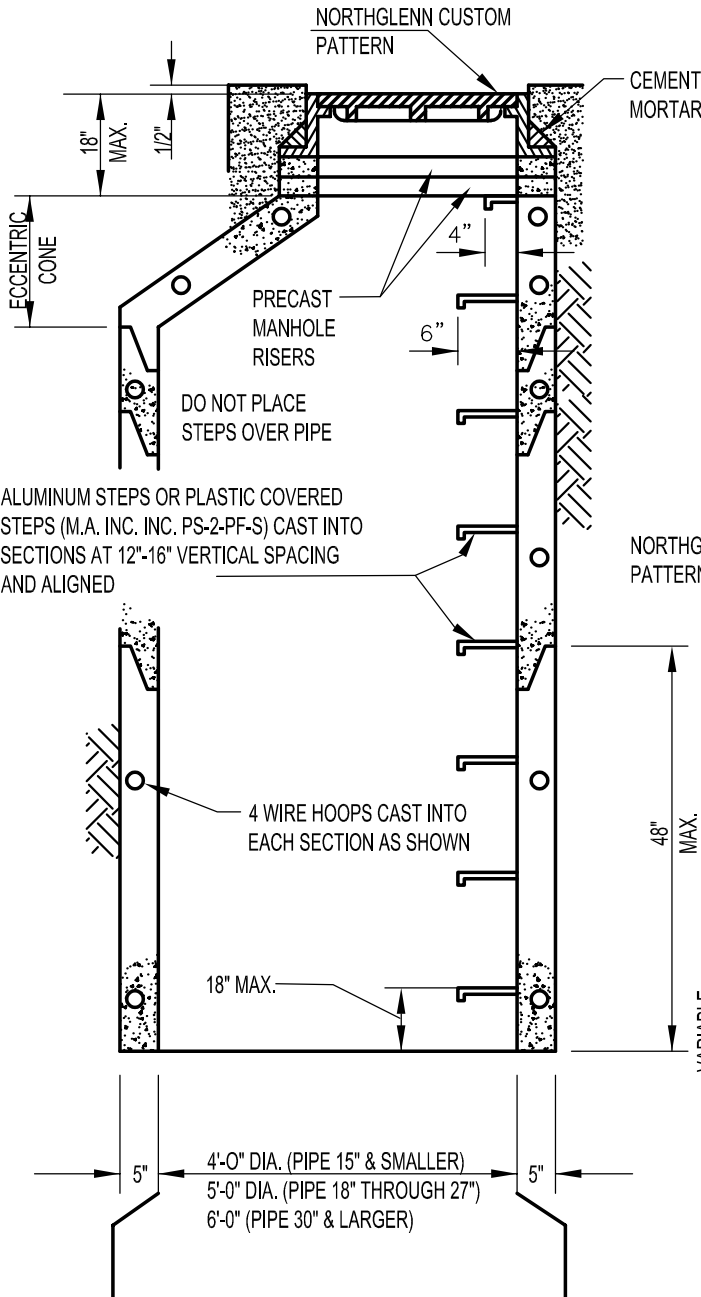
STANDARD MANHOLE BASE

ISSUED

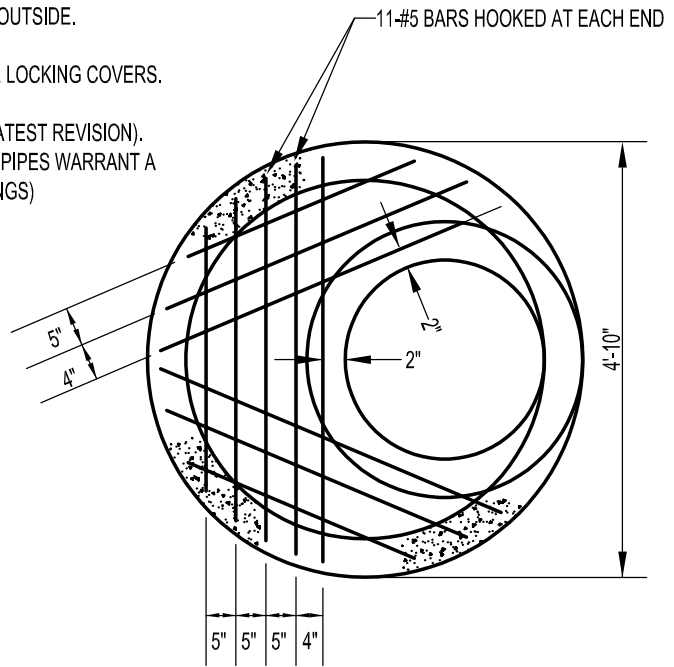
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	ST1
SCALE	N.T.S.

NOTES:

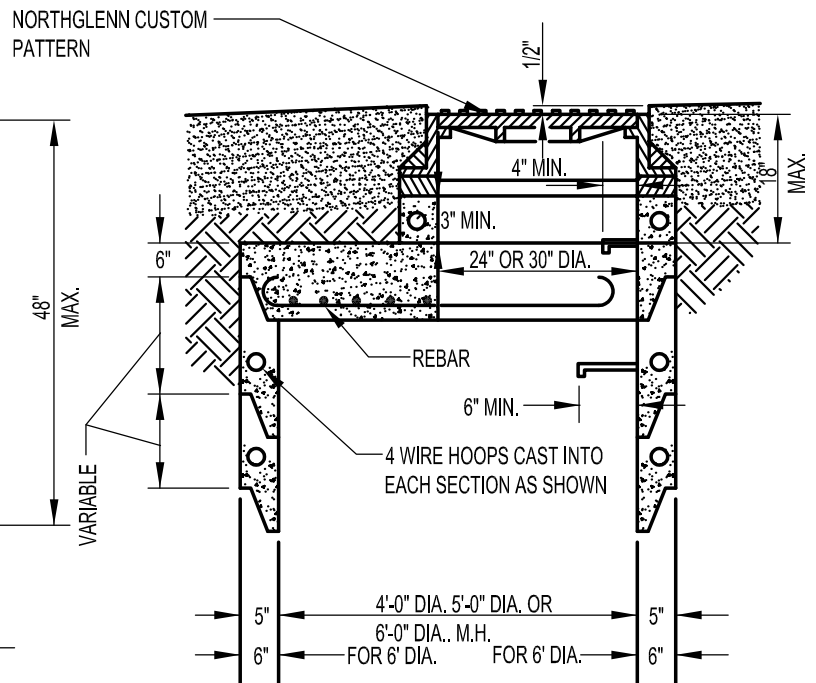
1. ALL JOINTS TO BE SET IN FLEXIBLE BUTYL RESIN SEALING COMPOUND AND PLASTERED WITH MORTAR 5/8" THICK AND EXTENDING 4" EACH SIDE OF JOINT INSIDE AND OUTSIDE.
2. MORTAR ON RISER RINGS IS ACCEPTABLE.
3. MANHOLES INSTALLED OUTSIDE OF STREET RIGHT-OF- WAY SHALL HAVE LOCKING COVERS.
4. "STORM SEWER" TO BE IMPRINTED ON COVER.
5. CONCRETE REINFORCEMENT PER CDOT STANDARD SPECIFICATIONS (LATEST REVISION).
6. FOR PIPES 36" AND LARGER OR WHERE CONDITIONS SUCH AS MULTIPLE PIPES WARRANT A CONCRETE BOX BASE WILL BE REQUIRED (SEE CDOT STANDARD DRAWINGS)



**TYPICAL MANHOLE SECTION
WITH ECCENTRIC CONE**



ALTERNATE TOP PLAN



ALTERNATE FLAT TOP

REVISIONS

DATE	ITEM	BY
3/2020		ULTEIG

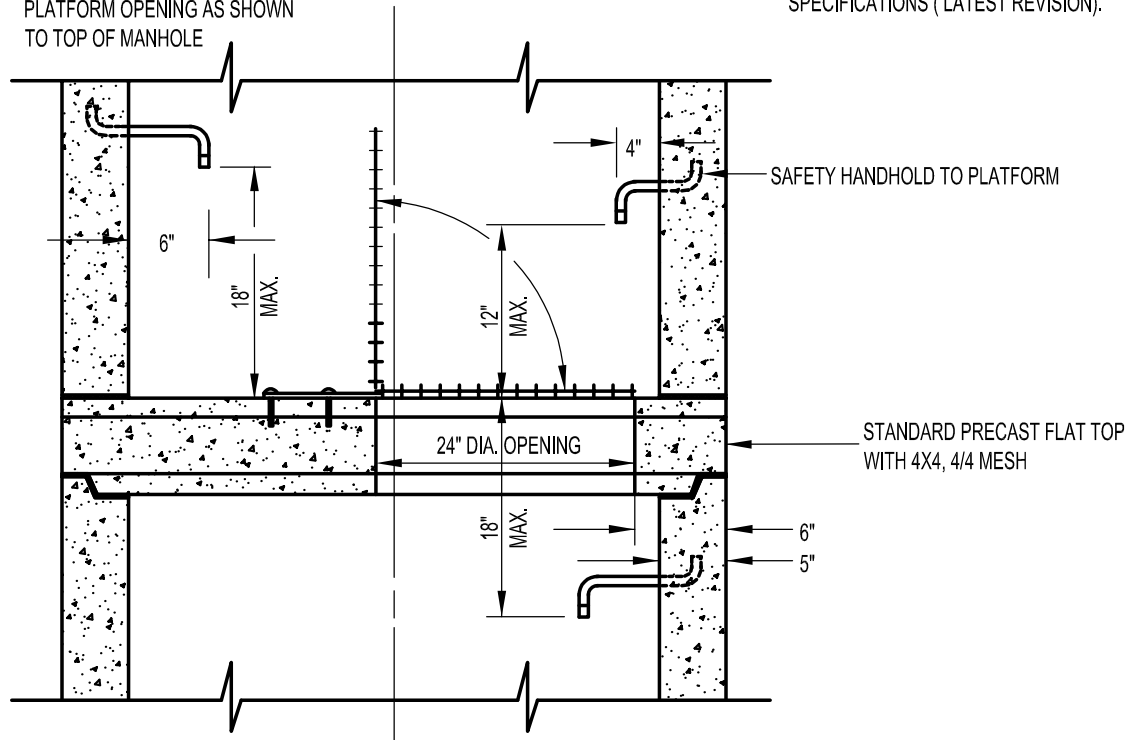
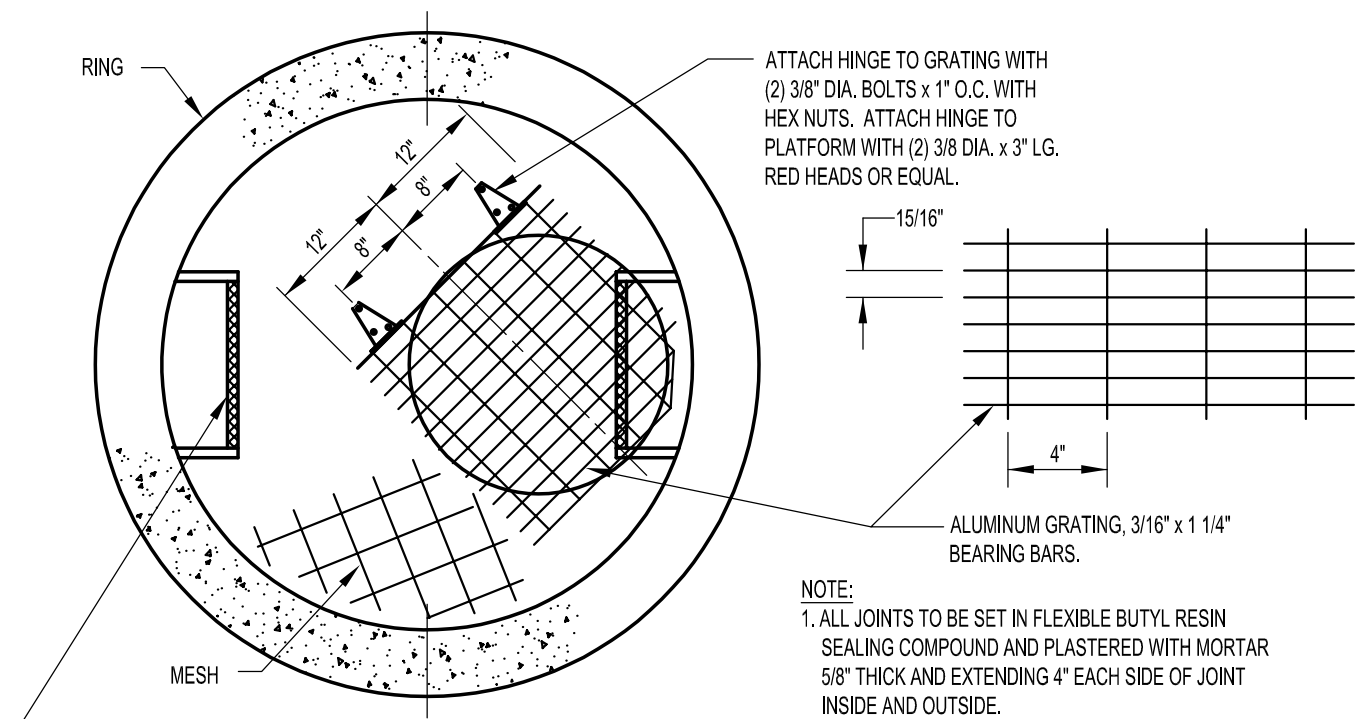


**PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION**


MANHOLE BARRELS AND ALTERNATIVE TOPS

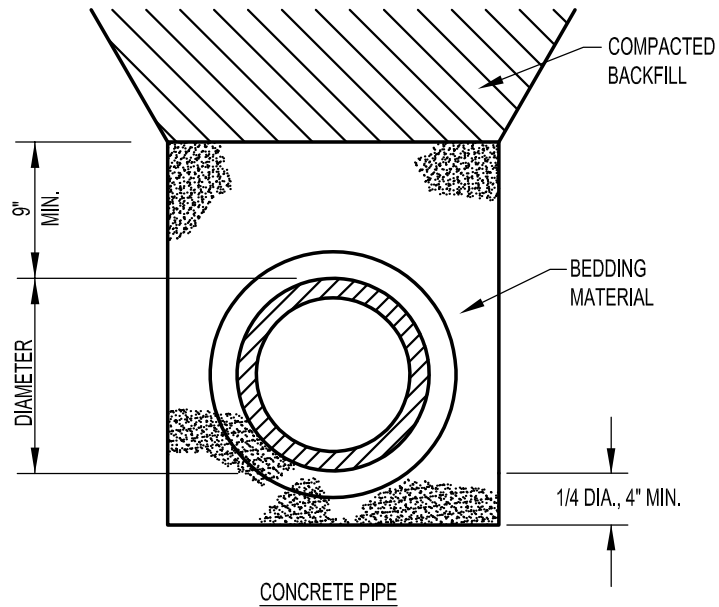
ISSUED

DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	ST2
SCALE	N.T.S.




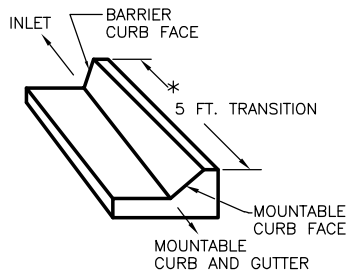
TO BE USED WHEN THE DISTANCE FROM INVERT TO TOP OF COVER EXCEEDS 17 FT.

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
			INTERMEDIATE PLATFORM FOR MANHOLES OVER 17' IN DEPTH		DRAWING NO.	ST3
					SCALE	N.T.S.



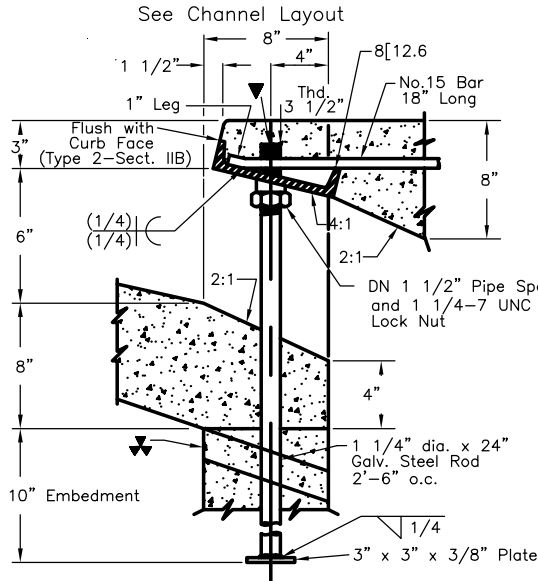
NOTES:
 THIS DETAIL IS TO BE USED UNDER NORMAL CONDITIONS.
 WHERE EXCESSIVE GROUND WATER IS PRESENT AN ALTERNATE DESIGN WILL BE REQUIRED.

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
			TYPICAL PIPE BEDDING		DRAWING NO.	ST4
					SCALE	N.T.S.



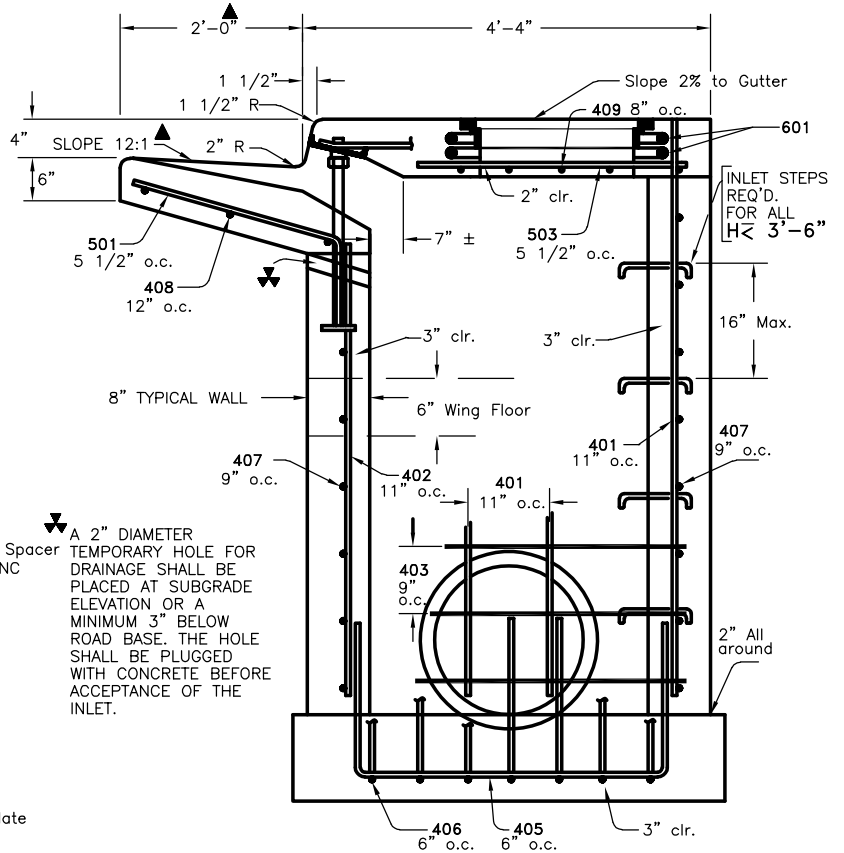
TRANSITION CURB

MEET SHAPE OF NORMAL BARRIER



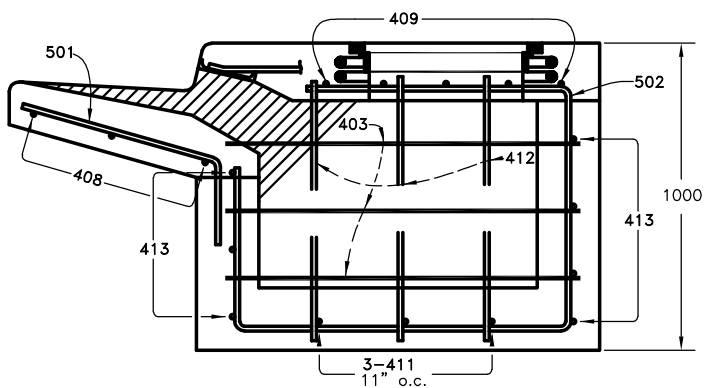
▼ CURB FACE ASSEMBLY,
PLACE ENTIRE ASSEMBLY BEFORE
POURING CONCRETE

▲ - FOR A 1'-0" PAN SLOPE 6:1



SECTION B-B TYPICAL END VIEW

NOTE:
MANHOLE COVER, STATION POINT AND OUTFLOW
PIPE SHALL BE LOCATED AT THE SAME END OF
THE INLET.



(DOTTED BARS ARE IN SECTION d-d)

SECTIONS c-c & d-d

(SHOWN FOR REFERENCE PURPOSES ONLY - REFER TO CDOT
STANDARDS FOR ALL UPDATED DETAILS TO TYPE R INLET)

REVISIONS

DATE	ITEM	BY
3/2020		ULTEIG



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

CURB INLET TYPE R

ISSUED

DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	ST5 - B
SCALE	N.T.S.

TABLE ONE ~ BAR LIST FOR CURB INLETS, TYPE "R"

MARK	DIA (in)	O.C. SPACING (in)	TYPE	ALL INLETS				INLETS, H \leq 5'				INLETS, H $>$ 5'			
				L = 5'				10'		15'		10'		15'	
				NO. REQ'D.	LENGTH (ft-in)	NO. REQ'D.	LENGTH (ft-in)	NO. REQ'D.	LENGTH (ft-in)	NO. REQ'D.	LENGTH (ft-in)	NO. REQ'D.	LENGTH (ft-in)	NO. REQ'D.	LENGTH (ft-in)
401		11"	II	15	*	21	*	26	*	11	*	11	*		
402		11"	II	7	*	13	*	18	*	7	*	7	*		
403		9"	II	*	4'-0"	*	4'-0"	*	4'-0"	*	4'-0"	*	4'-0"	*	4'-0"
405		6"	VI	11	6'-10"	21	6'-10"	31	6'-10"	11	6'-10"	11	6'-10"		
406		6"	VIII	7	8'-10"	7	13'-10"	7	18'-10"	7	8'-10"	7	8'-10"		
407	1/2"	9"	II	*	5'-10"	*	10'-10"	*	15'-10"	*	5'-10"	*	5'-10"		
408		12"	II	3	6'-0"	3	11'-0"	3	16'-0"	3	11'-0"	3	16'-0"		
409		8"	II	6	5'-10"	6	10'-10"	6	15'-10"	6	10'-10"	6	15'-10"		
410		11"	VI							3	*	3	*		
411		11"	II							3	5'-2"	3	10'-2"		
412		11"	II							3	2'-9"	3	2'-9"		
413		9"	II							7	10'-10"	7	15'-10"		
501		5 1/2"	IV	11	3'-4"	22	3'-4"	33	3'-4"	22	3'-4"	33	3'-4"		
502	5/8"	5 1/2"	III							11	11'-5"	17	11'-5"		
503		5 1/2"	II	5	3'-6"	16	3'-6"	27	3'-6"	6	3'-6"	6	3'-6"		
504		5 1/2"	II									5	8'-4"		
601	3/4"	2 1/2"	V	2	8'-10"	2	8'-10"	2	8'-10"	2	8'-10"	4	8'-10"		
Ø8[8.5				1	5'-10"	1	10'-10"	1	15'-10"	1	10'-10"	1	15'-10"		
▼				2 BARS, 1 ROD		4 BARS, 3 RODS		8 BARS, 5 RODS		4 BARS, 3 RODS		8 BARS, 5 RODS			

* VARIABLE, REFER TO TABLE TWO.

Ø INCLUDE 18" NO. 4 BARS (SEE CHANNEL LAYOUT DETAIL).

▼ SEE CURB FACE ASSEMBLY ON SHEET ST5B AND CHANNEL LAYOUT DETAILS.

REGULAR
INLETS

DROP BOX
INLETS

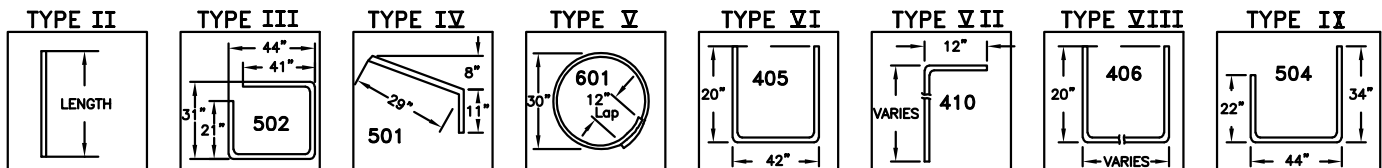
TABLE TWO ~ BARS AND QUANTITIES VARIABLE WITH "H"

"H" (ft-in)	LENGTH (ft-in)			NO. REQ'D. REGULAR		NO. REQ'D. DROP BOX		L = 5'		L = 10'		L = 15'	
	401	402	410	403	407	403	407	CONC. CU.YD.	STEEL LBS.	CONC. CU.YD.	STEEL LBS.	CONC. CU.YD.	STEEL LBS.
3'-0"	2'-8"	1'-8"		10	7			3.2	285	5.3	497	7.4	706
3'-6"	3'-2"	2'-2"		10	7			3.4	305	5.7	528	7.9	747
4'-0"	3'-8"	2'-8"		12	9			3.7	326	6.0	559	8.4	786
4'-6"	4'-2"	3'-2"		12	9			3.9	334	6.4	571	8.8	803
5'-0"	4'-8"	3'-8"		14	11			4.1	354	6.7	602	9.3	844
5'-6"	5'-2"	4'-2"	3'-5"	16	13	15	6	4.4	375	6.0	607	7.4	850
6'-0"	5'-8"	4'-8"	3'-11"	16	13	16	6	4.6	382	6.2	616	7.6	860
6'-6"	6'-2"	5'-2"	4'-5"	18	15	18	8	4.8	402	6.4	637	7.8	880
7'-0"	6'-8"	5'-8"	4'-11"	20	17	19	10	5.0	423	6.6	654	8.0	897
7'-6"	7'-2"	6'-2"	5'-5"	20	17	20	10	5.3	430	6.9	664	8.3	907
8'-0"	7'-8"	6'-8"	5'-11"	22	19	22	12	5.5	451	7.1	684	8.5	927
8'-6"	8'-2"	7'-2"	6'-5"	24	21	23	14	5.7	471	7.3	702	8.7	944
9'-0"	8'-8"	7'-8"	6'-11"	24	21	24	14	6.0	479	7.6	711	9.0	954
9'-6"	9'-2"	8'-2"	7'-5"	26	23	26	16	6.2	499	7.8	732	9.2	974
10'-0"	9'-8"	8'-8"	7'-11"	28	25	27	18	6.4	520	8.0	749	9.4	992
10'-6"	10'-2"	9'-2"	8'-5"	28	25	28	18	6.7	527	8.3	759	9.7	1001
11'-0"	10'-8"	9'-8"	8'-11"	30	27	30	20	6.9	547	8.5	779	9.9	1022

NOTE: FOR L = 5',
L = 10' AND L = 15'

REGULAR INLETS:
TOTAL QUANTITIES NEEDED
ARE OUTSIDE OF THE
HEAVY BLACK LINE.
DROP BOX INLETS:
TOTAL QUANTITIES NEEDED
ARE INSIDE OF THE
HEAVY BLACK LINE.

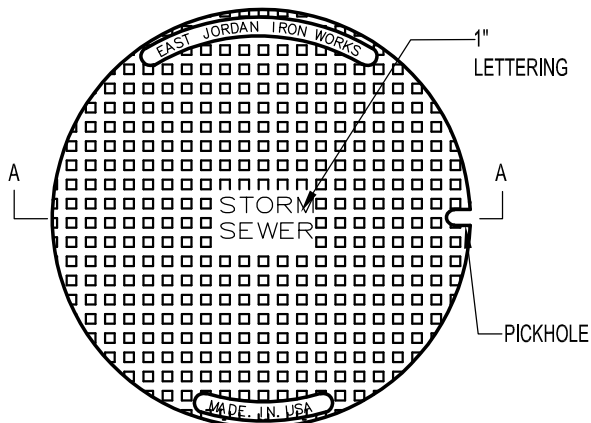
STEEL WEIGHTS DO NOT
INCLUDE STRUCTURAL
STEEL.



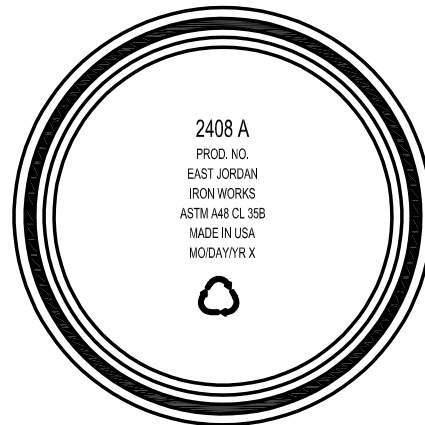
BAR BENDING DIAGRAMS ~ (Dimensions are Out-to-Out of bar)
(SHOWN FOR REFERENCE PURPOSES ONLY - REFER TO CDOT
STANDARDS FOR ALL UPDATED DETAILS TO TYPE R INLET)

REVISIONS			CITY OF Northglenn	PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
					DRAWING NO.	ST5 - C
					SCALE	N.T.S.

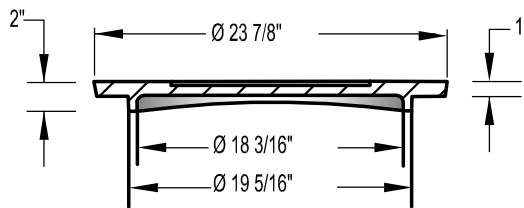
CURB INLET TYPE R



TOP OF COVER



BOTTOM OF COVER



SECTION A-A

COVER: GRAY IRON ASTM A 48 CL35 B
 LOAD RATING: HEAVY DUTY
 WEIGHT: 135LBS. (61kg)
 MACHINED SURFACE
 EAST JORDAN IRON WORKS PRODUCT
 OR APPROVED EQUAL

REVISIONS

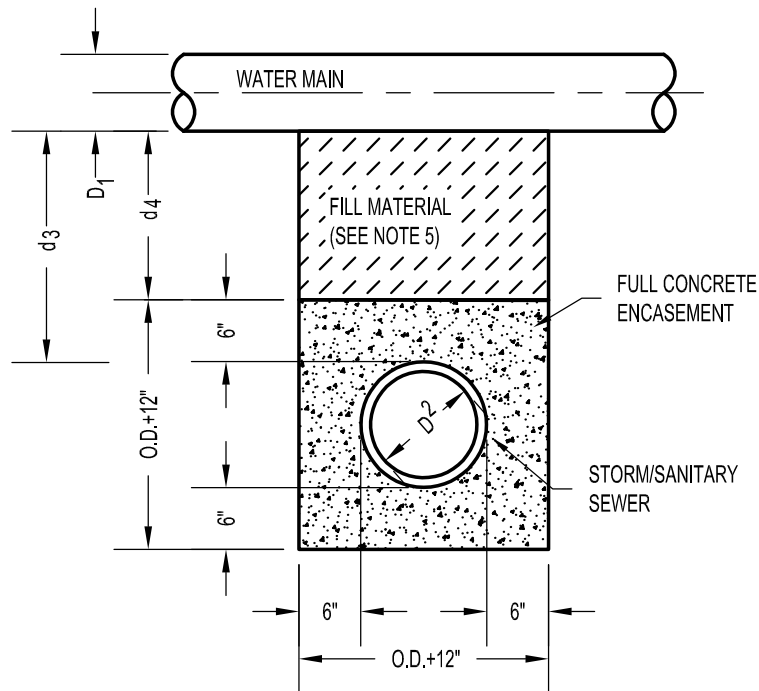
DATE	ITEM	BY
3/2020		ULTEIG



PUBLIC WORKS DEPARTMENT
 ENGINEERING DIVISION

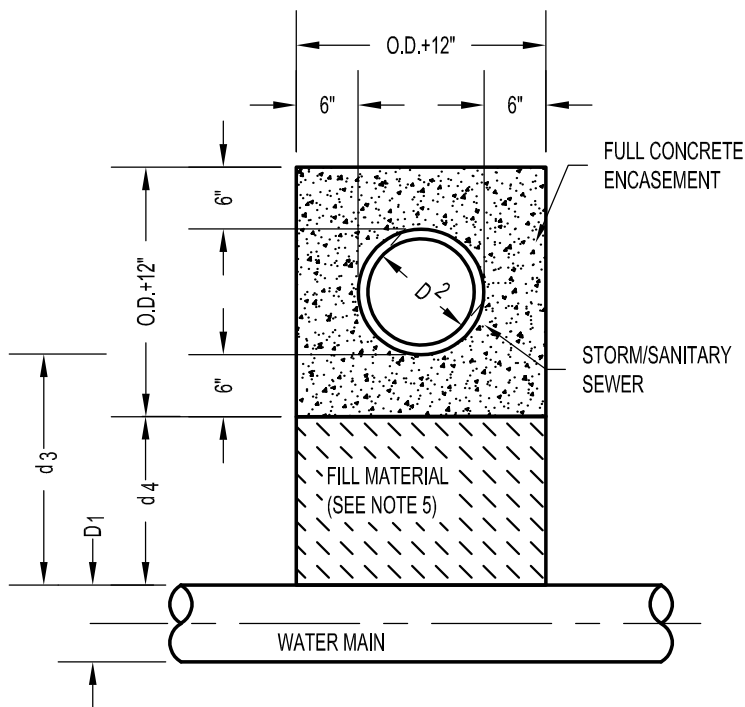
STORM SEWER MANHOLE COVER

ISSUED	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	ST6
SCALE	N.T.S.



STORM OR SANITARY SEWER CROSSING UNDER WATER MAIN

IF $d_3 > 24"$, ENCASEMENT NOT REQUIRED



STORM OR SANITARY SEWER CROSSING OVER TOP OF WATER MAIN ENCASEMENT

REQUIRED REGARDLESS OF DIMENSION d_3
(SEE NOTE 1 FOR SPECIAL CASES)

NOTES:

1. CONCRETE COLLAR AROUND STORM SEWER JOINTS MAY BE ACCEPTED WITH WRITTEN APPROVAL BY THE CITY ENGINEER AND ONLY FOR PIPE 30" OR LARGER.
2. CONCRETE TO BE CAST AGAINST UNDISTURBED SOIL OR SHORING.
3. LENGTH OF ENCASEMENT SHALL EXTEND AT LEAST 10-FEET EACH SIDE OF WATER MAIN.
4. UNLESS OTHERWISE NOTED ON PLAN/PROFILE DRAWINGS, ENCASEMENTS NEED NOT BE REINFORCED.
5. FILLER MATERIAL BETWEEN CONDUITS TO BE:
 - a. APPROVED COMPRESSIBLE MATERIAL SUCH AS STYROFOAM, ETC. IF $d_4 \leq 6"$.
 - b. COMPACTED BACKFILL, IF $d_4 > 6"$.
6. SHORING OR SHEETING, IF USED, TO BE CUT OFF AT TOP OF ENCASEMENT

REVISIONS

DATE	ITEM	BY
3/2020		ULTEIG

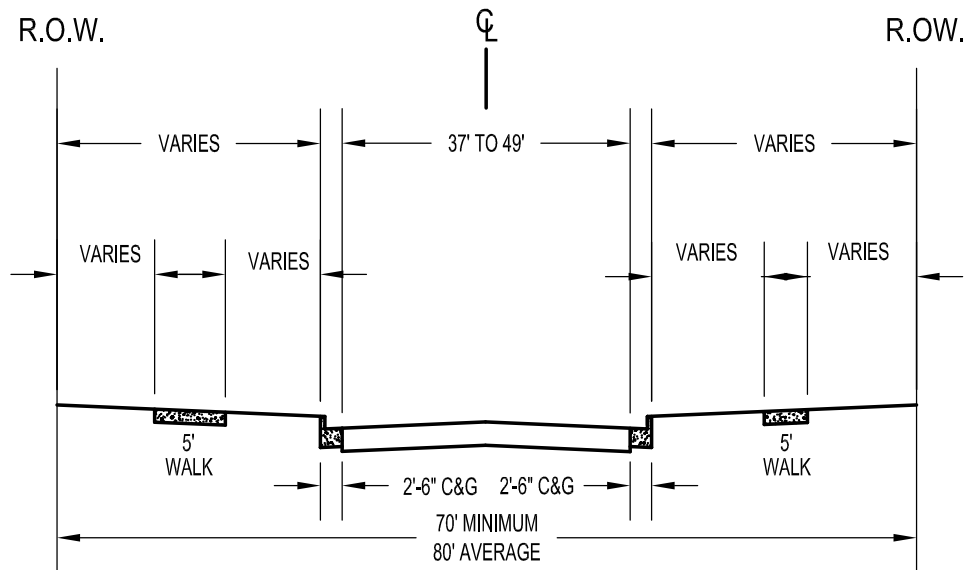


PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

ENCASEMENT FOR CONDUIT CROSSINGS


ISSUED

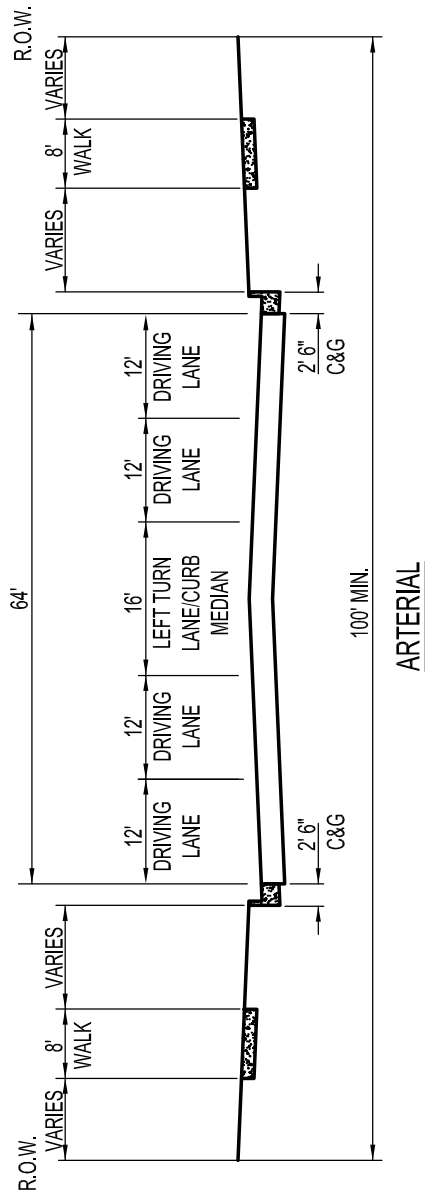
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	ST7
SCALE	N.T.S.



- PARKING ALLOWED BY APPROVAL OF PUBLIC WORKS DIRECTOR
- UTILIZED IN INDUSTRIAL, COMMERCIAL, MULTI-FAMILY, AND SINGLE-FAMILY RESIDENTIAL AREAS WHERE ON-STREET PARKING IS REQUIRED
- 80' AVERAGE RIGHT-OF-WAY (ROW) IS EXTENDED TO PROVIDE VARIOUS FENCE ALIGNMENTS ALONG ROW LINE


COLLECTOR

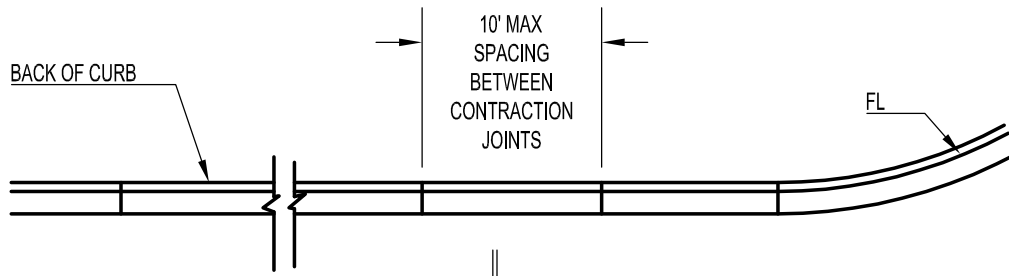
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	GY
3/2020		UTLEIG			APPROVED BY:	
			COLLECTOR TYPICAL SECTION		DRAWING NO.	R2
					SCALE	N.T.S.



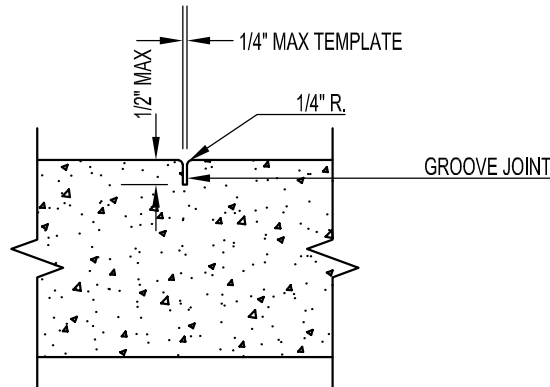
ARTERIAL

- NO PARKING ALLOWED.
- MEDIAN MAY BE PAINTED OR CURBED..

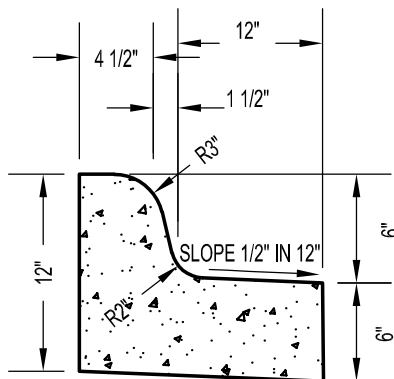
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
			ARTERIAL TYPICAL SECTION		DRAWING NO.	R3
					SCALE	N.T.S.



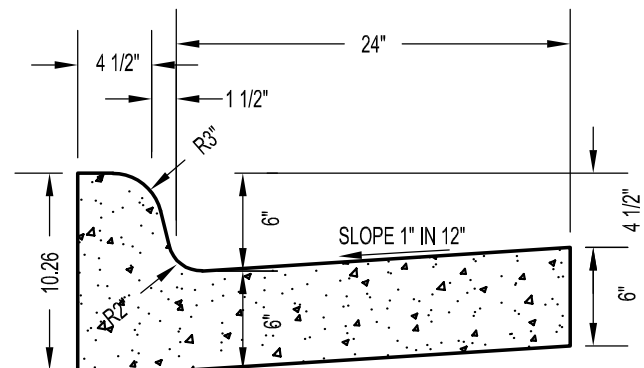
LAYOUT



CONTRACTION JOINT
10' MAXIMUM SPACING

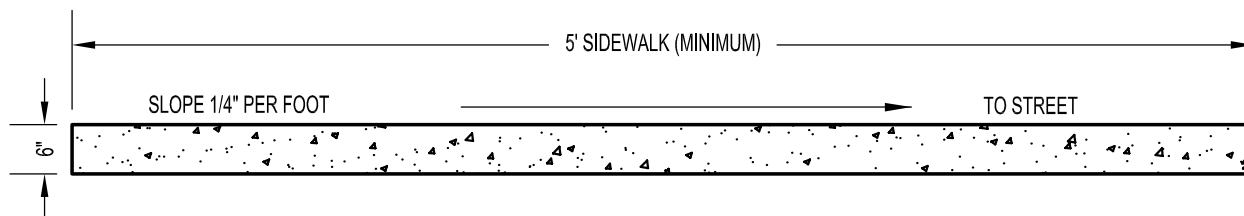


6" VERTICAL MEDIAN
CURB AND GUTTER




6" VERTICAL CURB AND GUTTER

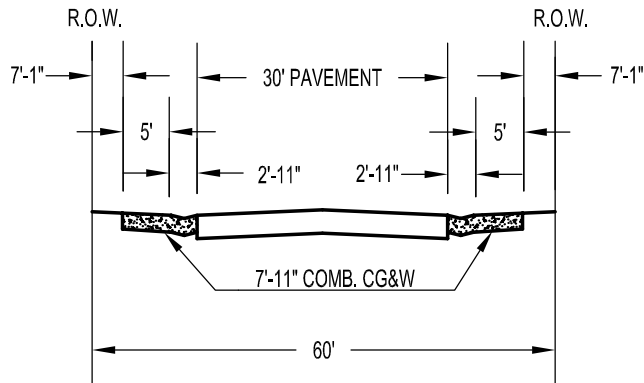
NOTE: 2' 6" CURB AND GUTTER FOR NEW
CONSTRUCTION



ATTACHED OR DETACHED WALK

REVISIONS			 PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		ULTEIG		APPROVED BY:	
				DRAWING NO.	R4
				SCALE	N.T.S.

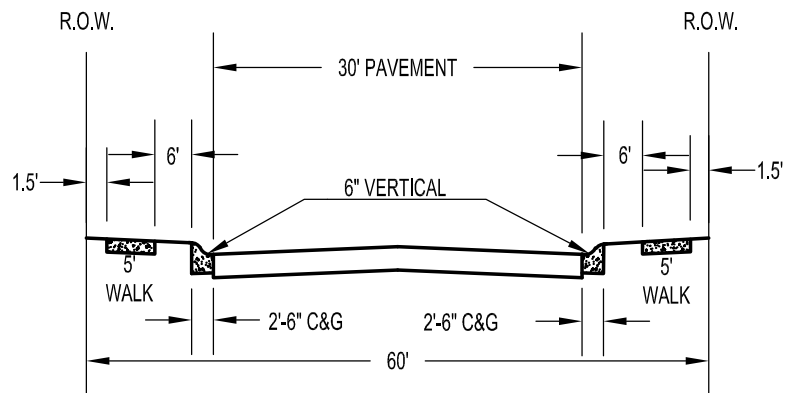
VERTICAL CURB AND GUTTER



- PARKING ALLOWED ON BOTH SIDES OF STREET
- UTILIZED IN SINGLE FAMILY RESIDENTIAL AREAS


LOCAL W/ ATTACHED WALK

TO BE USED ONLY WITH WRITTEN PERMISSION FROM
THE PUBLIC WORKS DIRECTOR

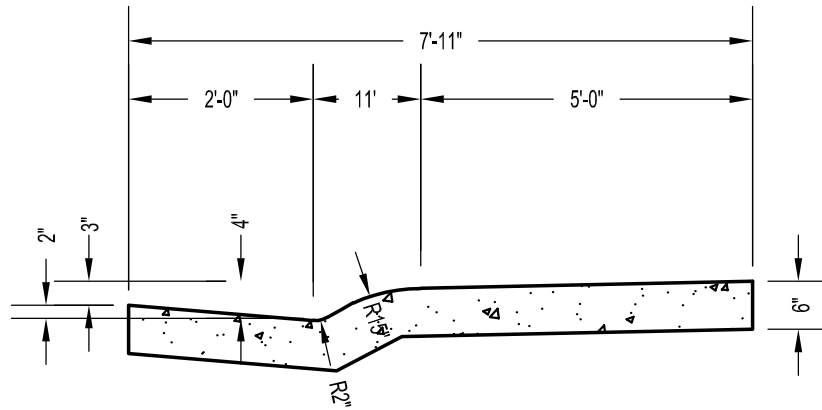


- PARKING ALLOWED ON BOTH SIDES OF STREET
- UTILIZED IN SINGLE FAMILY RESIDENTIAL AREAS

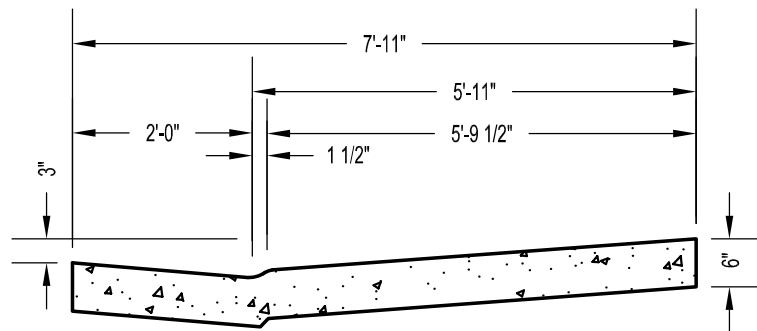
LOCAL W/ DETACHED WALK

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
					DRAWING NO.	R1
					SCALE	N.T.S.

LOCAL TYPICAL SECTION




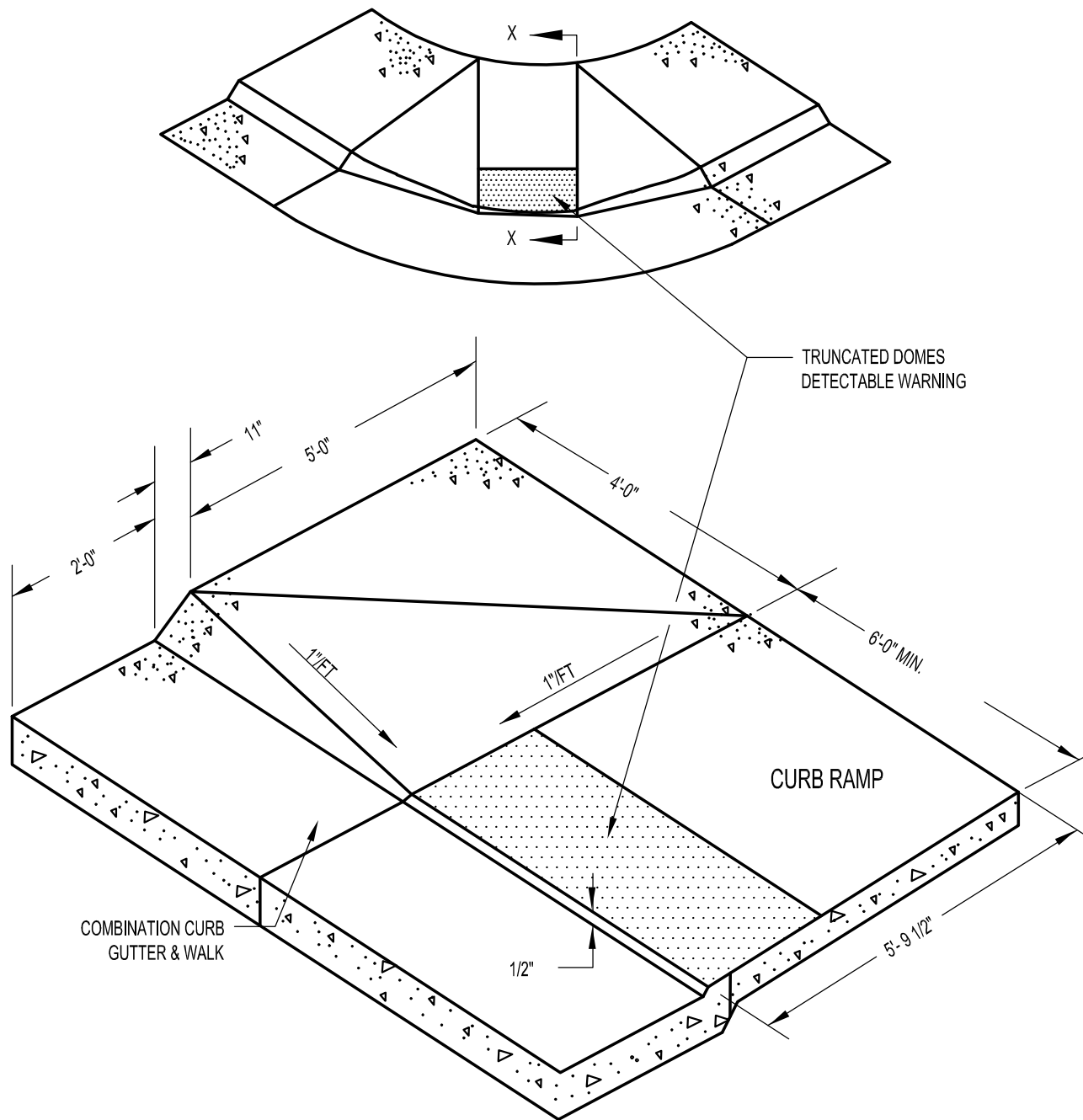
COMBINATION CURB, GUTTER & WALK STANDARD SECTION



COMBINATION CURB, GUTTER & WALK DEPRESSED SECTION

ONLY AS APPROVED BY THE PUBLIC WORKS DIRECTOR

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG	COMBINATION CURB, GUTTER AND WALK		APPROVED BY:	
					DRAWING NO.	R5
					SCALE	N.T.S.



SECTION X-X

NOTE:

1. COARSE BROOM FINISH ON RAMP.
2. SPECIAL DESIGNS ARE REQUIRED WHEN GRADES ARE OVER 4% OR WHERE THE ANGLE OF THE INTERSECTION IS LESS THAN 78 DEGREES OR MORE THAN 105 DEGREES.
3. MAINTAIN BACK OF WALK ELEVATION AT 2.0% ABOVE TOP OF CURB.

REVISIONS

DATE	ITEM	BY
3/2020		ULTEIG

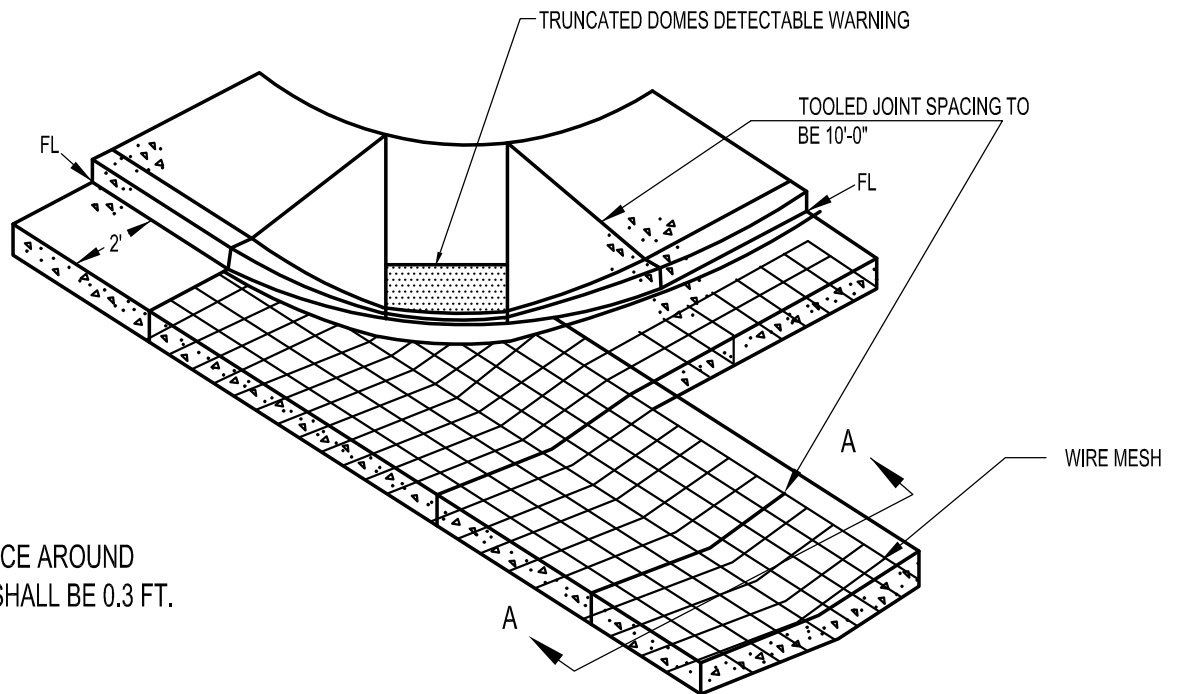


PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

CURB RAMP COMBINATION
CURB GUTTER AND WALK

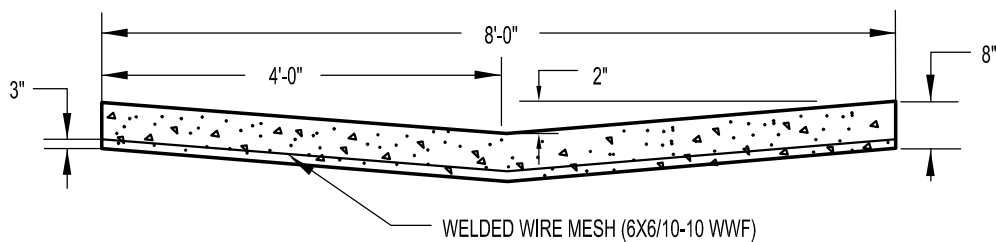
ISSUED

DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	R6
SCALE	N.T.S.




NOTE:
MINIMUM FACE FACE AROUND
CURB RETURNS SHALL BE 0.3 FT.

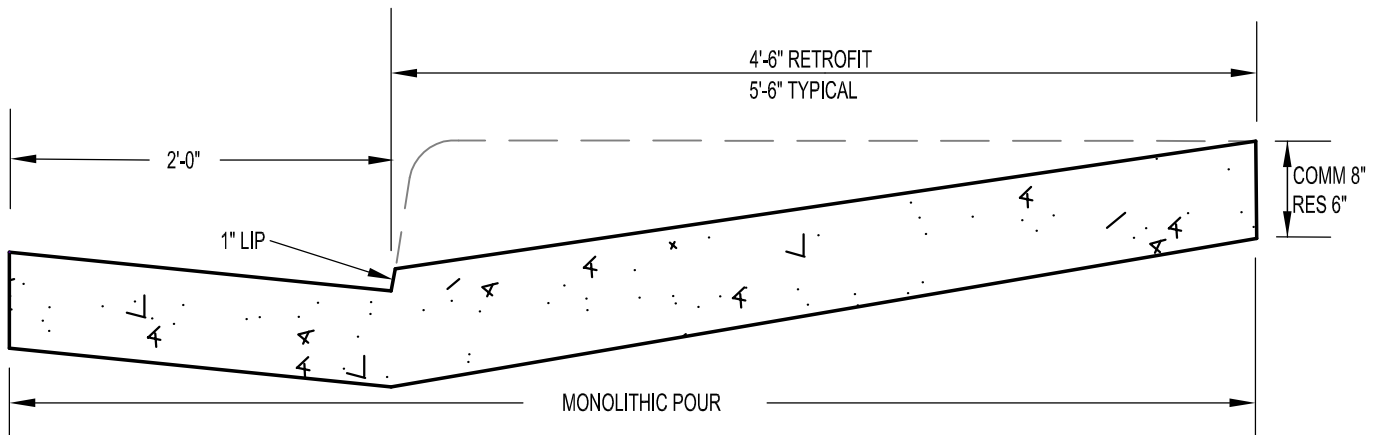
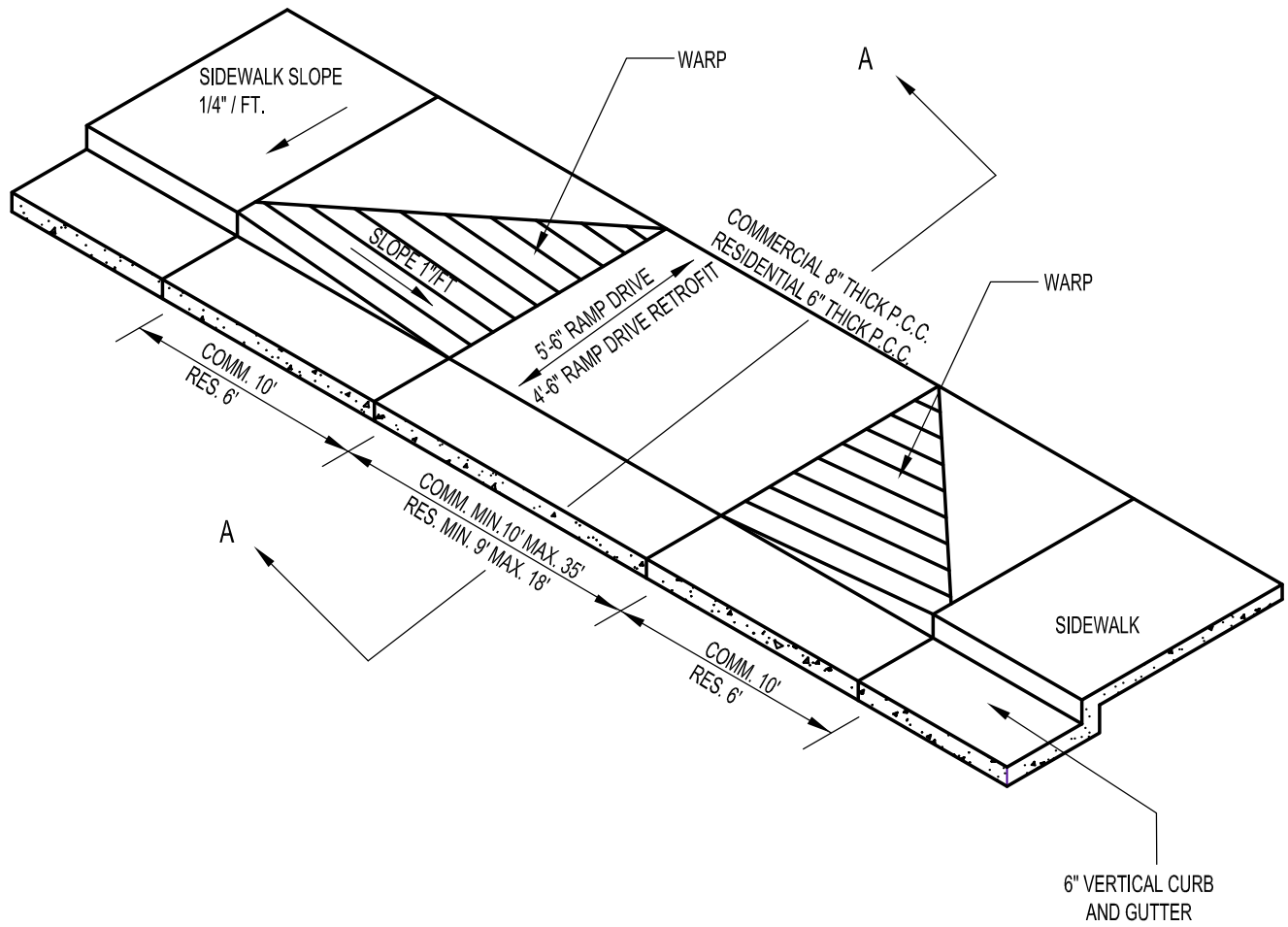
CURB, GUTTER & WALK




SECTION A-A

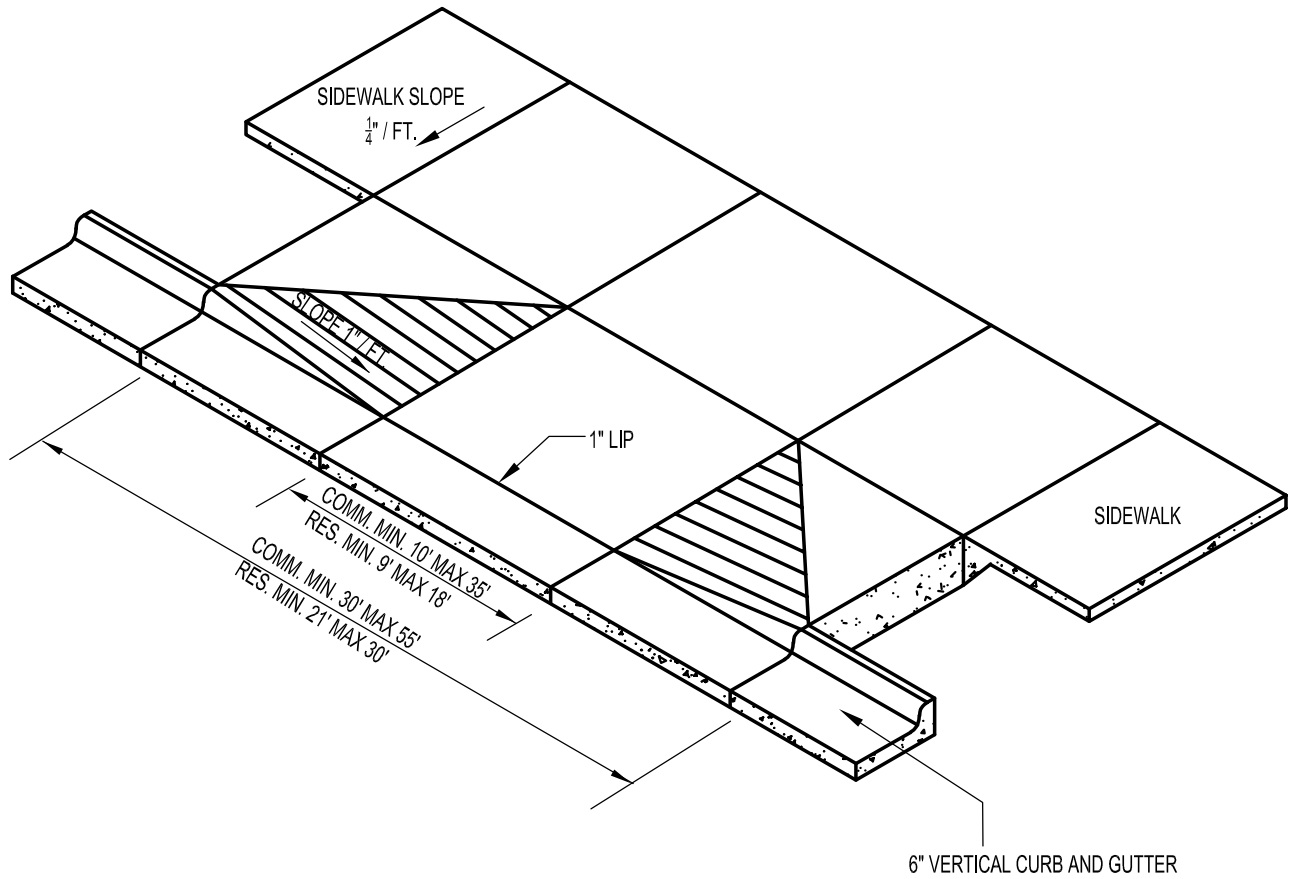
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
			SIDEWALK RAMP WITH CROSS PAN VERTICAL CURB		DRAWING NO.	R8
					SCALE	N.T.S.


NOTE:
CONTRACTION JOINTS ARE REQUIRED AT EACH SIDE
OF WARPED SECTION AND EVERY 10' (MAX) ALONG
THE DRIVEWAY.

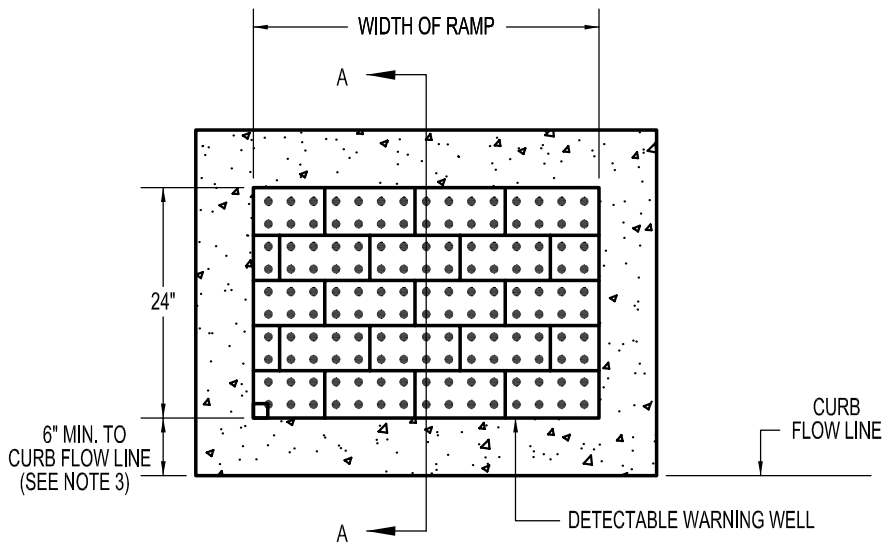


SECTION A-A

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
			RAMP DRIVE FOR VERTICAL CURB ATTACHED WALK		DRAWING NO.	R9
					SCALE	N.T.S.

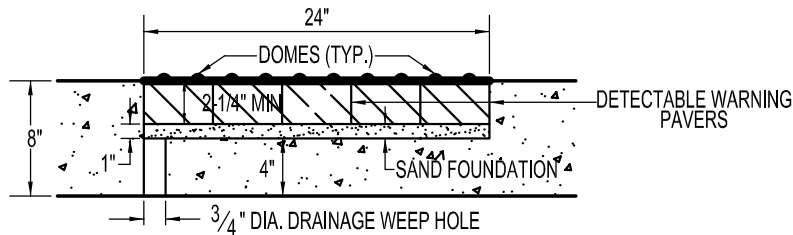


REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
			RAMP DRIVE FOR VERTICAL CURB AND DETACHED WALK		DRAWING NO.	R10
					SCALE	N.T.S.

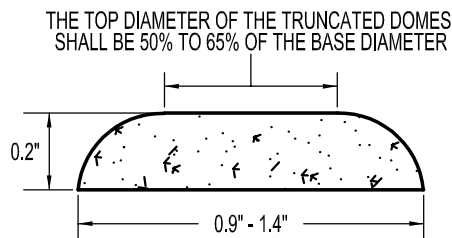


**PLAN VIEW OF
DETECTABLE WARNING AND WELL**

(PAVERS NOT DRAWN TO SCALE)

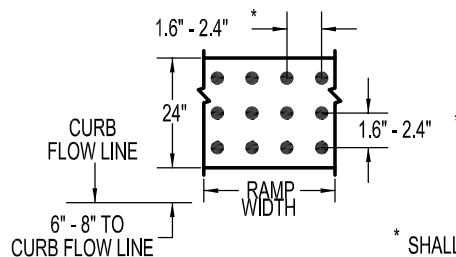


SECTION A-A



ELEVATION VIEW

DOMES AND DETECTABLE WARNING DETAILS



PLAN VIEW

* SHALL BE
EQUAL IN
BOTH DIRECTIONS.

GENERAL NOTES

1. THE DETECTABLE WARNINGS SHALL BE INSTALLED AT SIDEWALK/STREET TRANSITIONS. THEY SHALL BE MADE IN PAVER FORM WITH A TRUNCATED DOME SURFACE. THE DOMES SHALL BE PLACED IN A SQUARE GRID.
2. THE TOP OF THE DRAINAGE WEEP HOLE SHALL BE LOCATED AT THE LOWEST POINT OF THE DETECTABLE WARNING WELL.
3. ALL DETECTABLE WARNING AREAS SHALL START A MINIMUM OF 6 INCHES FROM THE FLOW LINE OF THE CURB AND NOT BE MORE THAN A MAXIMUM OF 8 INCHES FROM ANY POINT ON THE FLOW LINE OF THE CURB. ALL DETECTABLE WARNING AREAS SHALL BE 24 INCHES IN LENGTH AND COVER THE COMPLETE WIDTH OF THE RAMP AREA ONLY. THE DETECTABLE WARNING AREA SHALL BE INCLUDED IN THE COST OF THE CONCRETE CURB RAMP.
4. RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1.
5. DETECTABLE WARNING AND WELL AREA SLOPES SHALL NOT BE STEEPER THAN 20:1.
6. COLOR SHALL BE PAVESTONE "RIVER RED"
7. CONTRACTOR MAY USE PRE-MANUFACTURED TRUNCATED DOME PLATES THAT MEET THE MINIMUM REQUIREMENTS SET FORTH.

REVISIONS

DATE	ITEM	BY
3/2020		ULTEIG




**PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION**

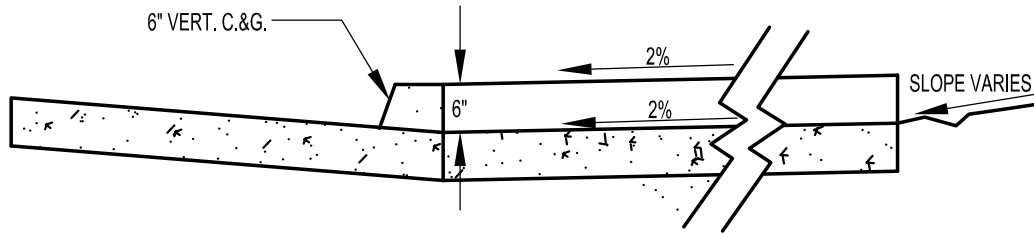
TRUNCATED DOME/DETECTABLE WARNING

ISSUED

DRAWN BY:	GY
APPROVED BY:	
DRAWING NO.	R11
SCALE	N.T.S.

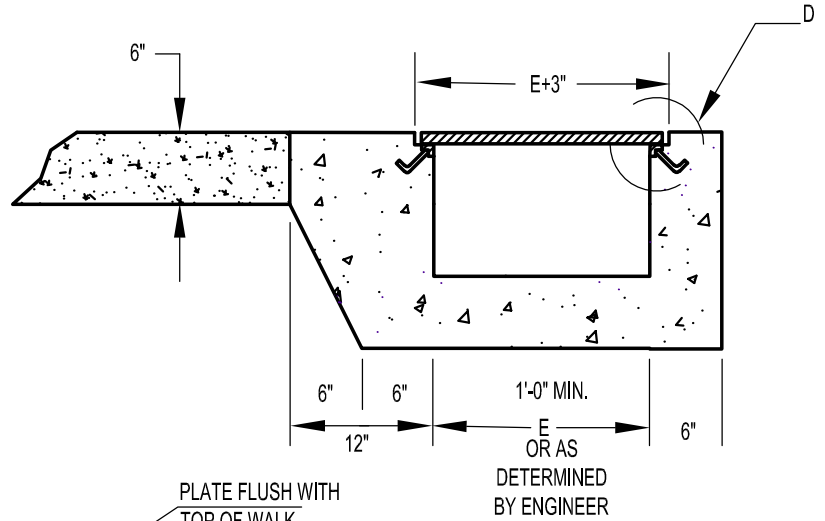


REVISIONS			 PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		ULTEIG		APPROVED BY:	
			STANDARD SIDEWALK CHASE DRAIN	DRAWING NO.	R12 - A
				SCALE	N.T.S.



SECTION B-B

SECTION C-C



1/4" STEEL PLATE
NON SLIP RAISED PATTERN

PLATE FLUSH WITH
TOP OF WALK
3/16" CLEARANCE

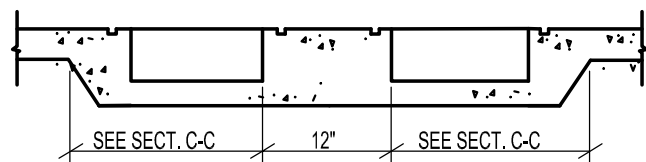
1 1/2"x1 1/2"x1/4" ANGLE IRON
DRILLED & TAPPED FOR 1/4"
MACHINE SCREWS

1/4"x3/4" F.H. MACHINE SCREWS @ 24" O.C.
COUNTER SINK FLUSH WITH PLATE

#3 REBAR 6" LONG WELD TO
ANGLE 18" O.C.

DETAIL D

MULTIPLE CHASE



REVISIONS

DATE	ITEM	BY
3/2020		ULTEIG



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

STANDARD SIDEWALK CHASE DRAIN

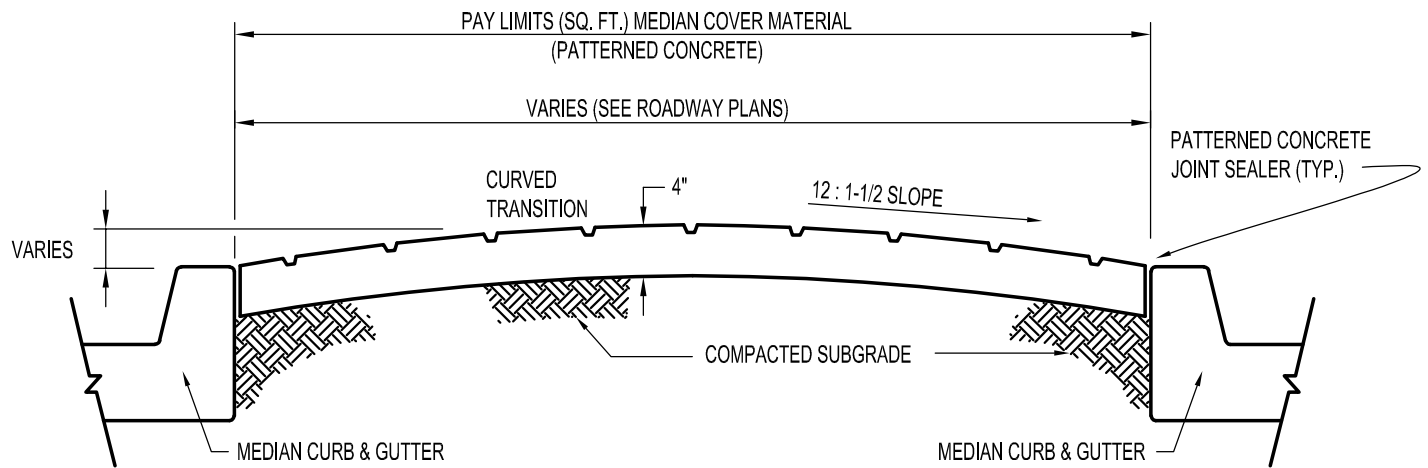
ISSUED

DRAWN BY: JLT

APPROVED BY:

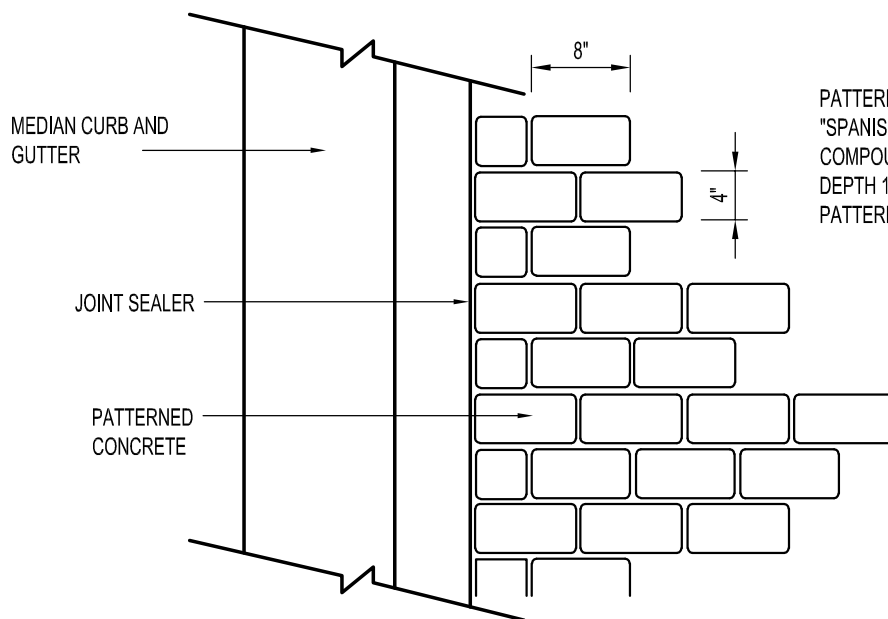
DRAWING NO. R12 - B

SCALE N.T.S.



SECTION VIEW

PLACE JOINT SEALER IN JOINT BETWEEN PATTERNED CONCRETE ABUTTING CONCRETE (TYP). JOINT SEALER TO BE PEARL WHITE SIKAFLEX-2C OR APPROVED EQUAL. COST OF JOINT SEALER TO BE INCLUDED IN PATTERNED CONCRETE.



PLAN VIEW

PATTERNED CONCRETE - RUNNING BOND BRICK PATTERN DAVIS "SPANISH GOLD" COLOR FINISH WITH CLEAR CURING COMPOUND. CONTROL JOINT SPACED EVERY 10'. MINIMUM DEPTH 1". REFER TO PERSPECTIVE DETAIL SHOWING PATTERNED CONCRETE MEDIAN AT RAISED MEDIAN.

REVISIONS

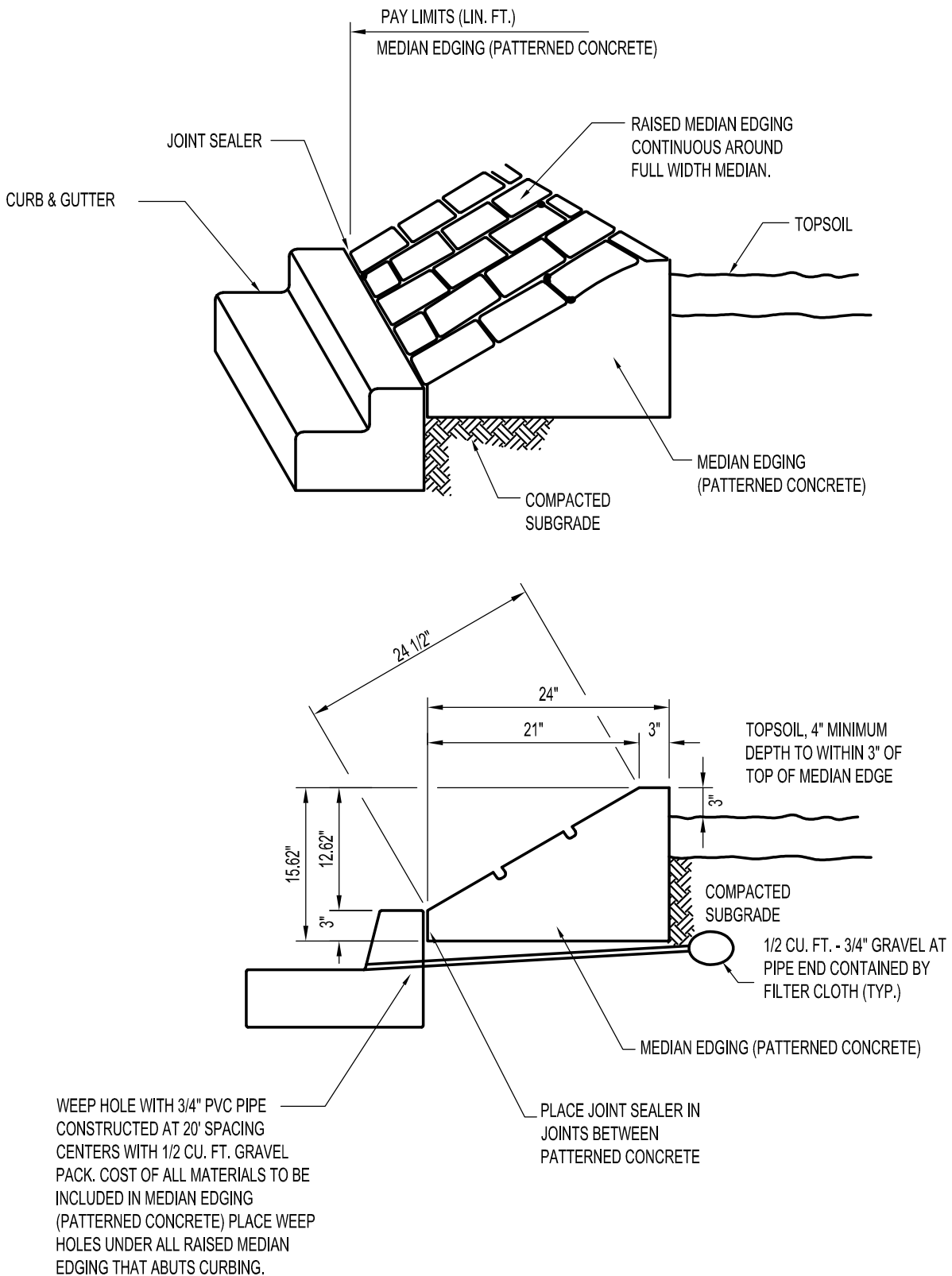
DATE	ITEM	BY
3/2020		ULTEIG




PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

MEDIAN COVER MATERIAL
(PATTERNED CONCRETE)

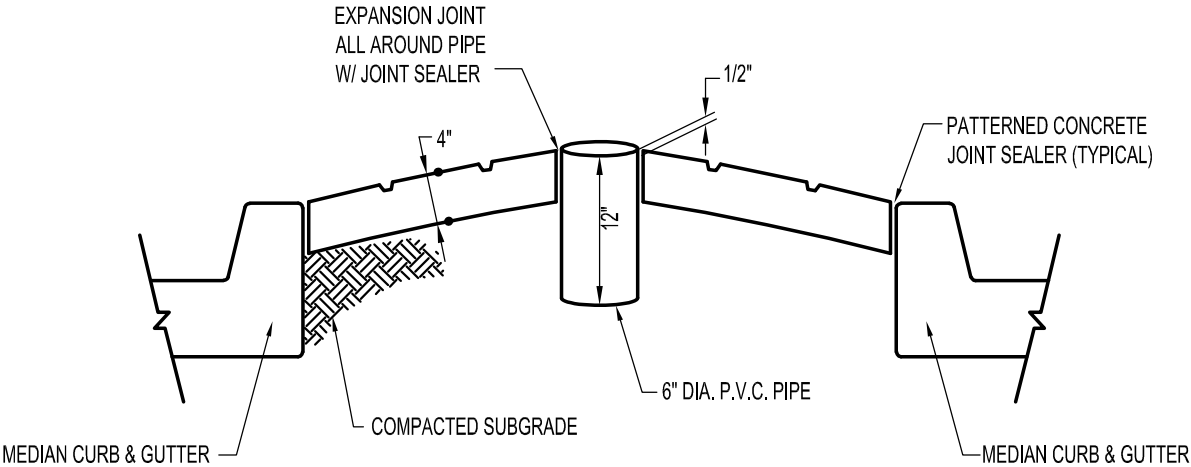
ISSUED	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	R13
SCALE	N.T.S.




REVISIONS			 PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		ULTEIG		APPROVED BY:	
				DRAWING NO.	R14
				SCALE	N.T.S.

MEDIAN EDGING
(PATTERNED CONCRETE)

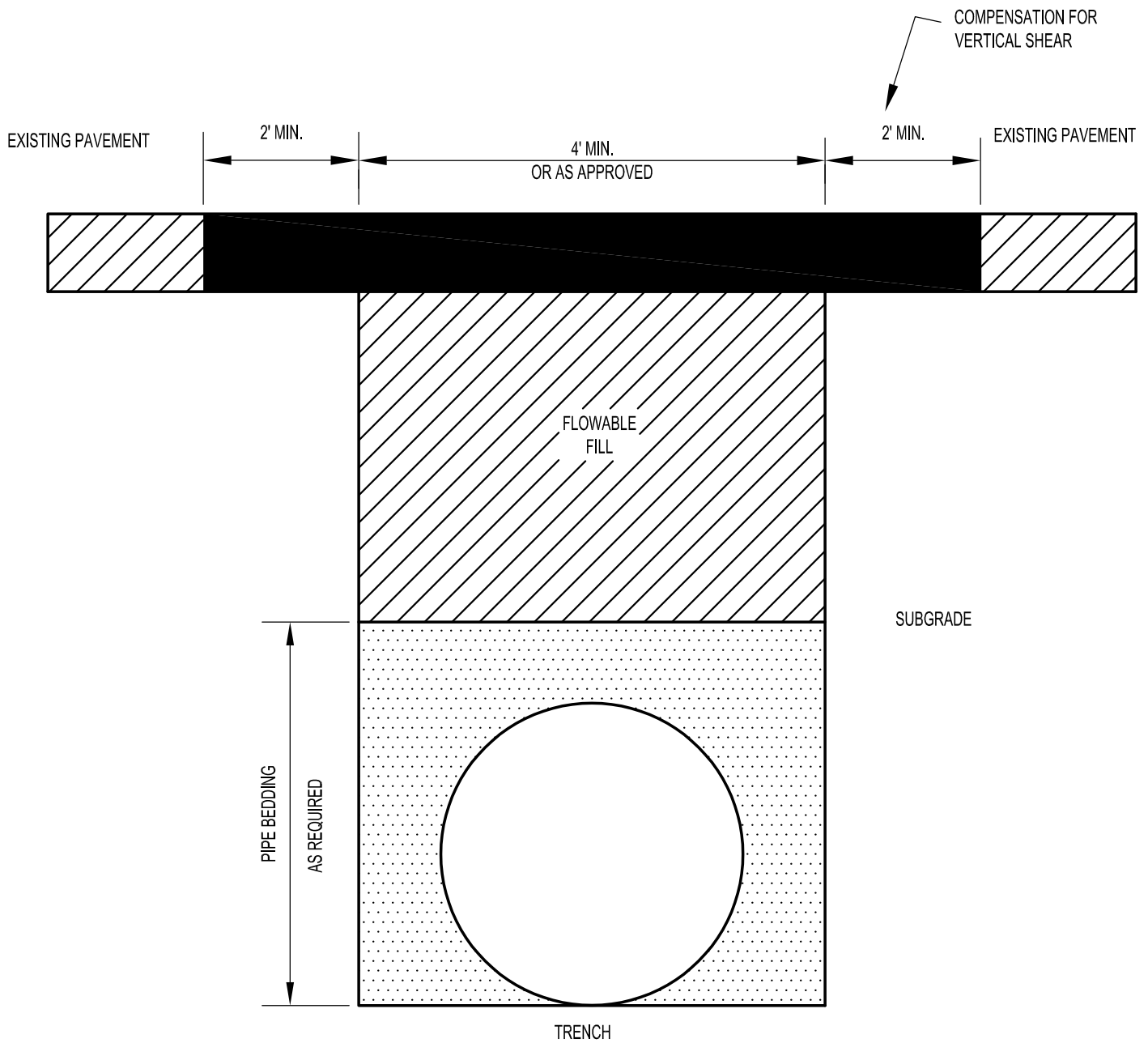
USE SLEEVE WHERE TRAFFIC SIGN POST
IS TO BE PLACED IN MEDIAN ISLAND WITH
PATTERNED CONCRETE. COST INCLUDED
IN COST OF PATTERNED CONCRETE.
(LOCATION AS DIRECTED BY ENGINEER OR
AS SHOWN ON PLANS.)




SLEEVE DETAIL

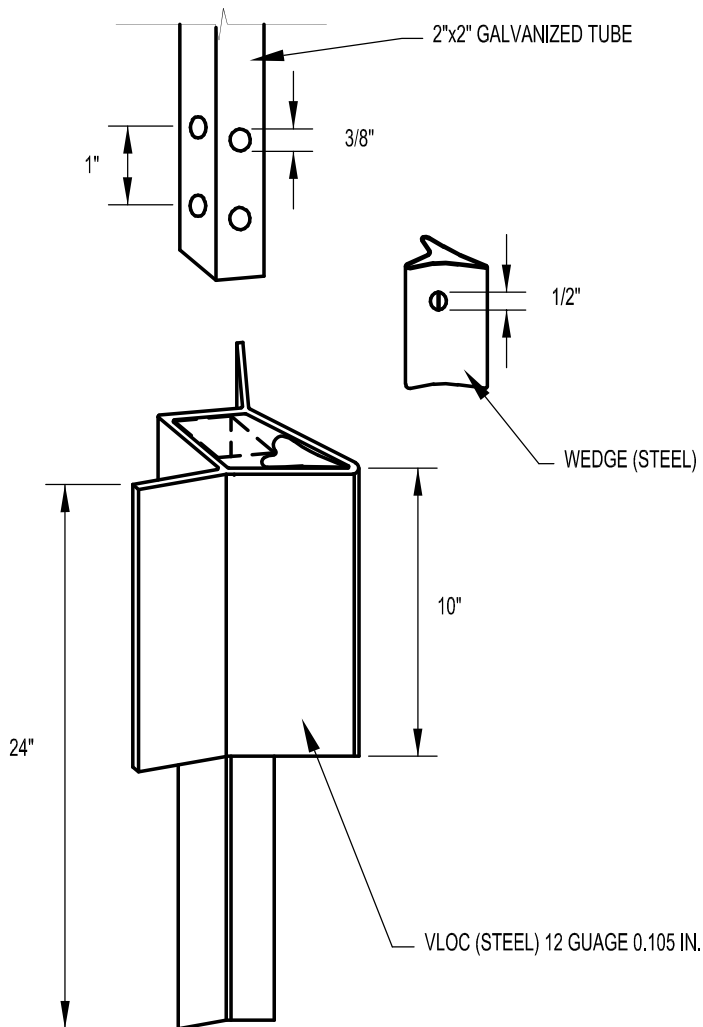
REVISIONS			 <div> PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION </div>	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		UTLEIG		APPROVED BY:	
				DRAWING NO.	R15
				SCALE	N.T.S.

SLEEVE DETAIL




NOTE: SEE CHAPTER 9 FOR ADDITIONAL REQUIREMENTS

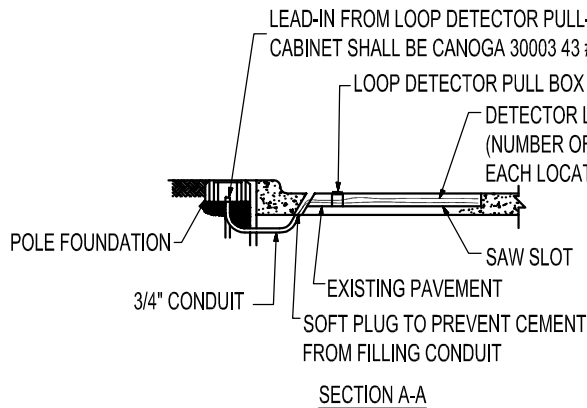
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG	APPROVED BY:			
			TRENCH PATCH BACK		DRAWING NO.	R16
					SCALE	N.T.S.



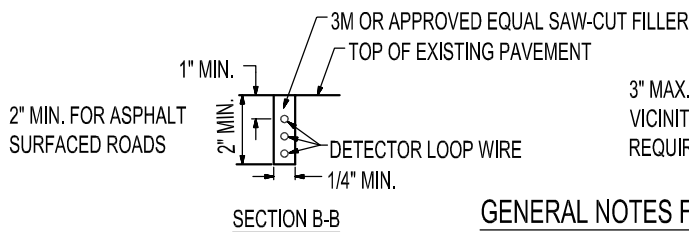
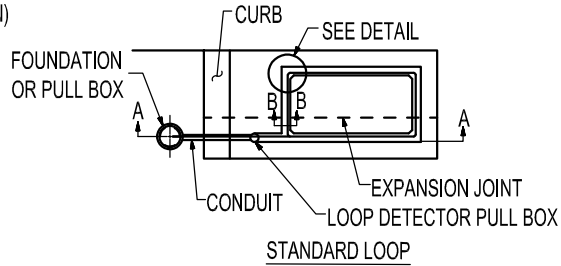
NOTES:

1. CONTRACTOR MAY USE APPROVED CDOT POST ANCHOR WITH APPROVAL OF PUBLIC WORKS DIRECTOR

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
			TYPICAL SIGN POST ANCHOR DETAIL		DRAWING NO.	T1
					SCALE	N.T.S.



NOTE:
FINISHED LOOP MUST SHOW NO SHORTED TURNS NO
BROKEN WIRE AND 15 MEGOHMS (MINIMUM) TO
GROUND, MEASURED WITH A QUALITY MEGOHM
METER (SEE GENERAL NOTES).

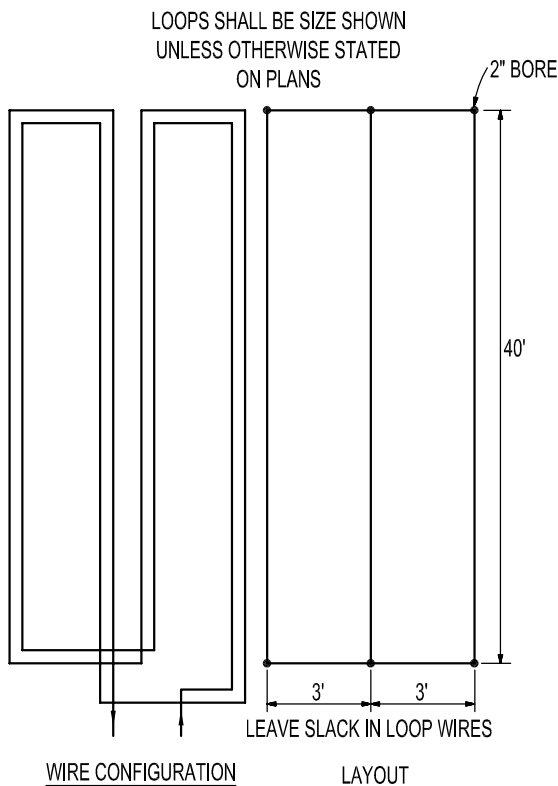


3" MAX. WILL BE PERMITTED IN ASPHALT AND IN
VICINITY OF EXPANSION JOINTS TO ALLOW FOR
REQUIRED CLEAR DISTANCE TO TUBING.


GENERAL NOTES FOR TD-5 DETECTORS:

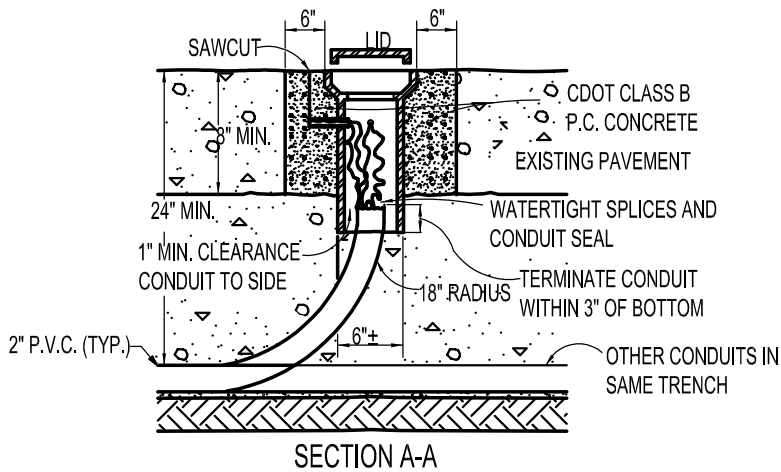
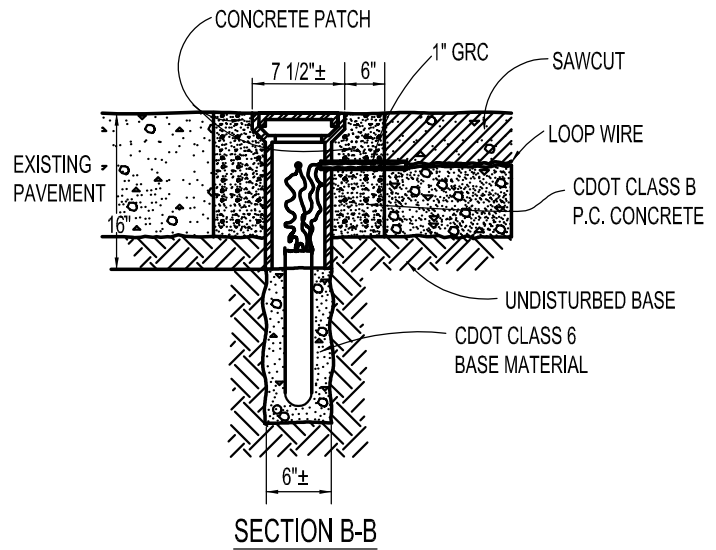
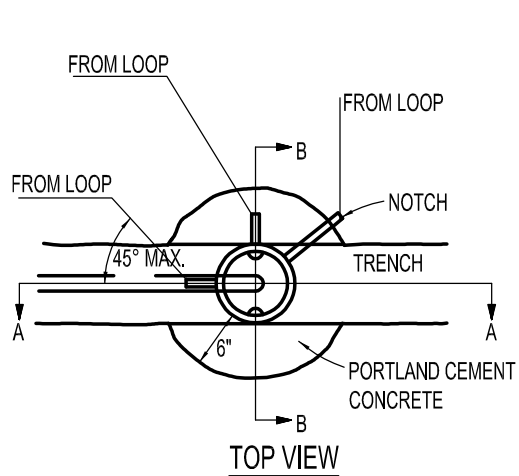
1. LOOP SIZE AND LOCATION SHALL BE AS SHOWN IN THE PLANS.
2. THE NUMBER OF TURNS OF WIRE SHALL BE AS INDICATED IN THE PLANS OF THE SPECIFIC INSTALLATION OR AS OTHERWISE SPECIFIED BY THE EQUIPMENT MANUFACTURER SUPPLYING THE LOOP DETECTOR AMPLIFIERS AND APPROVED BY THE TRAFFIC ENGINEERING DIVISION. ALL LOOP WIRE IN ADJACENT LOOPS SHALL BE LAID EITHER IN A CLOCKWISE OR COUNTER-CLOCKWISE DIRECTION AND THE LEADS TAGGED AT THE TIME OF INSTALLATION TO CLEARLY IDENTIFY THEIR DIRECTION.
3. IMMEDIATELY BEFORE LAYING THE LOOP CABLE, THE SAW CUT SHALL BE THOROUGHLY CLEANED AND DRIED WITH HIGH PRESSURE COMPRESSED AIR.
4. THE WIRE SHALL BE POSITIONED BY USE OF A BLUNT INSTRUMENT SO AS TO MINIMIZE THE CHANCE OF DAMAGE TO THE CABLE INSULATION. (THE USE OF A SCREWDRIVER, SAW BLADE, ETC. WILL NOT BE PERMITTED.)
5. LOOP WIRE SHALL BE CONTINUOUS (NO SPLICES PERMITTED) FROM THE PULL BOX OR FOUNDATION THROUGHOUT THE LOOP CONFIGURATION.
6. AFTER THE LOOP WIRE IS INSTALLED, 3M OR APPROVED EQUAL SAW-CUT SEALER SHALL BE USED TO FILL THE SAW CUT BEFORE MOISTURE OR DIRT CAN ACCUMULATE. LOOP INSTALLATION MAY BE RESTRICTED DUE TO ADVERSE CLIMATICAL CONDITIONS (DAMPNESS, DUST, ETC.)
7. SPLICES TO THE LOOP LEAD-IN CABLE SHALL BE WATERPROOFED WITH 3M SPLICE KITS OR APPROVED EQUAL.
8. ELECTRICAL CONTINUITY TESTS SHALL BE PERFORMED FOR EACH LOOP:
 - A. BEFORE ANY LOOP SEALER IS INSTALLED.
 - B. AFTER LOOP SEALER IS PLACED BUT PRIOR TO CONNECTION TO LEAD-IN CABLE.
 - C. AFTER LEAD-IN CABLE IS SPLICED AND TRAINED TO THE CONTROLLER.

IN ADDITION, "RESISTANT-TO-GROUND" AND "INDUCTANCE" OF EACH LOOP SHALL BE MEASURED AND RECORDED FOR EACH OF THE THREE TESTS PERFORMED TO THE LOOP DETECTOR.




LOOP DETECTOR INSTALLATION DETAIL

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
					DRAWING NO.	T2
					SCALE	N.T.S.
LOOP DETECTOR DETAILS						

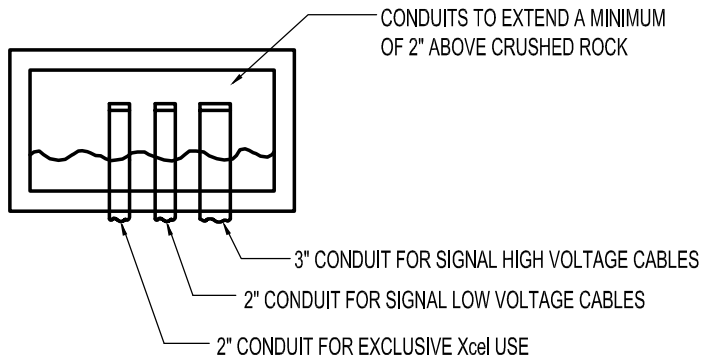


NOTES ON PULL BOX INSTALLATION:

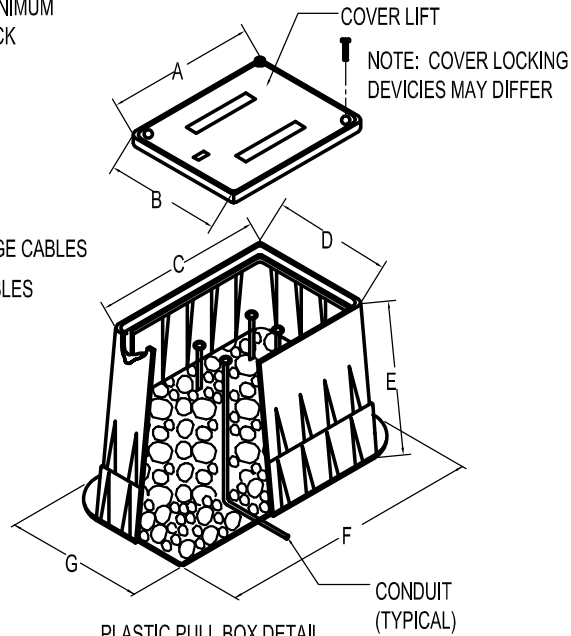
1. PULL BOX WILL HAVE AT LEAST TWO 1" DIA. HOLES DRILLED OR TORCHED 3" FROM TOP TO ACCEPT 6" OF 1" GALVANIZED RIGID CONDUIT.
2. 4" MIN. SLACK IS TO BE PROVIDED SO THAT ALL TESTING AND SPLICING CAN BE DONE OUTSIDE OF THE PULL BOX.
3. PULL BOX LID IS TO BE SEALED WATER TIGHT BY CAULKING.
4. PULL BOX IS TO BE LOCATED IN AN AREA OF THE STREET NOT HEAVILY TRAVELED, IF POSSIBLE, AND CENTERED A MINIMUM OF 12" FROM THE CONCRETE GUTTER PAN.
5. COST OF THE PORTLAND CEMENT CONCRETE SHALL BE INCLUDED IN THE INSTALLATION OF THE PULL BOXES.
6. THE PULL BOX LID SHALL HAVE THE WORD "TRAFFIC" CAST INTO THEM.

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
					DRAWING NO.	T3
					SCALE	N.T.S.

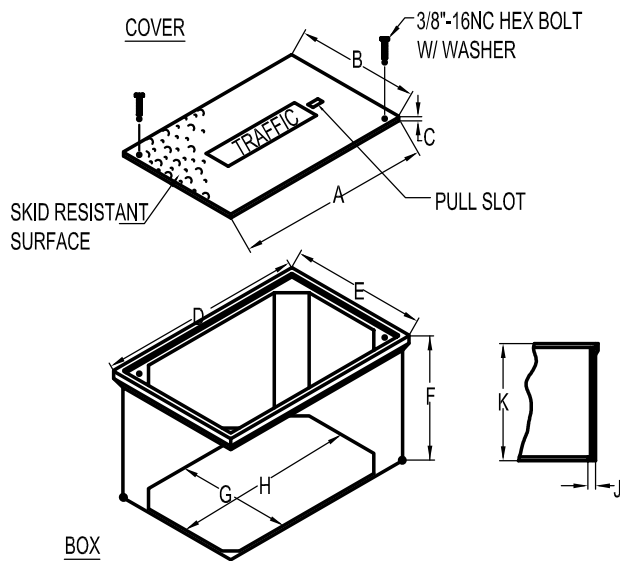
LOOP DETECTOR/PULL BOX
WATER VALVE STEM TYPE



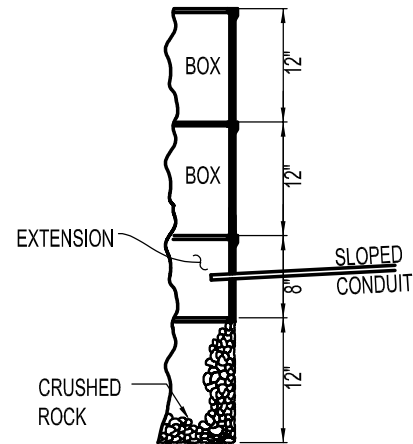
TYPICAL PULL BOX



PLASTIC PULL BOX DETAIL
FOR USE IN GRASS/SOIL AREAS



FIBERGLASS REINFORCED POLYMER CONCRETE
DESIGNED FOR FULL VEHICULAR TRAFFIC (H2O
LOADING)




TWO BOXES
AND EXTENSION

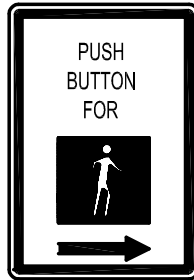
TABLE OF DIMENSIONS (MINIMUMS)

DESCRIPTION	DIMENSIONS (IN.)										TO BE USED AT
	A	B	C	D	E	F	G	H	J	K	
LARGE 18x30 2 BOXES & EXT.	31 1/4	18 1/4	3/4	33 1/8	20 1/8	12	16 3/8	29 3/8	1/2	11 1/4	CONTROLLER CABINET
MEDIUM 12x18 2 BOXES & EXT.	11 1/2	18 1/2	5/8	20 1/2	13 1/2	12	10 1/4	17 1/4	3/8	11 1/4	TRAFFIC SIGNAL POLE
SMALL 12x12 SINGLE BOX	12 7/8	12 7/8	5/8	14	14	12 3/4	10 1/2	10 1/2	1	12	UPSTREAM DETECTOR SPLICES, INTERCONNECT

PRECAST PULL BOX FOR USE IN CONCRETE/ASPHALT/ SIDEWALK AREAS BEHIND CURB
SEE CONTRACT DOCUMENTS FOR MATERIAL SPECIFICATIONS.

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
					DRAWING NO.	T4
					SCALE	N.T.S.

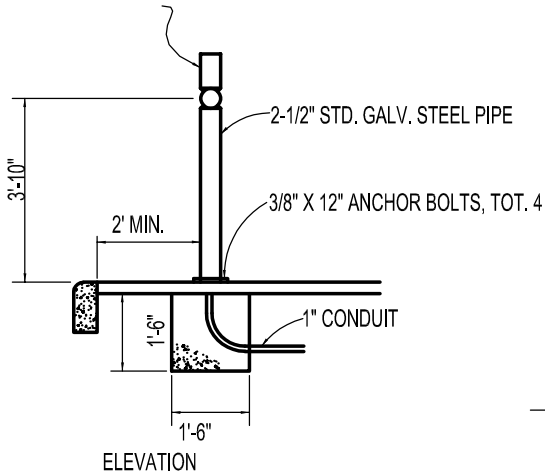
TRAFFIC SIGNAL POLE BOX



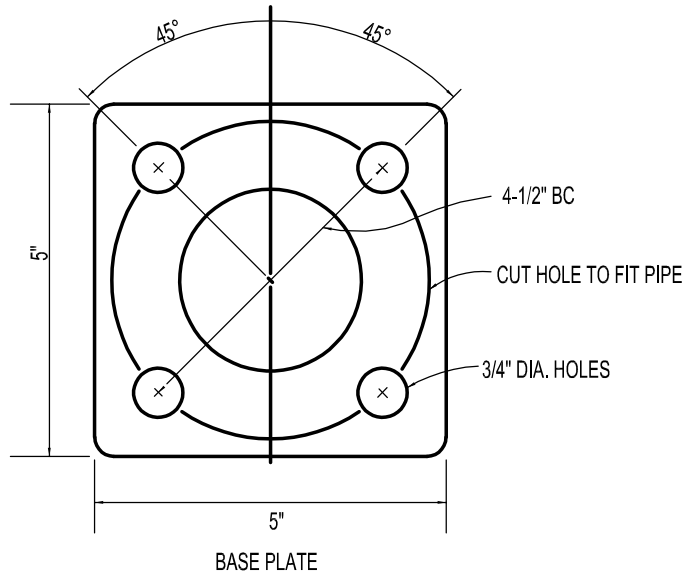
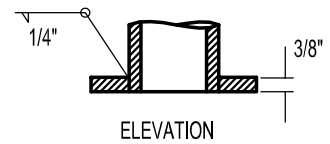
R10-4b
9"x12"

SIGN SHALL BE LABEL (STICK-ON) TYPE

PUSHBUTTON WITH 2-1/2" POLE TOP
MOUNTING FOR 5" X 7" SIGN



NOTE: CONDUIT SHALL PROTRUDE
2" MAX ABOVE FINISHED SURFACE
FOUNDATION.



REVISIONS

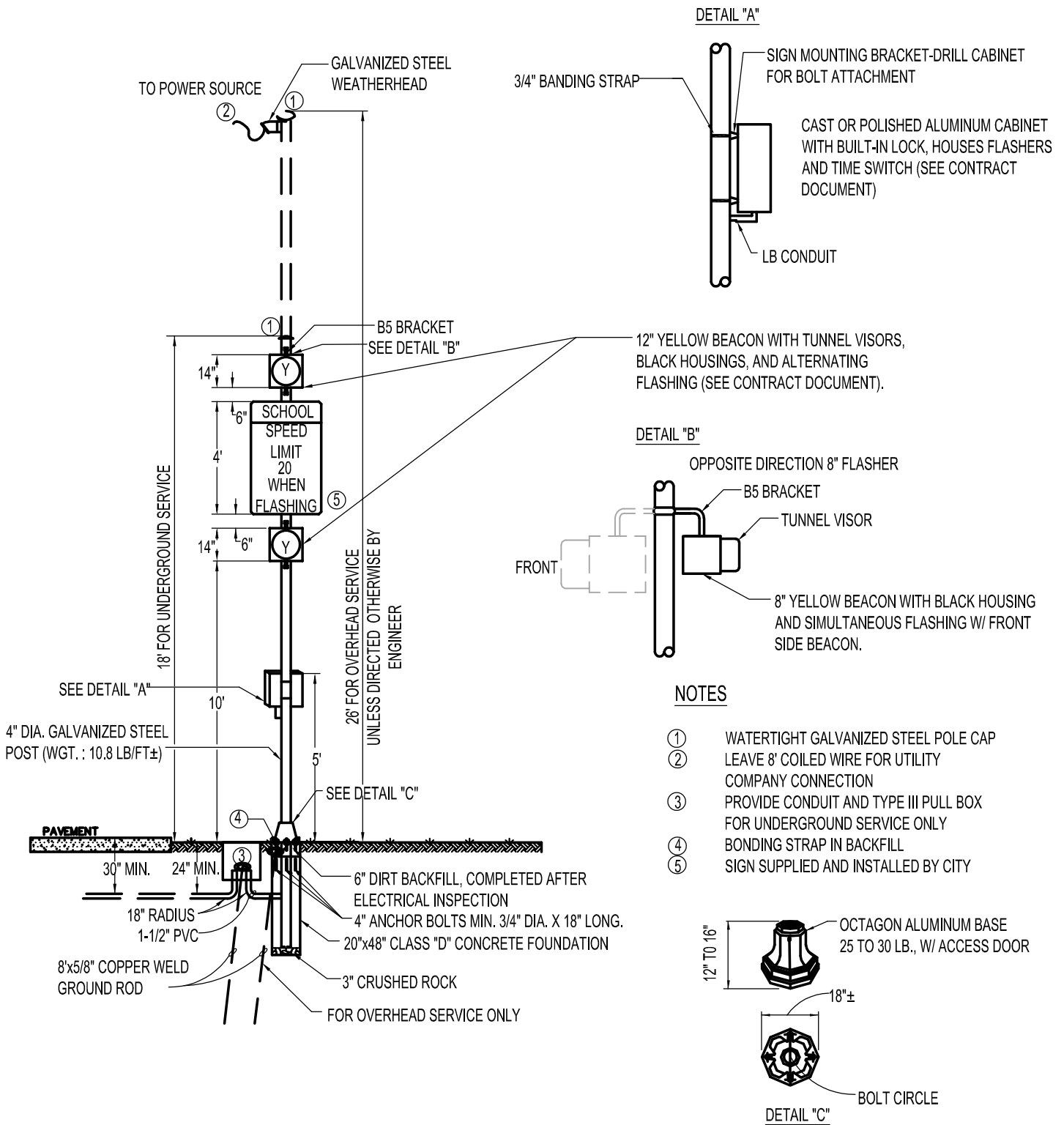
DATE	ITEM	BY
3/2020		ULTEIG




PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

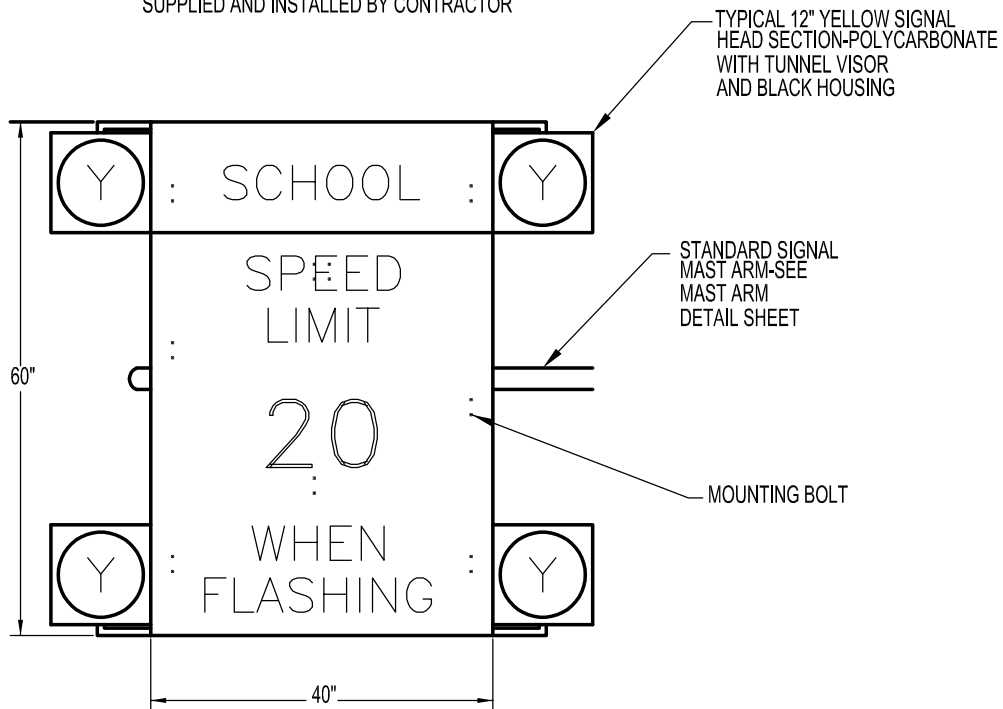
PEDESTRIAN PUSH BUTTON POST AND SIGN

ISSUED	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	T5
SCALE	N.T.S.

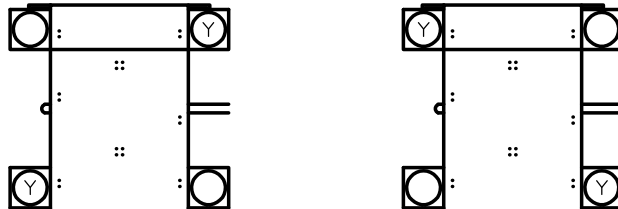


REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
					DRAWING NO.	T6
					SCALE	N.T.S.
				SCHOOL FLASHING BEACON ASSEMBLY SIDE OF ROAD		

FRONT VIEW
40"x60" SIGN TO BE
SUPPLIED AND INSTALLED BY CONTRACTOR




FLASHING SEQUENCE SHALL BE:

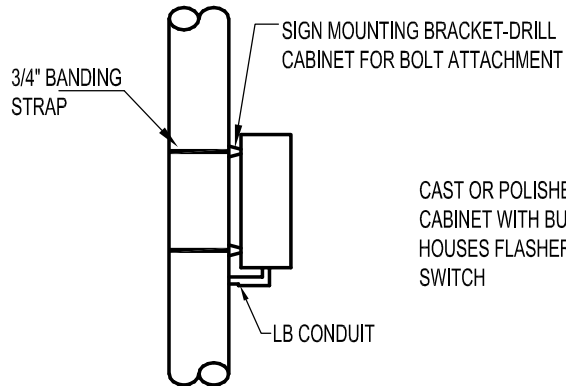


PLACEMENT NOTES:

1. ROADWAY WITH ONE THROUGH LANE: SIGN AND FLASHER ASSEMBLY CENTERED ON THROUGH LANE.
2. ROADWAY WITH TWO THROUGH LANES: SIGN AND FLASHER ASSEMBLY CENTERED ON LANE LINE BETWEEN THROUGH LANES.
3. ROADWAY WITH THREE THROUGH LANES: SIGN AND FLASHER ASSEMBLY CENTERED ON CENTER THROUGH LANE.

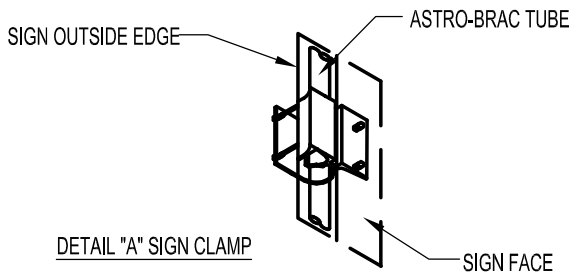
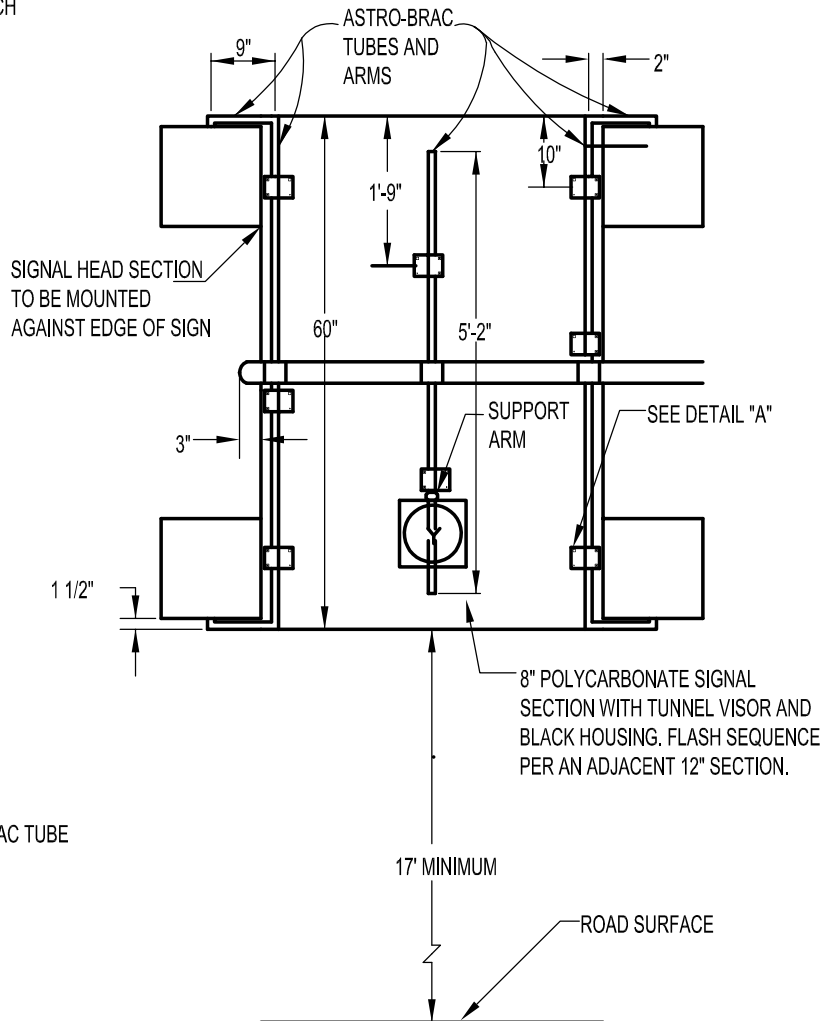
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
			SCHOOL FLASHING BEACON ASSEMBLY OVERHEAD		DRAWING NO.	T7 - A
					SCALE	N.T.S.


CABINET AND FLASHER DETAIL



CAST OR POLISHED ALUMINUM CABINET WITH BUILT-IN LOCK, HOUSES FLASHERS AND TIME SWITCH

BACK VIEW



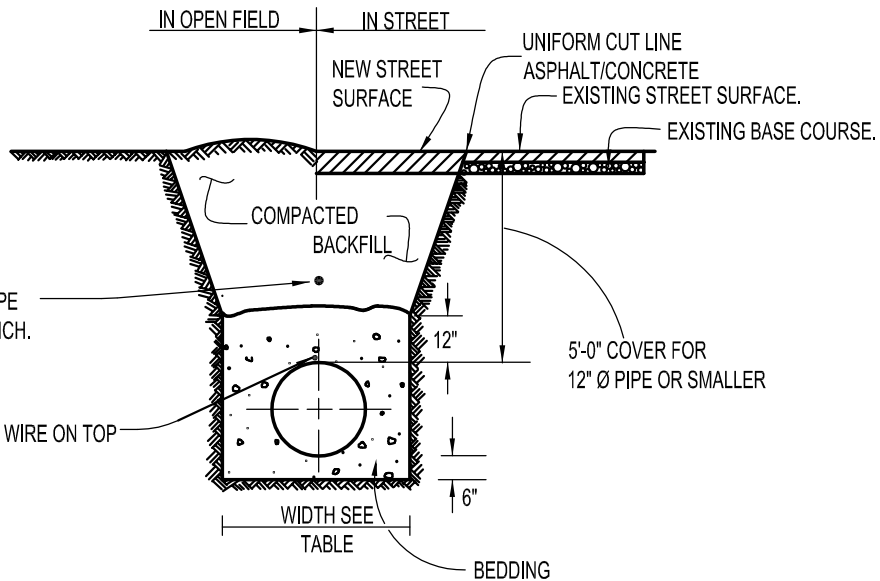
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		ULTEIG			APPROVED BY:	
			SCHOOL FLASHING BEACON ASSEMBLY OVERHEAD		DRAWING NO.	T7 - B
					SCALE	N.T.S.

NOTE: MINIMUM COVER
TO BE BELOW OFFICIAL
STREET GRADE.

TRENCH TO BE BRACED
OR SHEETED AS
REQUIRED BY OSHA.

2" WIDE LOCATOR TAPE
BURIED IN PIPE TRENCH.

#12 TRACER WIRE ON TOP
OF PIPE.



TYPICAL TRENCH SECTION

PIPE DIAMETER	MINIMUM WIDTH	MAXIMUM WIDTH
4"	1'-8"	2'-4"
6"	1'-10"	2'-6"
8"	2'-0"	2'-8"
12"	2'-4"	3'-0"

FOR PATCHING IN STREET SURFACE USE FULL DEPTH
ASPHALT AS NOTED BELOW OR MATCH EXISTING PLUS ONE
(1) INCH, WHICH EVER IS GREATER

STREET CLASSIFICATION	DEPTH ASPHALT
ARTERIAL	10"
COLLECTOR	8"
LOCAL	6"

REVISIONS

DATE	ITEM	BY
3/2020		UTLEIG

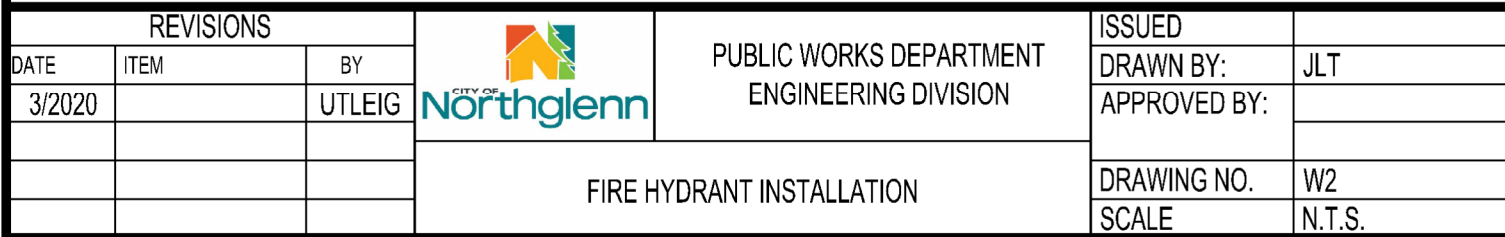


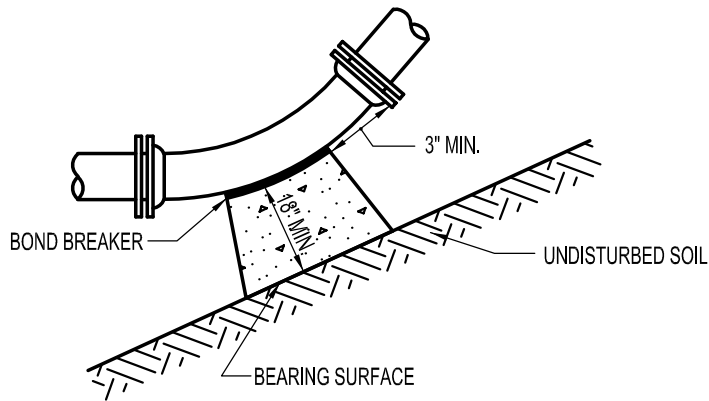
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

TYPICAL TRENCH SECTION PIPE PROTECTION

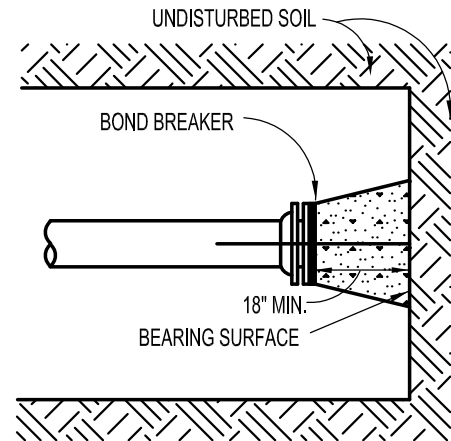
ISSUED	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	W1
SCALE	N.T.S.

1. ALL FITTINGS AND D.I. PIPE TO BE WRAPPED IN POLYETHYLENE.
2. IN UNSTABLE GROUND THE FIRE HYDRANT SHALL BE RODDED FROM THE TEE TO THE HYDRANT.
3. 5' UNOBSTRUCTED AREA IN FRONT AND ON SIDES WITH A 3' UNOBSTRUCTED AREA BEHIND. AREAS SHALL BE CONSTANTLY MAINTAINED.
4. VALVE NUT SHALL BE AT A DEPTH OPERABLE BY A 5' KEY.
5. THREADS ON HOSE FITTINGS TO BE GREASED.

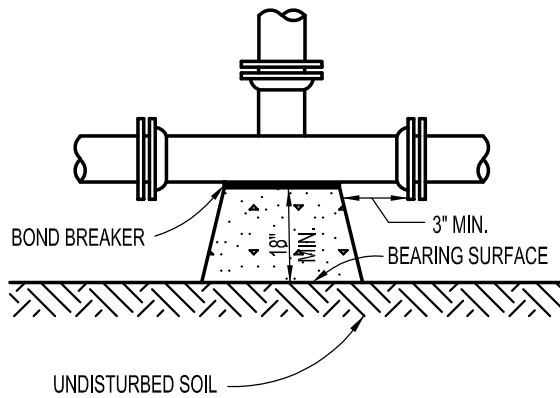




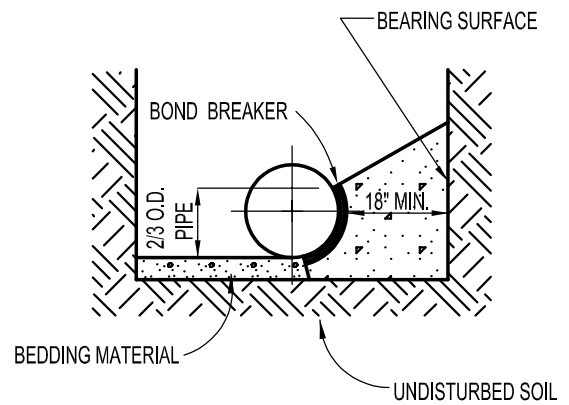
11 1/4°, 22 1/2° AND 45° BENDS



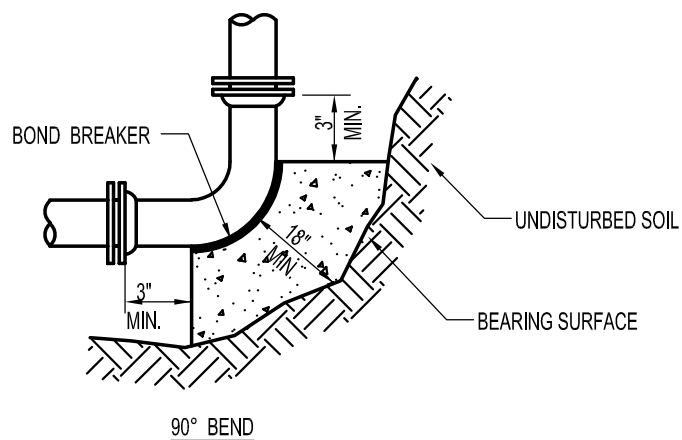
DEAD END




TEE



TYPICAL CROSS SECTION



90° BEND

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
			CONCRETE THRUST BLOCKS BEARING SURFACES AND INSTALLATION		DRAWING NO.	W3
					SCALE	N.T.S.

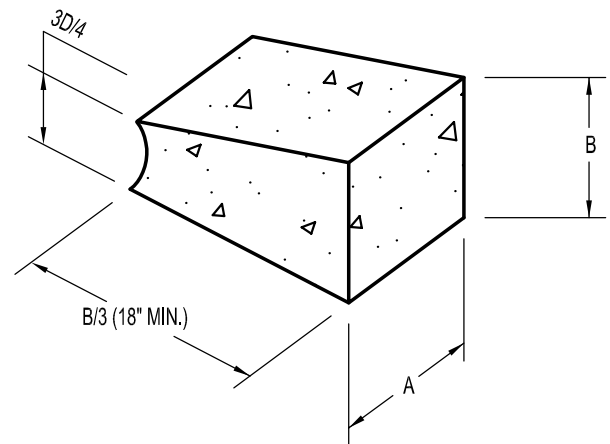
MINIMUM DIMENSIONS FOR THRUST BLOCKS

FITTING SIZE	TEES & PLUGS		90° BEND		45° BENDS & WYES	
	A	B	A	B	A	B
4"	1'-7"	1'-2"	1'-9"	1'-6"	1'-8"	0'-10"
6"	2'-0"	1'-11"	2'-5"	2'-2"	1'-10"	1'-7"
8"	2'-8"	2'-6"	3'-2"	3'-0"	2'-5"	2'-1"
10"	3'-4"	3'-3"	4'-0"	3'-10"	3'-0"	2'-9"
12"	4'-0"	3'-10"	4'-8"	4'-8"	3'-8"	3'-3"
14"	5'-5"	3'-10"	6'-6"	4'-11"	4'-9"	3'-5"
20"	5'-0"	5'-0"	6'-0"	6'-0"	5'-0"	4'-0"
24"	6'-0"	6'-0"	7'-0"	7'-0"	5'-0"	5'-0"
30"	7'-6"	7'-6"	8'-0"	8'-0"	6'-3"	6'-3"

FITTING SIZE	REDUCERS & 22 1/2° BENDS		11 1/4° BENDS	
	A	B	A	B
4"	1'-7"	0'-6"	0'-6"	0'-6"
6"	1'-9"	0'-10"	1'-0"	0'-6"
8"	1'-9"	1'-6"	1'-0"	1'-0"
10"	2'-2"	1'-11"	1'-6"	1'-0"
12"	2'-7"	2'-3"	2'-0"	1'-0"
14"	3'-5"	2'-5"	2'-0"	1'-6"
20"	3'-6"	3'-0"	3'-0"	2'-0"
24"	4'-6"	3'-0"	3'-0"	3'-0"
30"	4'-9"	4'-6"	3'-3"	3'-3"

GENERAL NOTES:

1. BEARING SURFACE AREAS SHOWN IN CHART ARE MINIMUM.
2. BASED ON 150 P.S.I. INTERNAL PIPE PRESSURE.
3. SOIL BEARING CAPACITY = 2000 LB./SQ. FT.
4. ALL FITTINGS TO BE WRAPPED WITH POLYETHYLENE (MINIMUM 8 MIL.).



NOT TO SCALE

REVISIONS

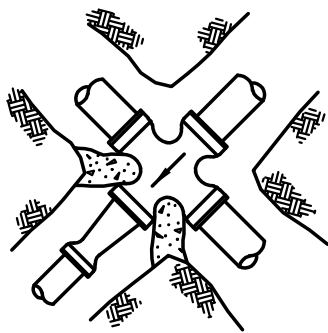
DATE	ITEM	BY
3/2020		UTLEIG



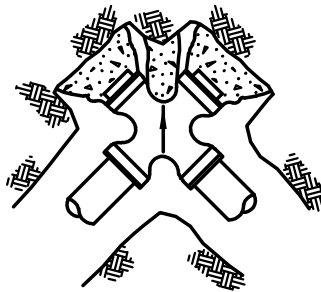
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

CONCRETE THRUST BLOCK DIMENSIONS

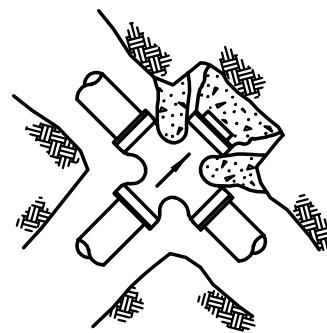
ISSUED	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	W4
SCALE	N.T.S.



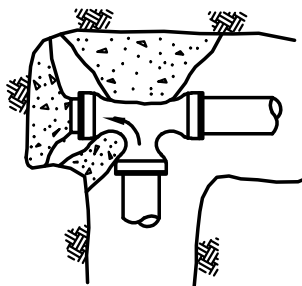
UNBALANCED CROSS



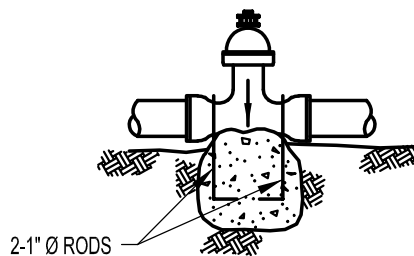
PLUGGED CROSS



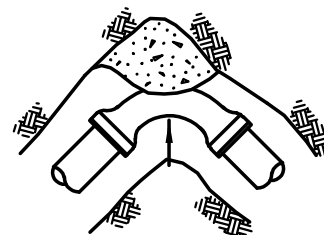
PLUGGED CROSS



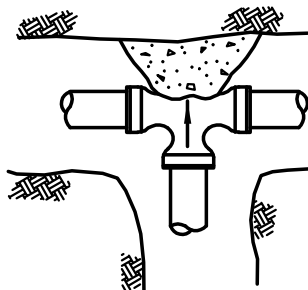
PLUGGED TEE



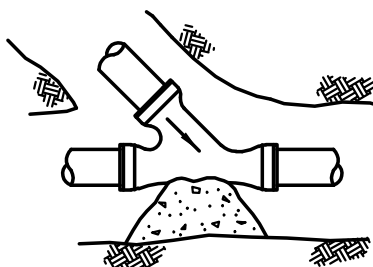
VALVE



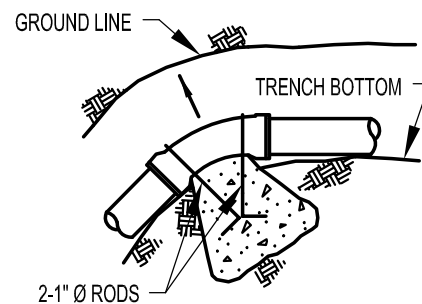
HORIZONTAL BEND



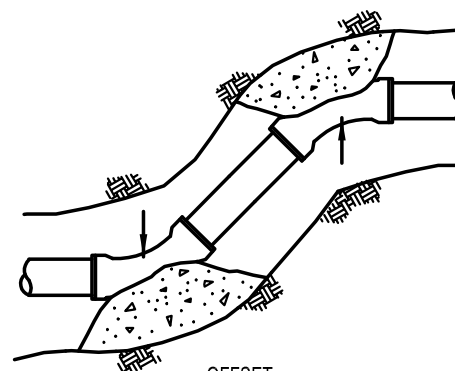
TEE



"Y" BRANCH




VERTICAL BEND

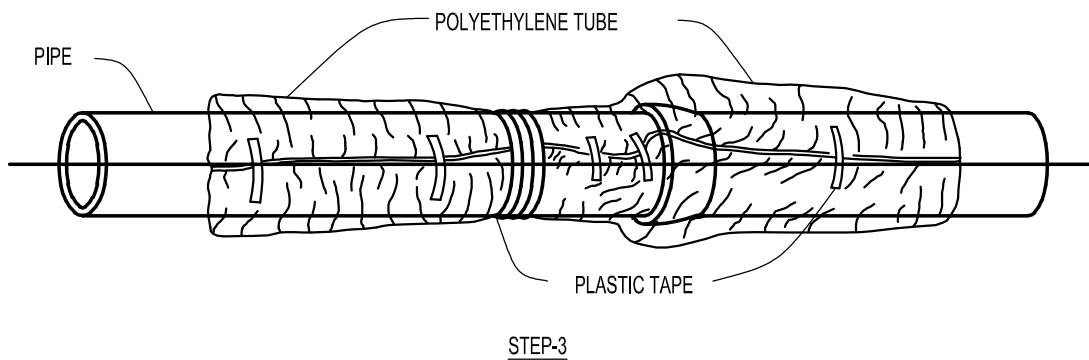
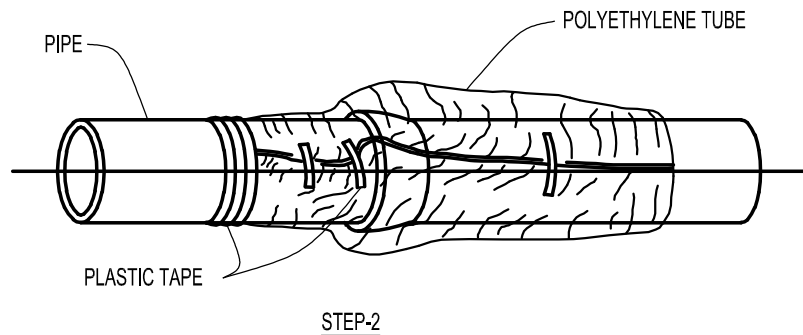
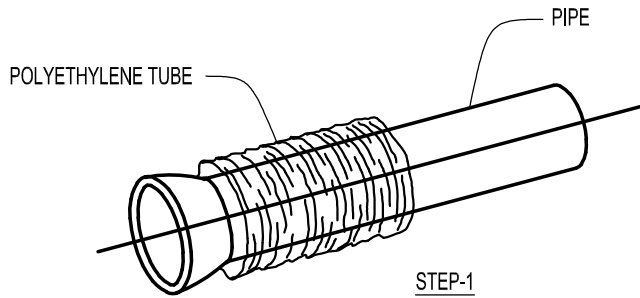


OFFSET

NOTES:

1. SIZE OF BLOCK TO BE A MINIMUM OF 18" THICK.
2. ALL BLOCKING TO BE ON UNDISTURBED MATERIAL.

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
					DRAWING NO.	W5
					SCALE	N.T.S.
			CONCRETE THRUST BLOCKING FOR UNBALANCED FITTINGS			




FIELD INSTALLATION-POLYETHYLENE WRAP

STEP-1 PLACE TUBE OF POLYETHYLENE MATERIAL AROUND PIPE PRIOR TO LOWERING PIPE INTO TRENCH.

STEP-2 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.

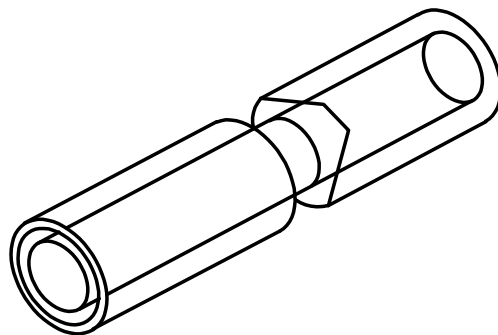
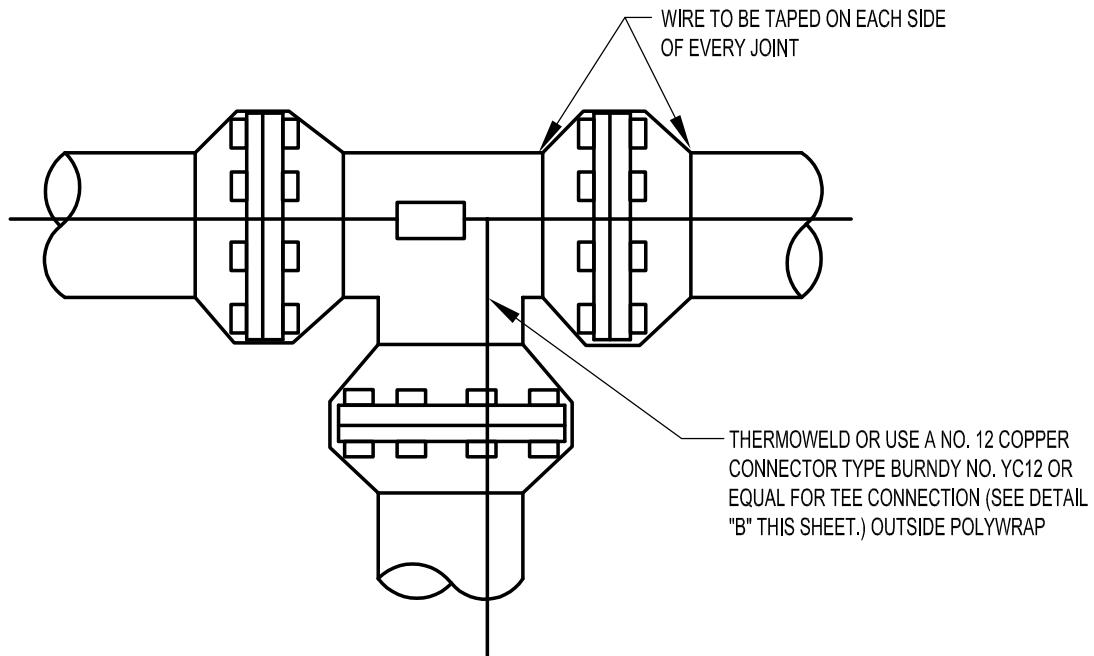
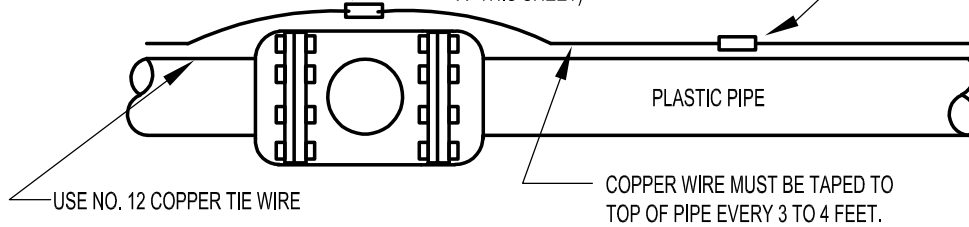
STEP-3 OVERLAP FIRST TUBE WITH ADJACENT TUBE AND SECURE WITH PLASTIC ADHESIVE TAPE. THE POLYETHYLENE TUBE MATERIAL COVERING THE PIPE SHALL BE LOOSE. EXCESS MATERIAL SHALL BE NEATLY DRAWN UP AROUND THE PIPE BARREL, FOLDED ON TOP OF THE PIPE AND TAPED IN PLACE.

NOTE: POLYETHYLENE SHALL BE MINIMUM 8-MIL THICKNESS

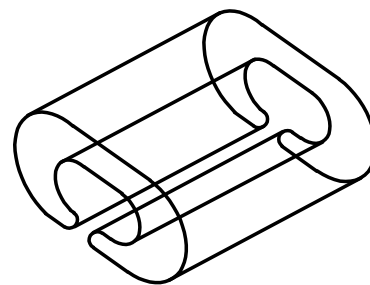
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
			POLYETHYLENE WRAP FOR DUCTILE IRON PIPE		DRAWING NO.	W6
					SCALE	N.T.S.

THERMOWELD OR USE A NO. 12 COPPER
CONNECTOR TYPE BURNDY NO. YC12 OR
EQUAL

THERMOWELD OR USE A NO. 12 COPPER
CONNECTOR TYPE DOSSERT NO. DCP2
HOMAC NO. CST OR EQUAL (SEE DETAIL
"A" THIS SHEET)



DETAIL A



DETAIL B

REVISIONS

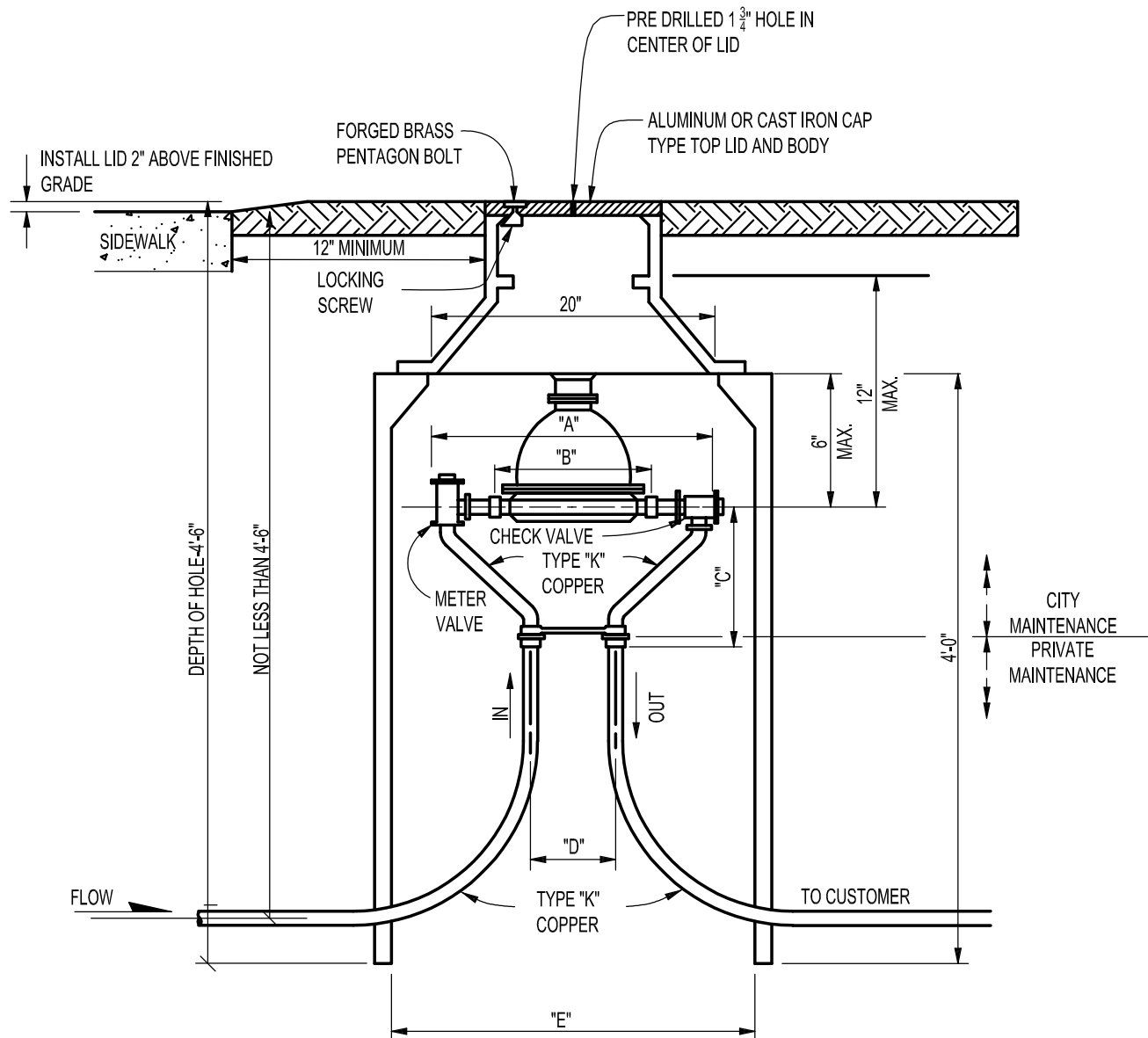
DATE	ITEM	BY
3/2020		UTLEIG



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION


TRACER WIRE ON PLASTIC PIPE

ISSUED	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	W7
SCALE	N.T.S.



METER SIZE	A	B	C	D	E
*5/8"x3/4"	14 1/4"	9 5/16"	8 15/16"	5"	20"
1"	17 1/4"	11 1/16"	11 1/4"	6"	24"

* REQUIRES FORD A23 ADAPTOR
 VERIFY ALL DIMENSIONS BASED ON MANUFACTURES SPECIFICATIONS

REVISIONS			 PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		ULTEIG	SETTINGS FOR 5/8" x 3/4" THRU 1" METERS	APPROVED BY:	
				DRAWING NO.	W8 - A
				SCALE	N.T.S.


GENERAL NOTES

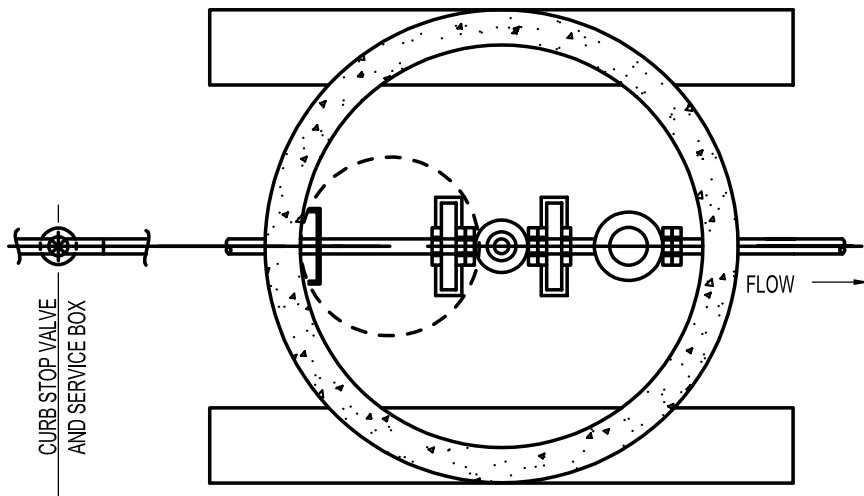
1. NOT FOR INSTALLATION IN ROADWAYS, DRIVEWAYS, PARKING AREAS, SIDEWALKS, OR CONCRETE.
2. IF SURFACE IS NOT TO OFFICIAL GRADE AT TIME OF INSTALLATION OF METER, OWNER MUST RAISE OR LOWER PIT WHEN SURFACE IS GRADED.
3. METER SHALL BE SET WITHIN PUBLIC R.O.W.
4. NO CONCRETE FLOOR TO BE LAID IN METER PIT.
5. METER PIT SHALL BE CONSTRUCTED OF MODIFIED HI-DENSITY POLYETHYLENE.
6. ADJUSTMENT RINGS SHALL BE 2", 3", 4" OR 6" IN HEIGHT AND SHALL BE INSERTED BETWEEN THE TWO TOP RINGS.
7. FOR WATER SERVICE LINES 1" AND LARGER: IF THE METER PIT IS NOT INSTALLED WITHIN THE PUBLIC R.O.W. THEN A CURB STOP AND BOX SHALL BE INSTALLED WITHIN THE PUBLIC R.O.W.
8. REINSPECTION FEE: A FEE WILL BE ASSESSED FOR EACH REINSPECTION IF THE METER PIT AND YOKE ASSEMBLY FAIL TO PASS THE FIRST TWO INSPECTIONS.
9. IRRIGATION TAPS SHALL BE PAID FOR PRIOR TO THE TAP BEING MADE.
10. ADDRESSES SHALL BE MARKED FOR EACH METER PRIOR TO SETTING THE METER.
11. ANY METER SETTING LOCATED IN A DRIVING SURFACE SHALL BE INSTALLED IN A VAULT IN CONFORMANCE WITH DETAIL W11

IN CASE OF A BROKEN RADIO FREQUENCY METER

1. REGISTER/HRT TO ORDER A PIT TRANSPONDER W/HRT II WHICH WILL FIT A BADGER MTR MODEL 25, PLEASE CALL NATIONAL METER AT 303-339-9100.
 2. RES DOME LTD PURCHASE A CASTING INC. METER LID ONLY (MADE OF CAST IRON).
 3. CALL CALL THE CITY CUSTOMER SERVICE. SET UP A MEETING AFTER ALL MATERIALS ARE IN HAND. (THE CITY WILL RE-INSTALL AFTER THE INSPECTION.)
- a. CONTRACTORS WILL HAVE FIVE (5) FULL WORKING DAYS TO COMPLY WITH THESE SPECIFICATIONS.
 - b. METERS WILL BE SET WITHIN THE SUBDIVISION UNTIL THE FIFTH DAY.
 - c. AFTER THE FIFTH DAY, IF NOT ALL OF THE REQUIREMENTS ARE MET, METERS WILL NOT BE SET IN THE SUBDIVISION UNTIL THE CITY REQUIREMENTS ARE COMPLIED WITH.
 - d. THE CITY ALSO REQUIRES A RECEIPT SHOWING THE REGISTER WAS PAID FOR BY THE CONTRACTOR.

PLEASE KEEP IN MIND THAT ALL JUMPERS FOUND IN THE METER PITS ARE SUBJECT TO A FINE.

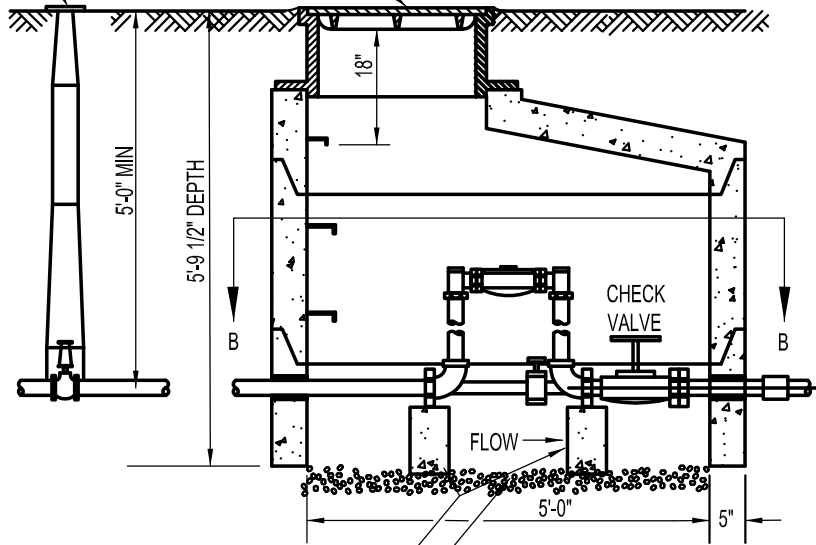
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
			SETTINGS FOR 5/8" x 3/4" THRU 1" METERS		DRAWING NO.	W8 - B
					SCALE	N.T.S.



SECTION B-B

CURB STOP AND BOX SHALL BE INSTALLED WITHIN THE PUBLIC R.O.W.

24" ALUMINUM MANHOLE RING AND COVER WITH CAM LOCK. INSTALL COVER TO 2" ABOVE FINISH GRADE.



3/4" OR 1-1/2" ROCK
SUPPORT UNDER METER
ELEVATION SECTION

GENERAL NOTES:

1. IF SURFACE IS NOT TO OFFICAL GRADE AT TIME OF INSTALLATION OF METER, OWNER MUST RAISE OR LOWER PIT WHEN SURFACE IS AT FINAL GRADE.
2. METER SETTING MUST BE INSPECTED BEFORE BACKFILLING.
3. BYPASS IS TO BE INSTALLED UNLESS OTHERWISE SPECIFIED.
4. NO CONCRETE TO BE LAID IN FLOOR OF METER PIT.
5. PIPING SHALL BE TYPE "K" COPPER OR THREADED BRASS.
6. IF GROUND CONDITIONS ARE UNSTABLE, THE ENGINEER MAY REQUIRE THAT FOOTINGS BE INSTALLED.
7. THE WORD "WATER" SHALL BE CAST ON THE LID.
8. 3/4" OR 1-1/2" ROCK SHALL BE PLACED IN THE FLOOR OF METER PIT 6" THICK.
9. SUPPORT UNDER METER MAY BE BRICK OR CONCRETE BLOCK.
10. COMPRESSION JOINTS ONLY WILL BE USED.

REVISIONS

DATE	ITEM	BY
3/2020		UTLEIG

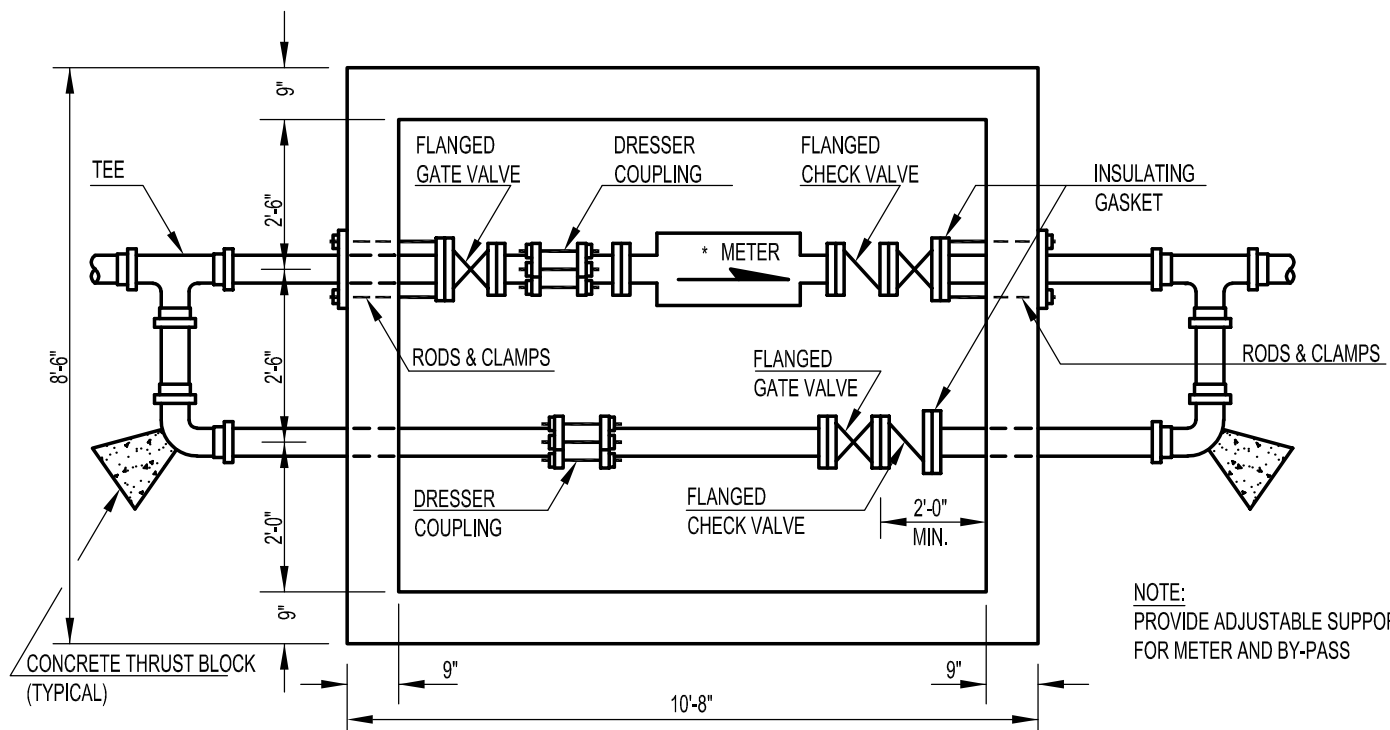


PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

METER SETTINGS FOR 1-1/2" AND 2"
METER WITH VALVE AND BYPASS

ISSUED

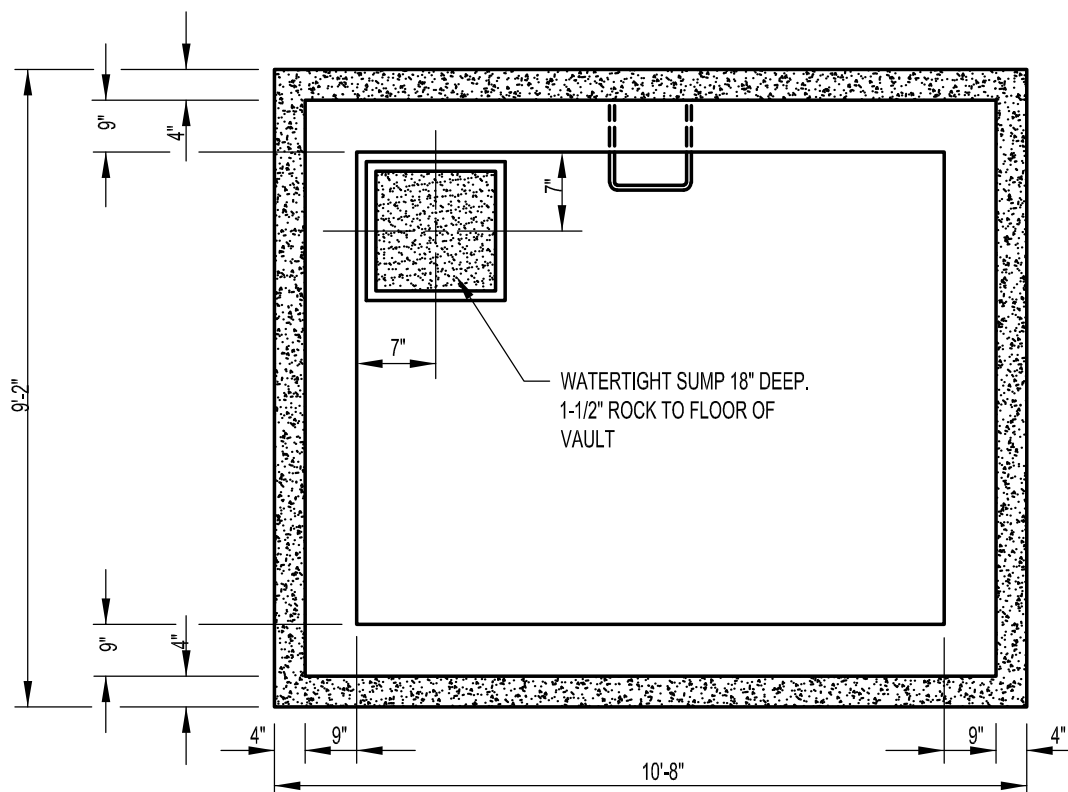
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	W9
SCALE	N.T.S.



PLAN OF PIPING

NOTE:
PROVIDE ADJUSTABLE SUPPORT
FOR METER AND BY-PASS

* STRAINERS TO BE INSTALLED
WITH ALL TURBINE AND
COMPOUND METERS.



PLAN OF VAULT

GENERAL NOTE:
1. SOME INSTALLATIONS MAY
REQUIRE INSULATION FOR
PROTECTION OF CATHODIC
PROTECTION SYSTEM

REVISIONS

DATE	ITEM	BY
3/2020		UTLEIG



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

STANDARD 3" AND 4" METER SETTING

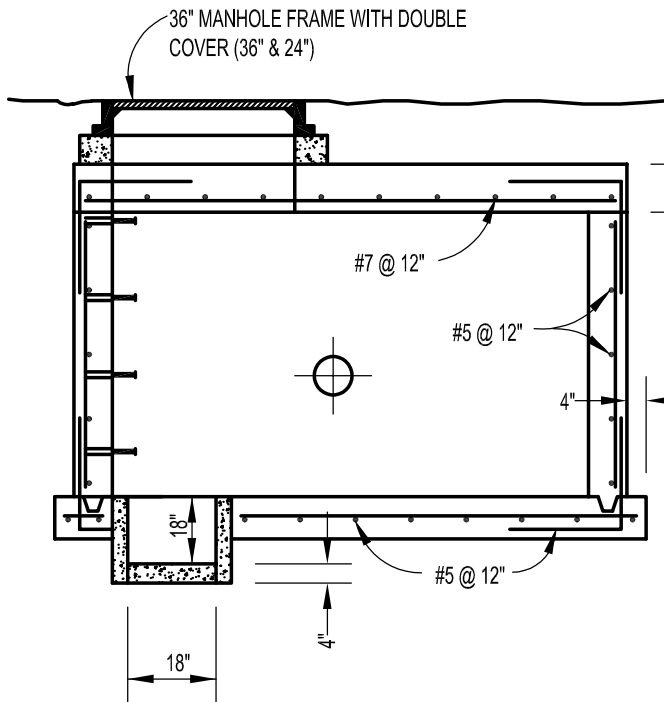
ISSUED

DRAWN BY: JLT

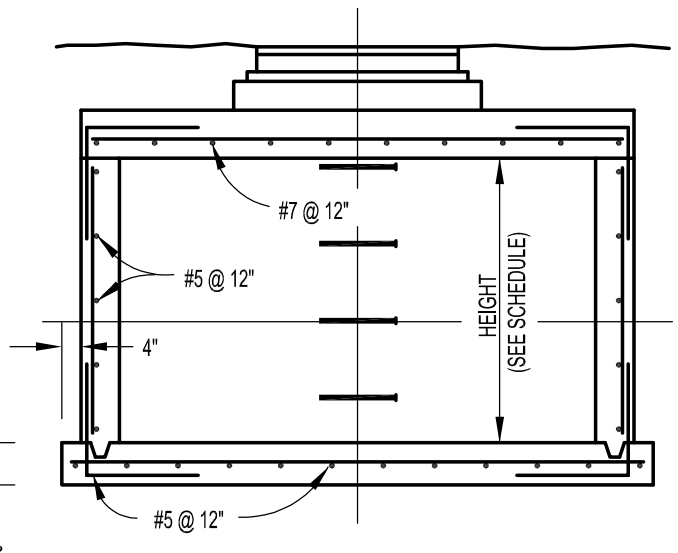
APPROVED BY:

DRAWING NO. W10

SCALE N.T.S.



SECTION A-A



SECTION B-B

METER VAULT-INSIDE DIMENSION SCHEDULE

METER SIZE	LENGTH	WIDTH	HEIGHT	WALL THICKNESS
3"	8'-0"	7'-0"	7'-0"	8"
4"	10'-0"	7'-0"	7'-0"	8"
6"	12'-0"	9'-0"	7'-0"	8"
8"	12'-0"	9'-0"	7'-0"	8"
12"	12'-0"	10'-0"	8'-0"	8"

REVISIONS

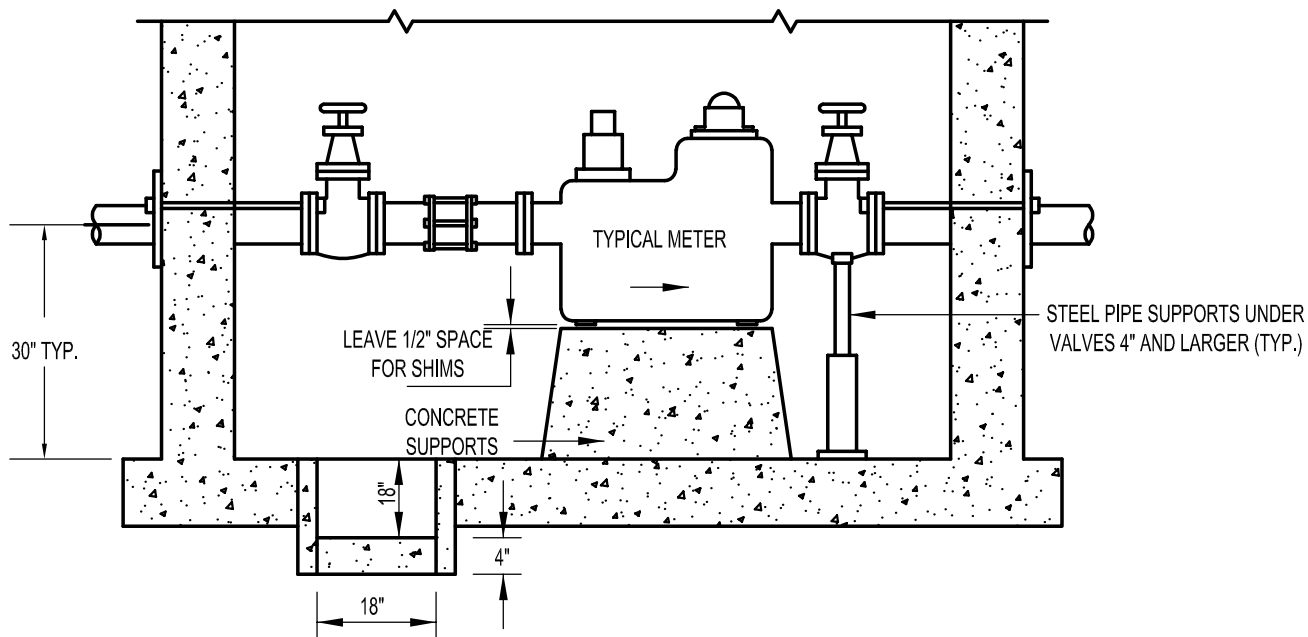
DATE	ITEM	BY
3/2020		UTLEIG



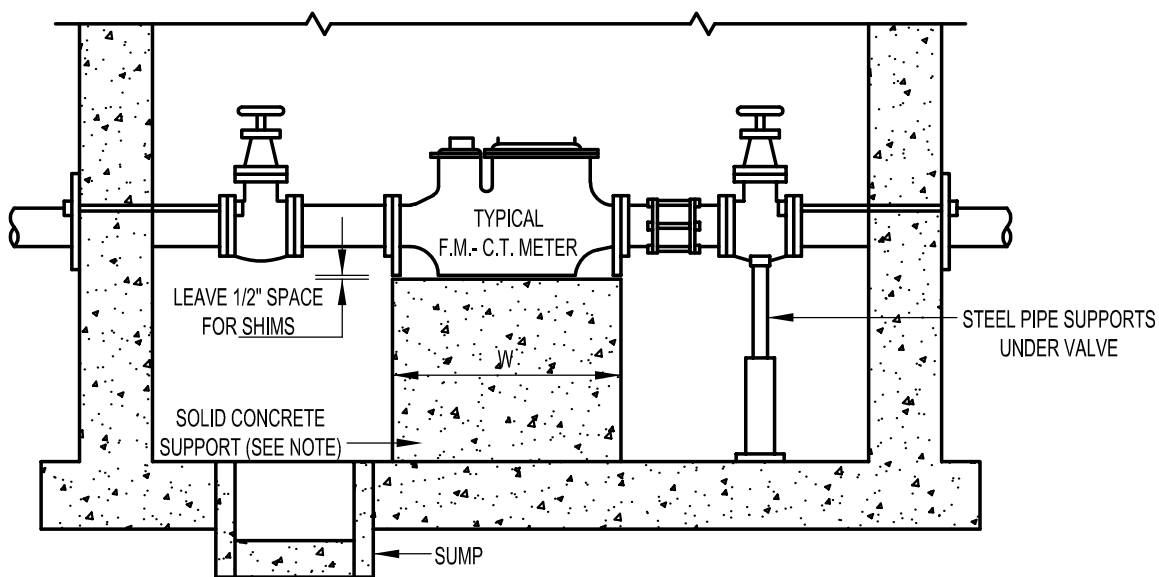
PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

TYPICAL METER VAULT

ISSUED	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	W11
SCALE	N.T.S.



TYPICAL CONC. METER SUPPORTS
FOR 3", 4", 6", 8", & 10" METERS




TYPICAL CONC. METER SUPPORT
FOR F.M.-M.C.T. OR TURBINE

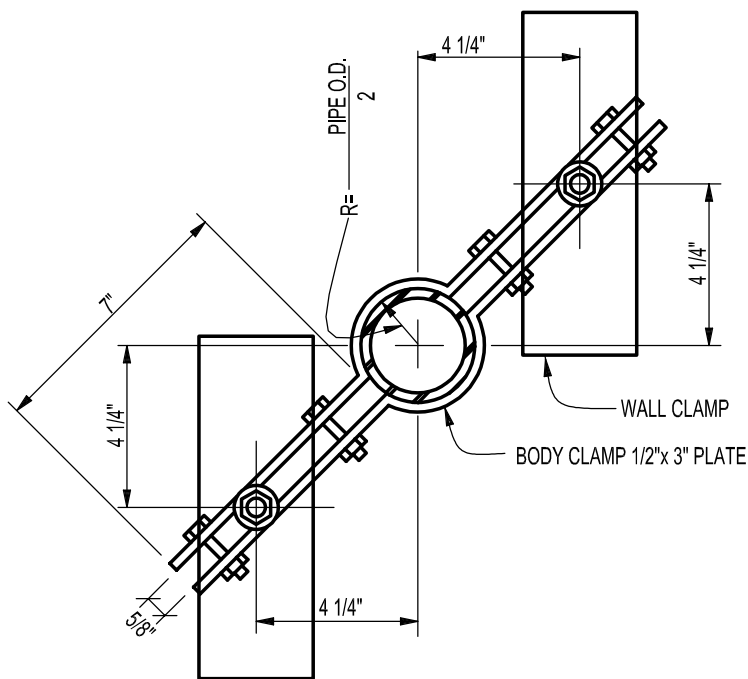
NOTES:

1. SOLID CONCRETE BASE EXTENDS UNDER THE F.M.-C.T. METER BYPASS FOR 6", 8" & 10".
2. SOLID CONCRETE BASE MAY BE PRECAST.

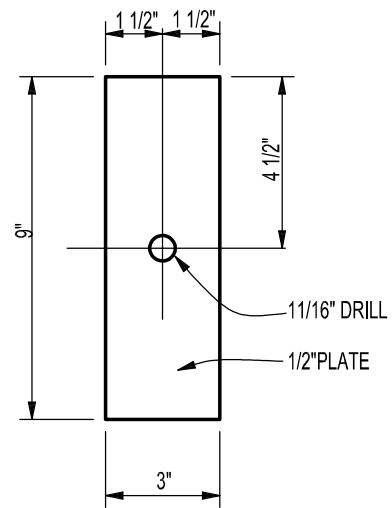
SIZE OF CONCRETE SUPPORT

- 6" F.M.-C.T. W=3'-9" L=3'-0"
 8" F.M.-C.T. W=4'-5" L=3'-8"
 10" F.M.-C.T. W=5'-8" L=4'-8"

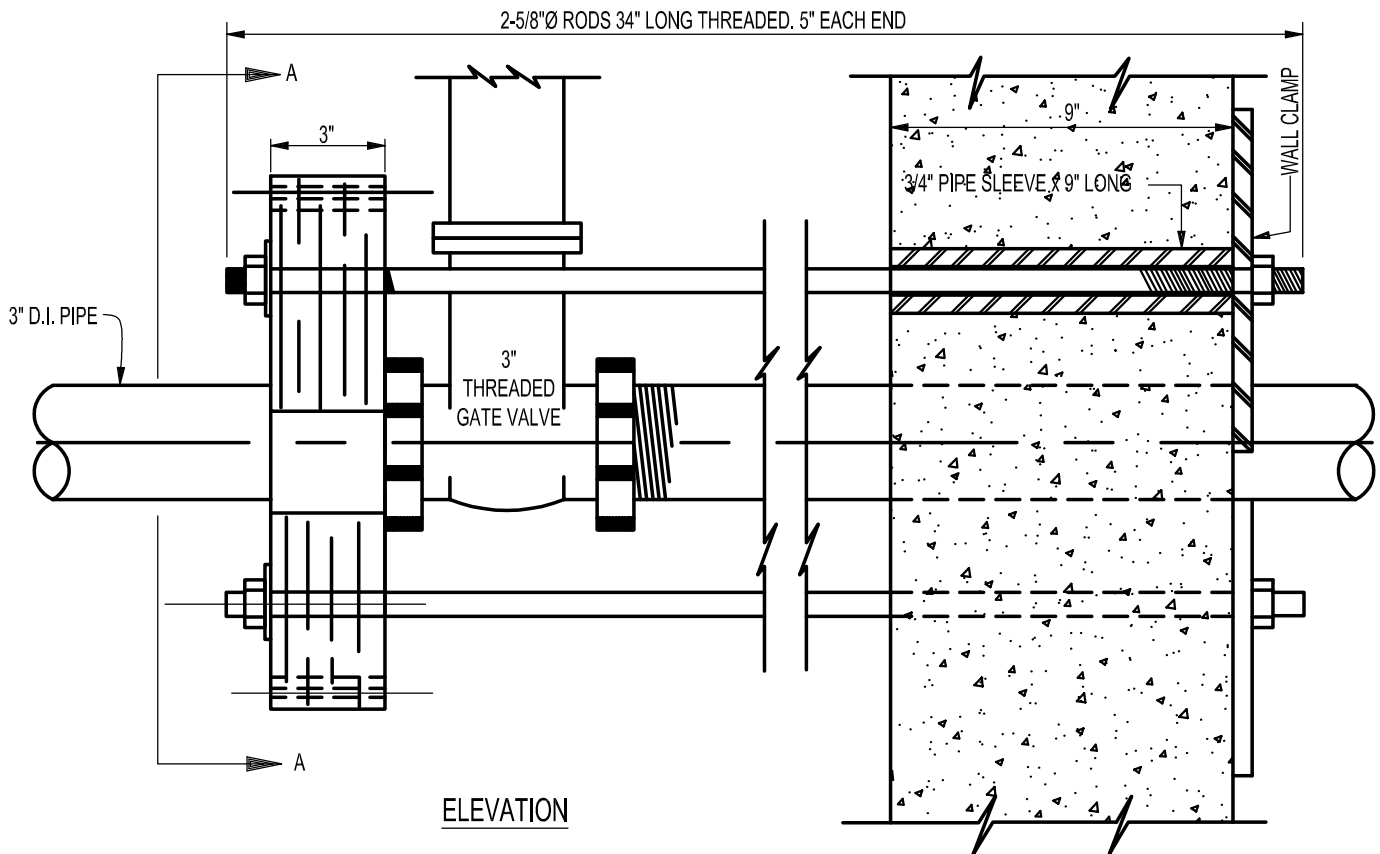
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
			STANDARD CONCRETE METER SUPPORT		DRAWING NO.	W12
					SCALE	N.T.S.



SECTION A-A



WALL CLAMP
4 REQUIRED



ELEVATION

REVISIONS

DATE	ITEM	BY
3/2020		UTLEIG

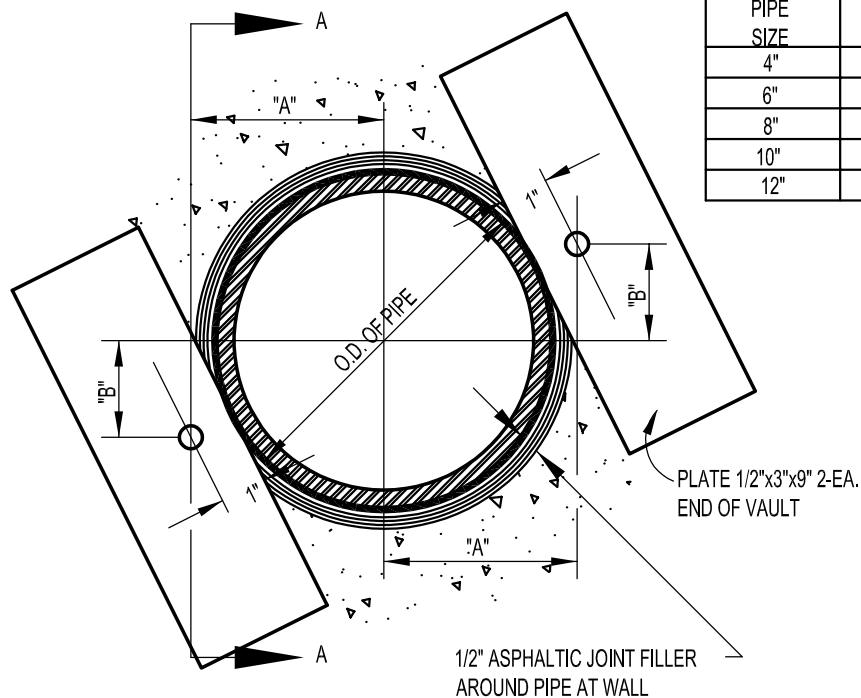


PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

WALL AND BODY CLAMPS 3" METER

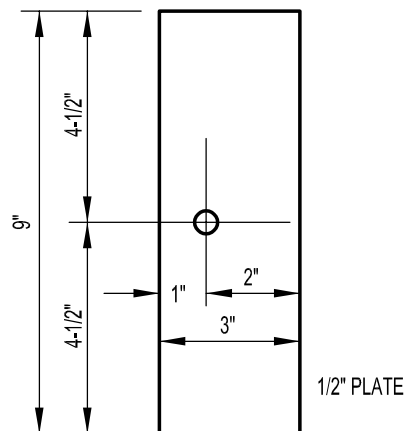
ISSUED

DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	W13
SCALE	N.T.S.

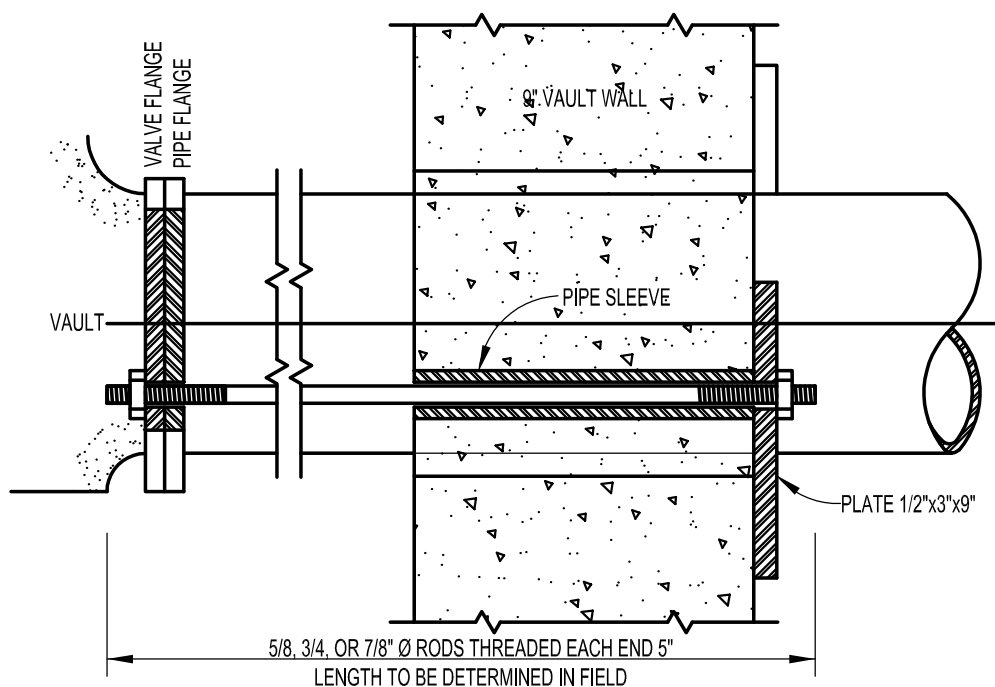


EXTERIOR ELEVATION


PIPE SIZE	RODS #, SIZE	WALL SLEEVE	"A"	"B"
4"	2-5/8 Ø	3/4x9"	3-1/2"	1-7/16"
6"	2-5/8 Ø	3/4x9"	4-3/8"	1-13/16"
8"	2-3/4 Ø	1"x9"	5-7/16"	2-1/4"
10"	2-7/8 Ø	1-1/2x9"	5-7/8"	3-3/8"
12"	2-7/8 Ø	1-1/2x9"	6-1/2"	3-15/16"



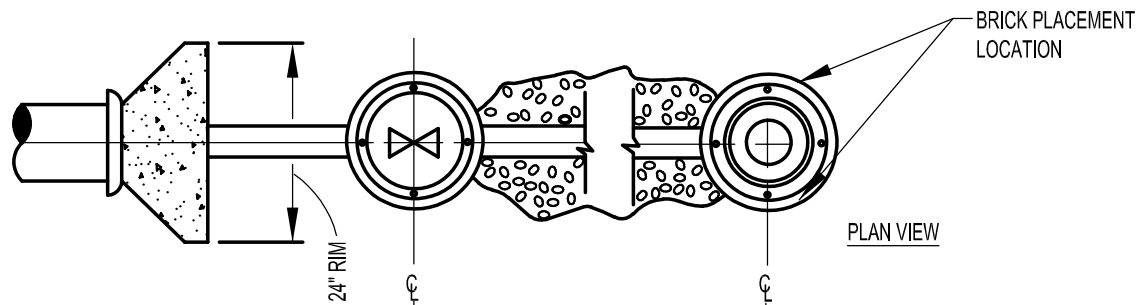
WALL PLATE



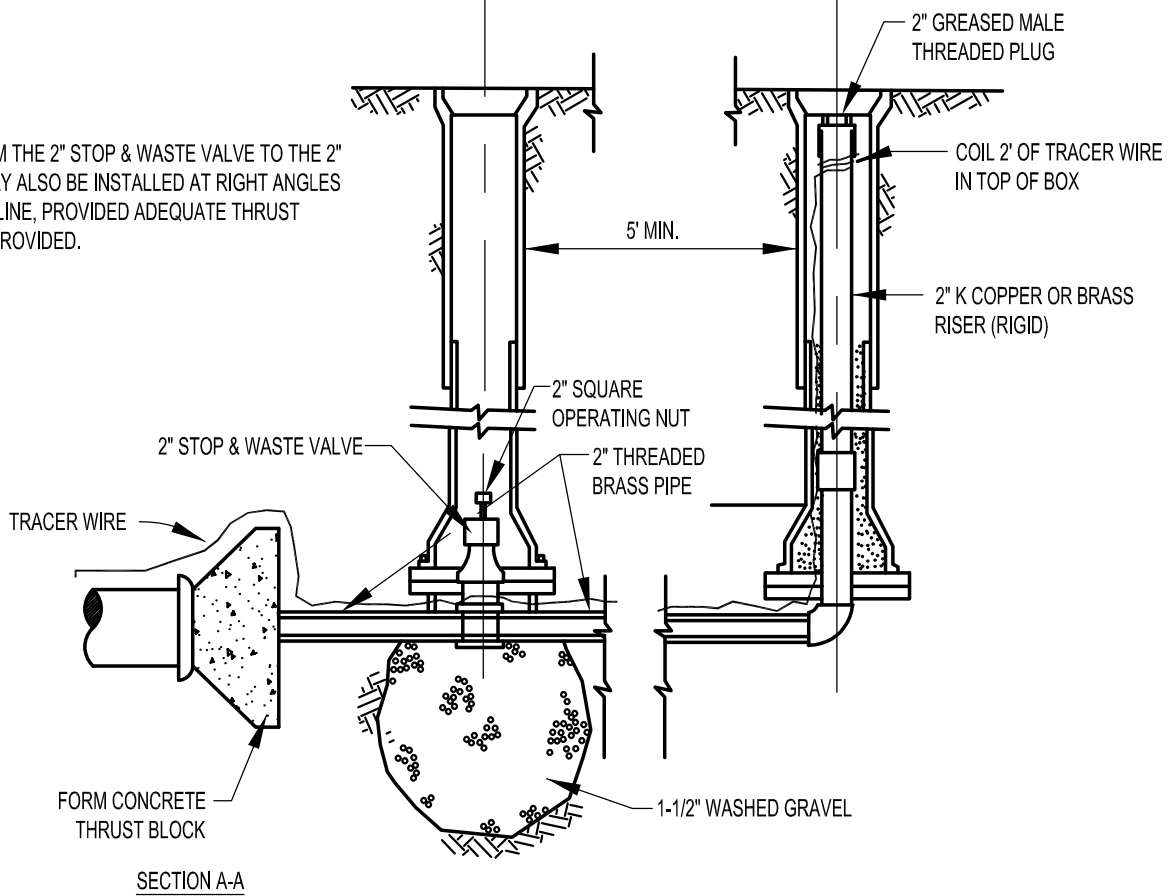
SECTION A-A


REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
					DRAWING NO.	W14
					SCALE	N.T.S.

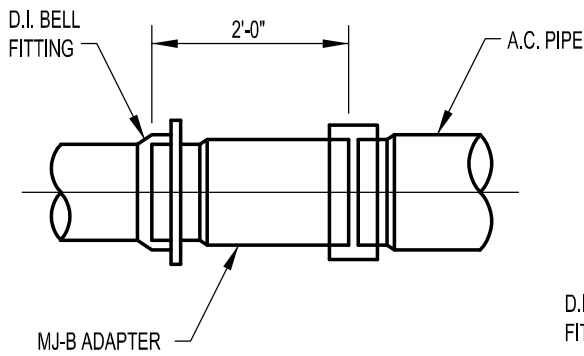
WALL CLAMPS FOR 4" TO 12" METERS



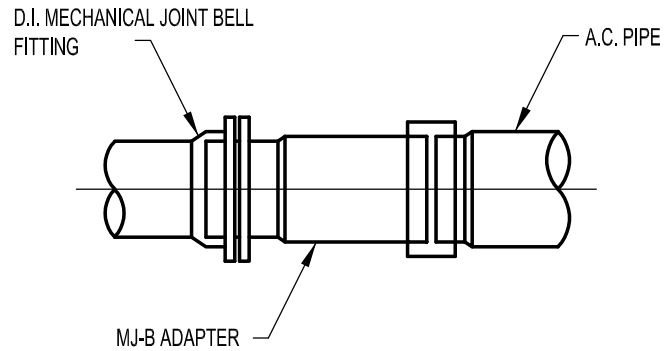
NOTE:
THE LINE FROM THE 2" STOP & WASTE VALVE TO THE 2" RISER PIPE MAY ALSO BE INSTALLED AT RIGHT ANGLES TO THE MAIN LINE, PROVIDED ADEQUATE THRUST BLOCKING IS PROVIDED.



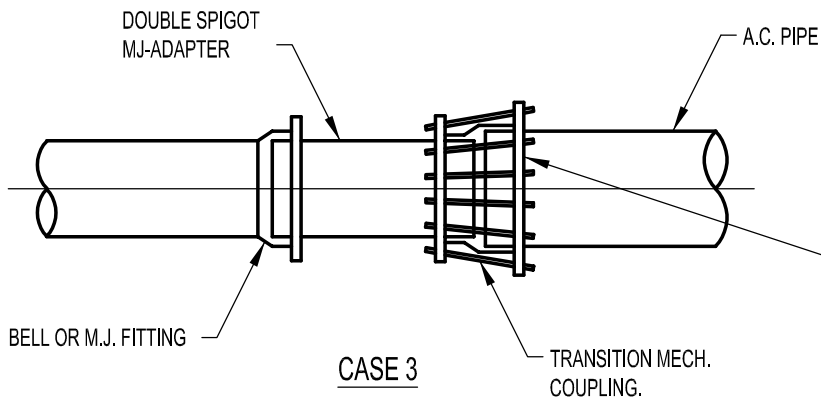
REVISIONS			 PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		UTLEIG	STANDARD BLOW-OFF INSTALLATION	APPROVED BY:	
				DRAWING NO.	W15
				SCALE	N.T.S.



CASE 1




CASE 2

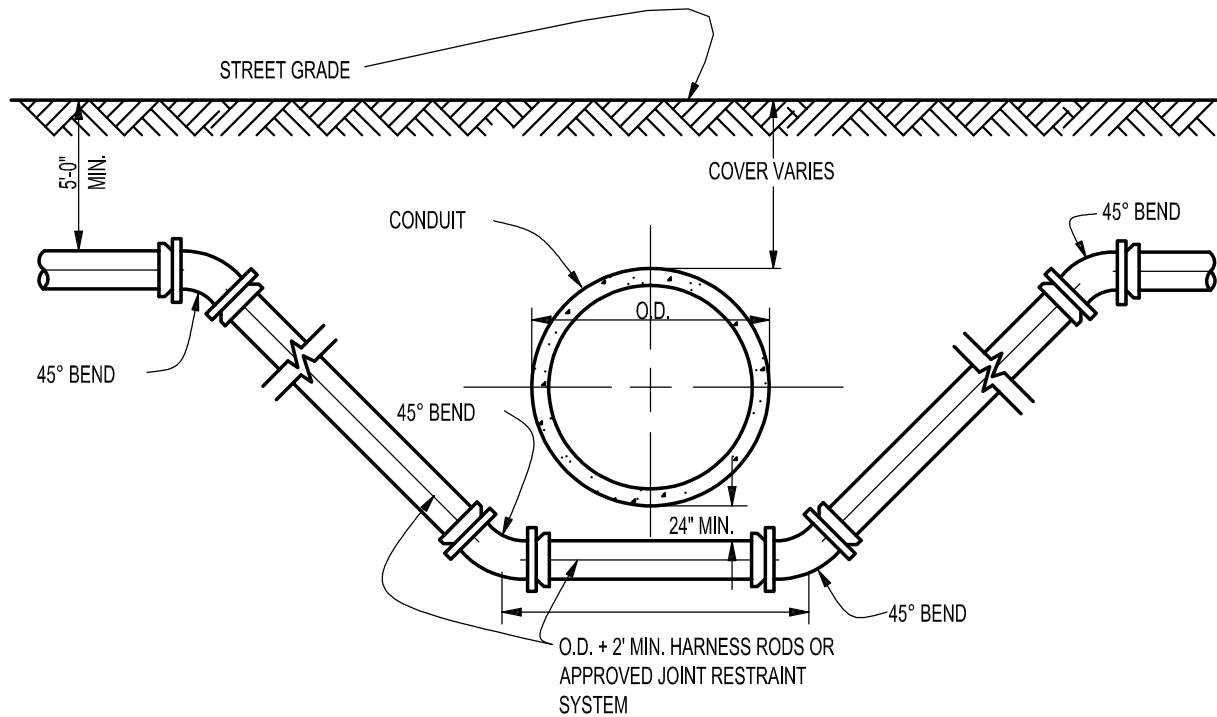


CASE 3

- TYPES OF COUPLINGS
- 1 - ROUGH BARREL TO D.I.
 - 2 - MOA TO D.I.
 - 3 - ROUGH BARREL TO ROUGH BARREL.
 - 4 - MEE TO ROUGH BARREL.


MOA = MACHINED OVER ALL.
 MEE = MACHINED EACH END.
 MJ = MECHANICAL JOINT.
 MJ-B = MECHANICAL JOINT-BELL ADAPTER.

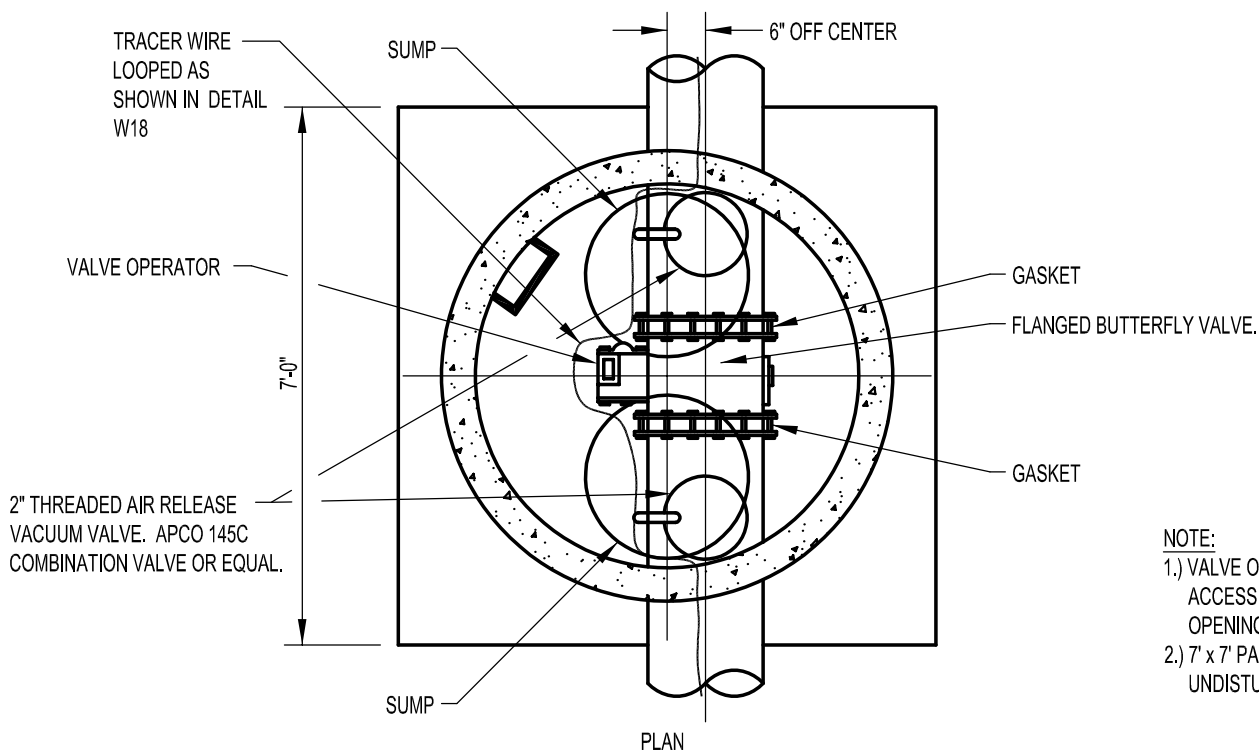
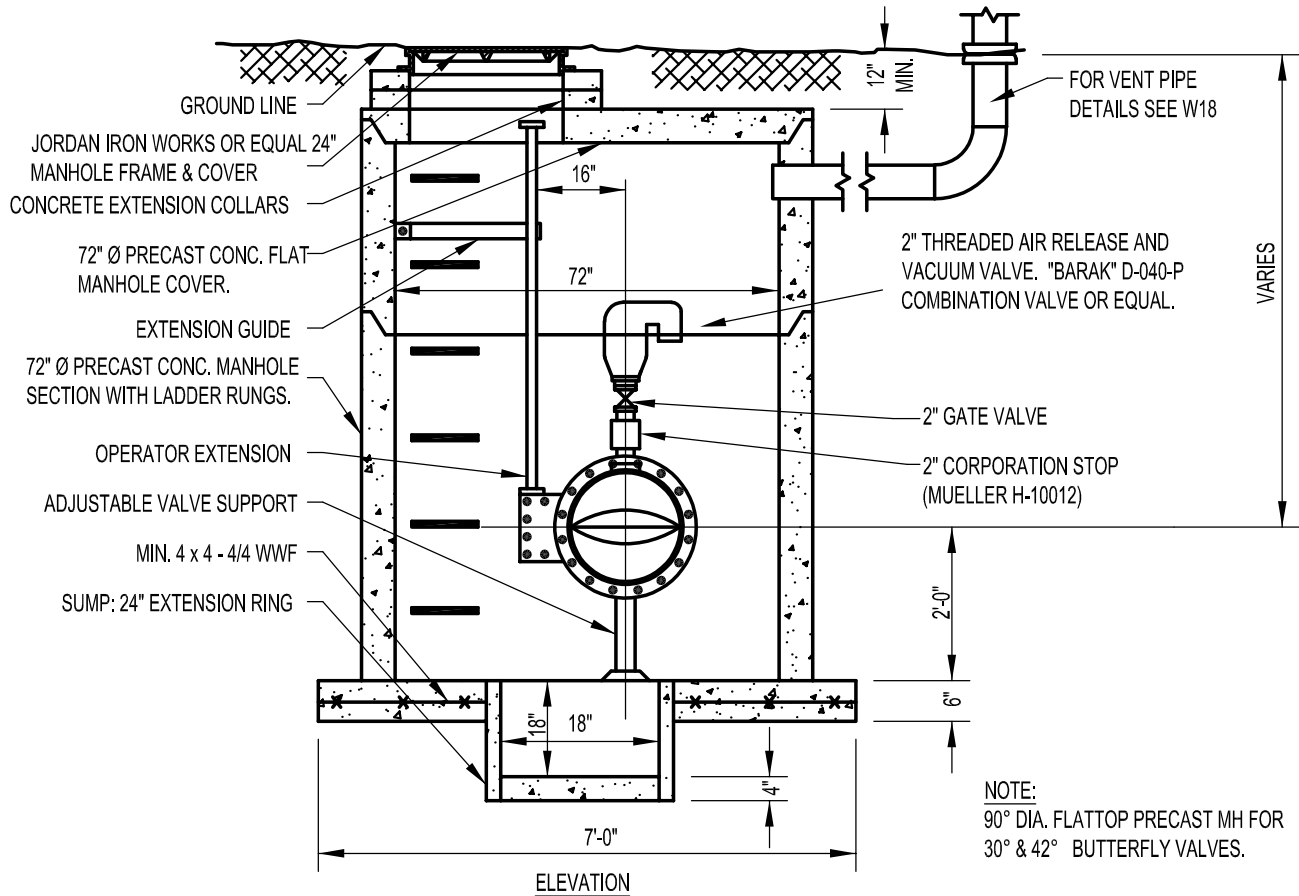
REVISIONS			 PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		UTLEIG	A.C. TO D.I. PIPE ADAPTER	APPROVED BY:	
				DRAWING NO.	W16
				SCALE	N.T.S.




NOTES:

1. SEWER LINES CROSSING ABOVE WATER MAINS SHALL BE DUCTILE IRON PIPE 9' EACH SIDE OF CROSSING (MIN.).
2. MINIMUM CLEARANCE 18" AS SHOWN ABOVE.
3. D.I.P. WILL BE WRAPPED.
4. CONDUIT TO BE PROPERLY SUPPORTED.
5. WHEN HARNESS RODS ARE USED, CONCRETE THRUST BLOCKS SHALL BE INCLUDED.
6. SEE ENCASEMENT DETAIL FOR CONDUIT CROSSING WHEN ENCASEMENT IS REQUIRED

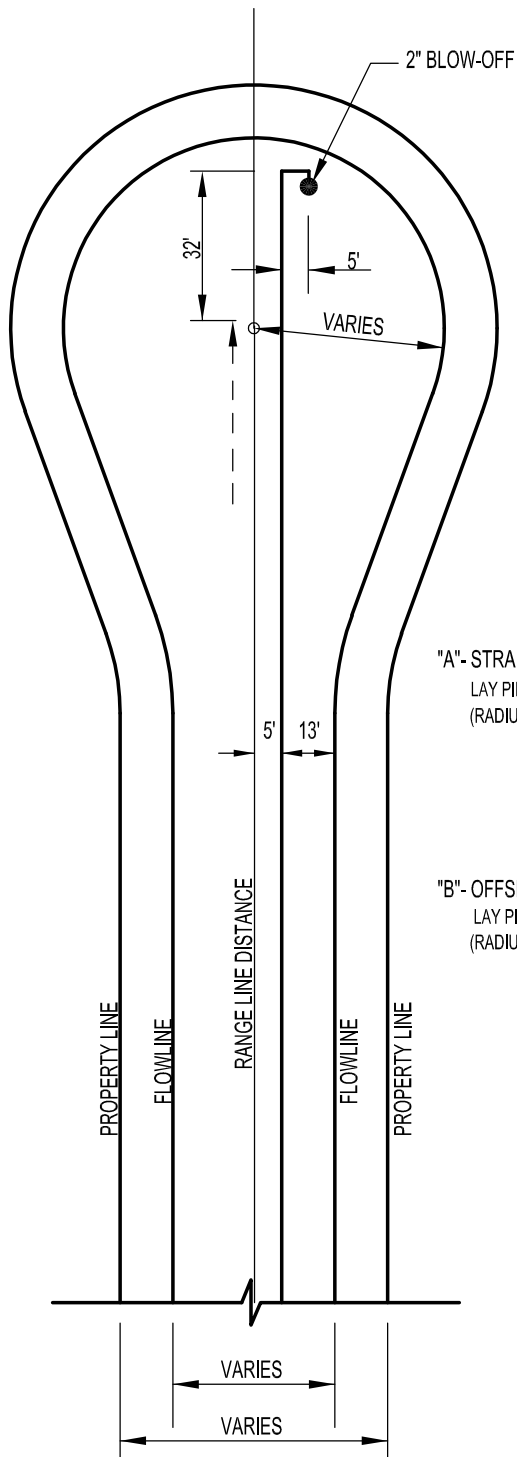
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG	<div>CONDUIT CROSSING</div>		APPROVED BY:	
					DRAWING NO.	W17
					SCALE	N.T.S.



- NOTE:
- 1.) VALVE OPERATOR SHALL BE ACCESSIBLE THRU MANHOLE OPENING.
 - 2.) 7" x 7" PAD TO REST ON UNDISTURBED SOIL.

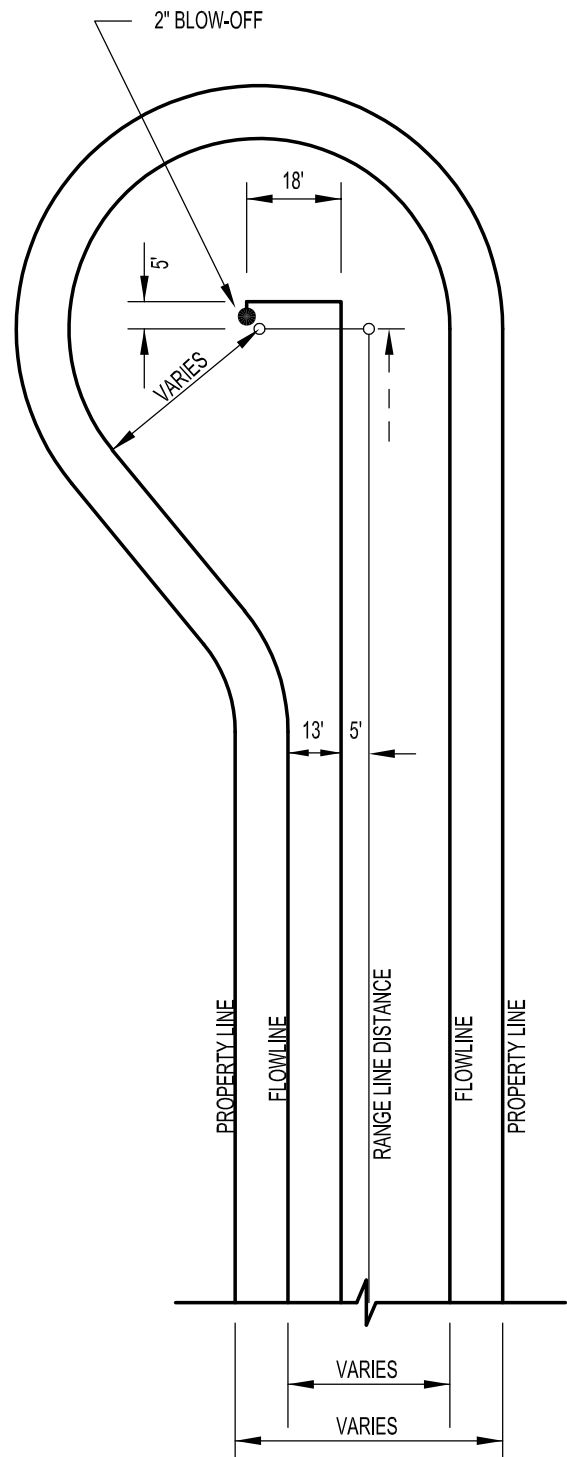
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
					DRAWING NO.	W19
					SCALE	N.T.S.

BUTTERFLY VALVE INSTALLATION IN
MAINS 16" OR LARGER



"A"- STRAIGHT LINE CUL-DE-SAC:
LAY PIPE TO 32' BEYOND THE CENTER
(RADIUS POINT) OF CUL-DE-SAC.

"B"- OFFSET CUL- DE-SAC:
LAY PIPE TO 5' BEYOND CENTER
(RADIUS POINT) OF CUL-DE-SAC.



"A"

"B"

REVISIONS

DATE	ITEM	BY
3/2020		UTLEIG



PUBLIC WORKS DEPARTMENT
ENGINEERING DIVISION

WATER DISTRIBUTION SYSTEM
TYPICAL PLAN FOR CUL-DE-SAC

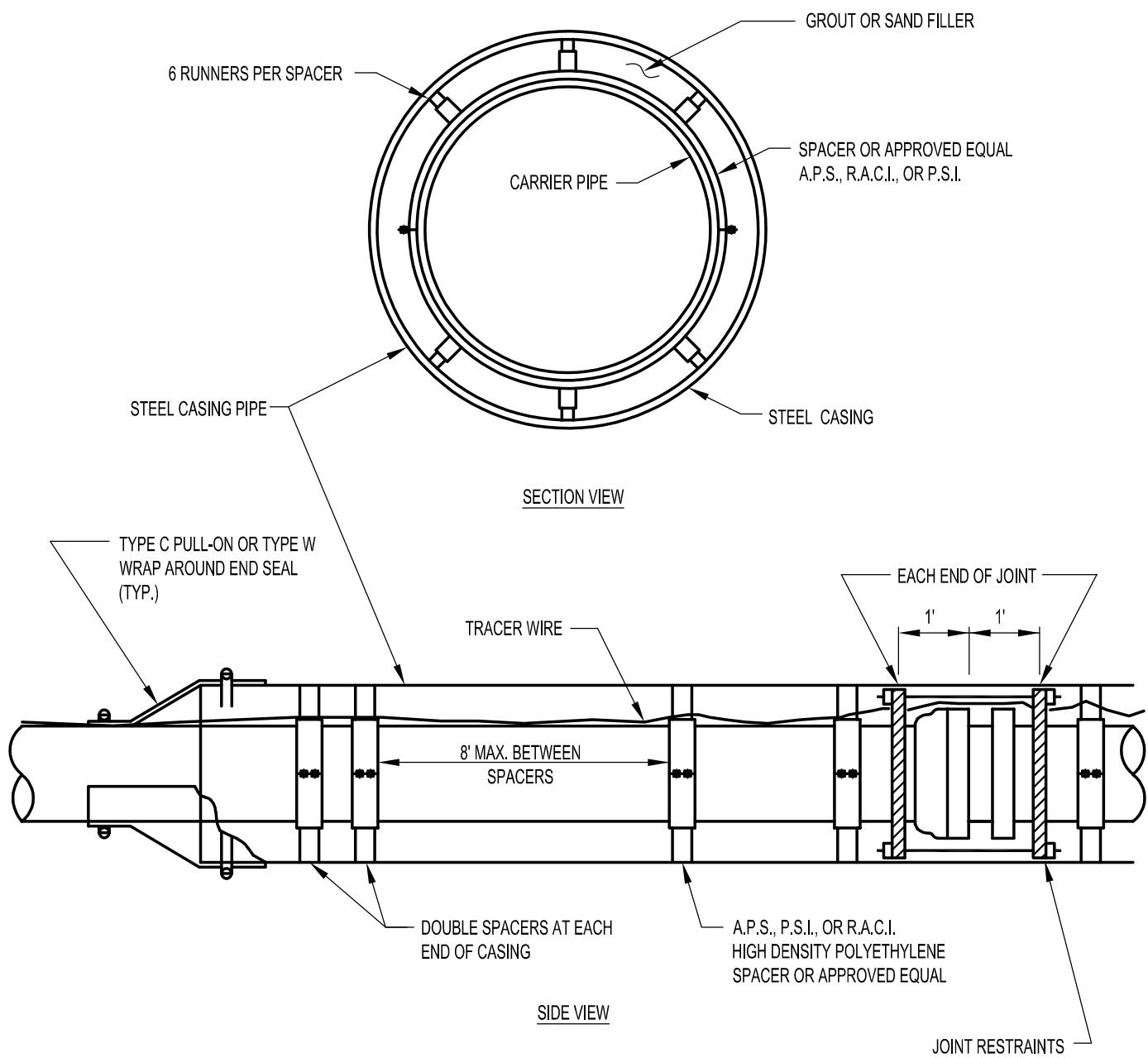
ISSUED


DRAWN BY: JLT

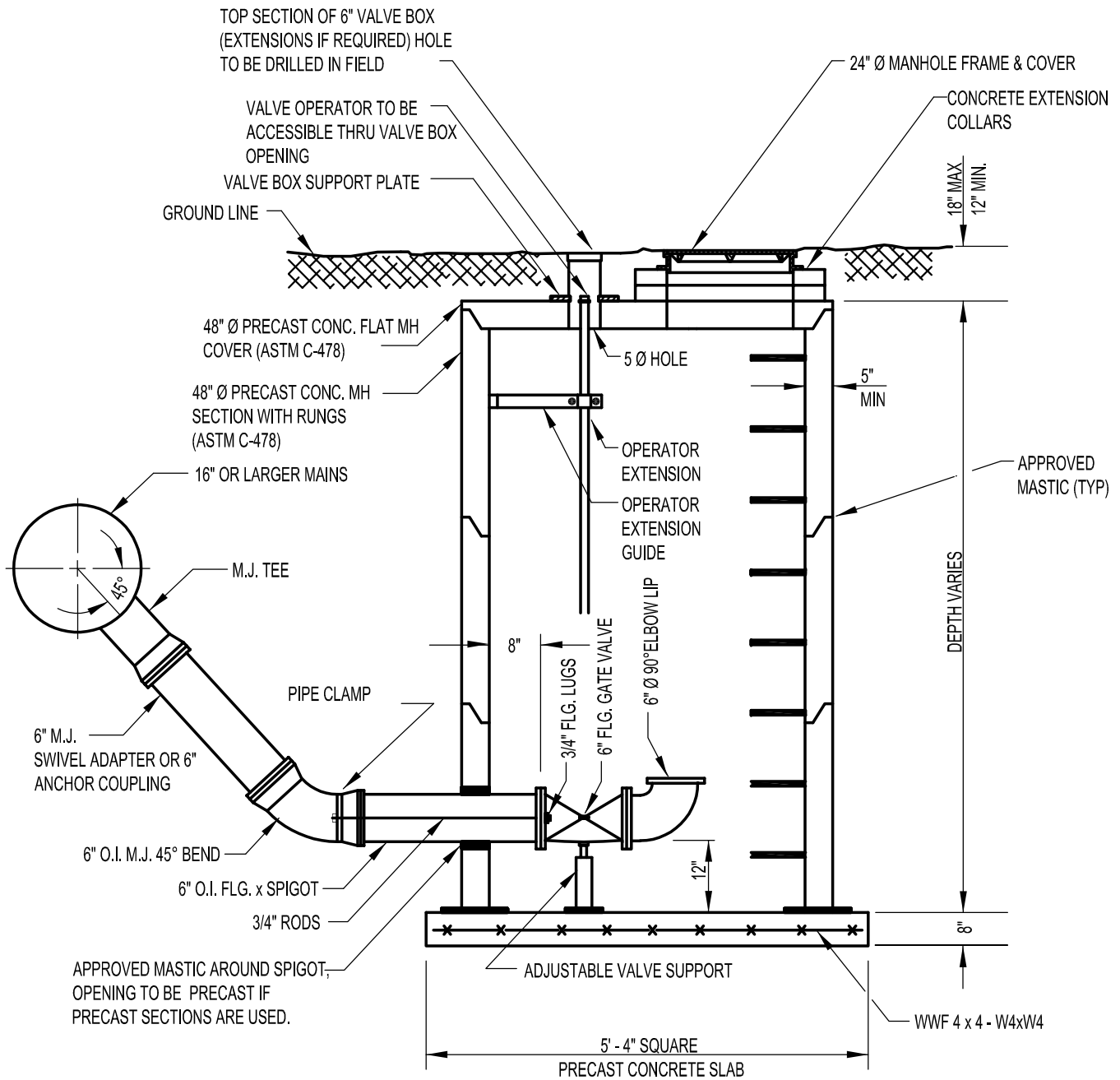
APPROVED BY:



DRAWING NO. W20

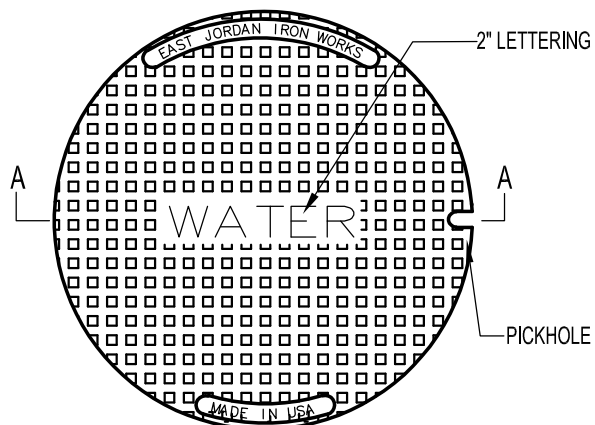
SCALE N.T.S.



REVISIONS			 PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY		DRAWN BY:	JLT
3/2020		UTLEIG		APPROVED BY:	
				DRAWING NO.	W21
				SCALE	N.T.S.
			BORING DETAIL		



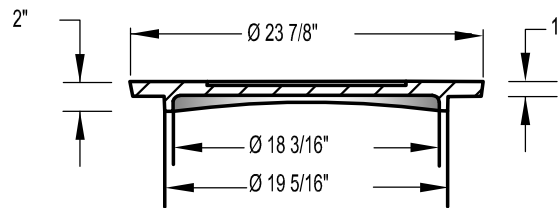
REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG		TRANSMISSION MAIN BLOW-OFF INSTALLATION	APPROVED BY:	
					DRAWING NO.	W22
					SCALE	N.T.S.



TOP OF COVER



BOTTOM OF COVER



SECTION A-A

COVER: GRAY IRON ASTM A 48 CL35 B
 LOAD RATING: HEAVY DUTY
 WEIGHT: 135LBS. (61kg)
 MACHINED SURFACE
 EAST JORDAN IRON WORKS PRODUCT
 OR APPROVED EQUAL

REVISIONS

DATE	ITEM	BY
3/2020		UTLEIG

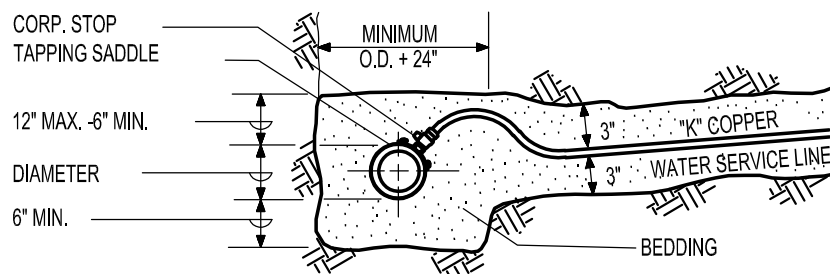


PUBLIC WORKS DEPARTMENT
 ENGINEERING DIVISION


WATER MANHOLE COVER

ISSUED	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO.	W23
SCALE	N.T.S.

NOTE:
 "K" COPPER SERVICE TO HAVE MIN. 6" BEDDING FOR UP TO 3" SERVICE.
 ANY SERVICE LARGER THAN 3" SHALL HAVE TYPICAL WATER MAIN
 BEDDING.



RESIDENTIAL SERVICE TAP
 AND SERVICE LINE BEDDING

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED	
DATE	ITEM	BY			DRAWN BY:	JLT
3/2020		UTLEIG			APPROVED BY:	
			RESIDENTIAL SERVICE TAP		DRAWING NO.	W24
					SCALE	N.T.S.