

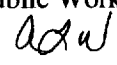


**PUBLIC WORKS DEPARTMENT  
MEMORANDUM # 2010 - 53**

**DATE:** November 11, 2010  
**TO:** Honorable Mayor Joyce Downing and City Council Members  
**FROM:** William A. Simmons, City Manager   
David H. Willett, Director of Public Works   
Amy L. Ward, Utility Engineer   
**SUBJECT:** CR-145 Public Right-of-Way Standards and Specifications  
CB-1731 Ordinance to Change Reference in Municipal Code

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**BACKGROUND**

The City of Northglenn currently has three (3) standards for work performed within the Right-of-Way (ROW): 1) Water & Sewer Utility Standards & Specifications, 2) Street & Drainage Standards and Specifications, and 3) Construction and Excavation Standards Supplement for Work in Public Rights-of-Way. These documents were last revised between 1987 and 1998 and many areas of the content are obsolete. Last year staff began the process of revising the existing standards and specifications into one cohesive document with current construction techniques, equipment, and requirements. The revised document will be referenced in the City's Municipal Code and provide more specific guidance to protect the public health, safety, and welfare.

The revised standards and specifications are contemporary and are not expected to increase the cost of doing business. Contractors in the current construction market bid and perform work using similar standards and specifications. Key areas of focus when performing work within City ROW are safety, quality, process, and warranty.

Staff submitted a draft in May 6, 2010. Our design team and City Attorney have provided input and the proposed final document is complete - "***Public Right-of-Way Standards and Specifications.***"

**RECOMMENDATIONS**

Attached is a Resolution to repeal the "Water & Sewer Utility Standards & Specifications", "Street & Drainage Standards and Specifications" and "Construction and Excavation Standards Supplement for Work in the Public Rights-of-Way" documents and to adopt the new "***Public Right-of-Way Standards and Specifications.***" Also, attached to this memorandum is an Ordinance that, if approved, will repeal and reenact attached Articles 10-4, 16-2, 16-8, 16-14, 16-17, and 16-19 of the Northglenn Municipal Code regarding the Public Right-of-Way Standards and Specifications.

**STAFF REFERENCE**

David Willett, P.E., Director of Public Works  
Amy Ward, P.E., Utility Engineer

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SPONSORED BY: MAYOR DOWNING

COUNCILMAN'S RESOLUTION

RESOLUTION NO.

No. CR-145  
Series of 2010

\_\_\_\_\_  
Series of 2010

A RESOLUTION ADOPTING THE PUBLIC RIGHT-OF-WAY STANDARDS AND SPECIFICATIONS

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF NORTHGLENN, COLORADO, THAT:

Section 1. The Public Right-of-Way Standards and Specifications, attached hereto as **Exhibit A**, are hereby adopted as the City of Northglenn Public Right-of-Way Standards and Specifications as referenced in Chapters 10 and 16 of the Northglenn Municipal Code.

Section 2. The City of Northglenn (a) Water & Sewer Utility Standards & Specifications; (b) Street & Drainage Standards and Specifications; and (c) Construction and Excavation Standards Supplement for Work in Public Rights-of-Way are hereby repealed and replaced in their entirety by the City of Northglenn Public Right-of-Way Standards and Specifications adopted by Section 1 above.

DATED at Northglenn, Colorado, this \_\_\_\_ day of \_\_\_\_\_, 2010.

\_\_\_\_\_  
JOYCE DOWNING  
Mayor

ATTEST:

\_\_\_\_\_  
JOHANNA SMALL, CMC  
City Clerk

APPROVED AS TO FORM:

\_\_\_\_\_  
COREY Y. HOFFMANN  
City Attorney

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# Public Right- of-Way Standards and Specifications

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City of Northglenn

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Updated: 2010

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**City of Northglenn**  
**Standards and Specifications**  
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## **CHAPTER 1    GENERAL REQUIREMENTS**

### **1.1.    AUTHORITY AND 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, 2010 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. In the case of City capital improvement contracts, the project specifications may supersede or modify these STANDARDS AND SPECIFICATIONS. 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.

#### **1.1.3    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.

#### **1.1.4    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.



### **1.1.5 INTERPRETATION**

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

- A. 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.
- B. 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.
- C. These STANDARDS AND SPECIFICATIONS shall not abrogate or annul any permits or approved 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 approval 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.

### **1.1.6 ENFORCEMENT RESPONSIBILITY**

It shall be the duty of the Public Works Director or designee to enforce the provisions of 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 Public Works Director or designee may order the work stopped by a written notice in accordance with Section 1.2.6.4 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 AND 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 Public Works Director or designee. 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.

#### **1.1.11 DEFINITIONS**

**CITY** - shall mean the City of Northglenn, in the State of Colorado, acting by and through the City Manager, Mayor, and City Council.

**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.

**CITY REPRESENTATIVE** - shall mean the Director of Public Works or the Director of Public Works' authorized representative acting on behalf of the City.

**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.

**DEVELOPER** - shall mean a person, partnership, company, firm, or corporation that is seeking to develop a property within the City.

**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.

**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.



**INSPECTOR** - shall mean the authorized representative of the Director of Public Works at the site of the work.

**MAY** - will be interpreted as being permissive.

**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.

**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.

**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 the licenses for conveying water from distribution mains to the premises.

**SHALL** - will be interpreted as being mandatory.

**STANDARDS AND SPECIFICATIONS** are used it shall be understood that 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. (Bonded)

**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 or the Director of Public Works' authorized representative acting on behalf of the City.

**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.



### 1.1.12 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
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
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
UDFCD	Urban Drainage and Flood Control District
UNCC	Utility Notification Center of Colorado
USDCM	Urban Storm Drainage Criteria Manual (MANUAL)
USGS	United States Geological Survey



## **1.2. GENERAL CONDITIONS**

### **1.2.1 RESPONSIBILITY FOR DESIGN AND CONSTRUCTION**

The City shall have full authority to review and approve all submittals and construction for compliance with these STANDARDS AND SPECIFICATIONS. An approval or acceptance by the City does not relieve the owner, engineer, 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 approved 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-CONSTRUCTION MEETINGS**

In conjunction with the "Notice to Proceed" for a development, the contractor shall arrange a "pre-construction meeting" which shall be attended by the owner/developer, all of the owner/developer's contractors, 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.

### **1.2.3 WORK CONDITIONS**

#### **1.1.1.1. 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.

#### **1.2.3.1. 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.

## **1.2.4 CONTROL OF WORK AND MATERIALS**

### **1.2.4.1. Authority of City**

The City will have the authority to stop work whenever such stoppage may be deemed necessary. The Public Works Director 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 Public Works Director 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 City and its inspector 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.

### **1.2.4.2. 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.



#### **1.2.4.3. Unauthorized and/or Unacceptable Work**

Work which does not conform to the approved 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.

#### **1.2.4.4. Samples and 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.

#### **1.2.4.5. 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.

#### **1.2.4.6. 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.



## 1.2.5 PROTECTION OF PUBLIC INTERESTS

### 1.2.5.1. Public Convenience and 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.

### 1.2.5.2. Protection of Property and 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 sewer, 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.

### **1.2.5.3. 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.

### **1.2.5.4. Explosives**

When blasting is permitted and approved in writing by the City, the developer and contractor will use the utmost care to protect life and property. Signals warning persons of danger will be given before any blast. Excessive blasting or overshooting will not be permitted. The City will have authority to order any method of blasting discontinued which leads to overshooting, is dangerous to the public, or destructive to property, environment or natural features.

Before any blasting will be done by the contractor, a certificate of insurance indicating special blasting coverage in the following minimum amounts will be filed with the City:

Property Damage, each accident	\$1,000,000
Public Liability, bodily Injury single limit or equivalent, each accident	\$1,000,000

The City reserves the right to require additional insurance coverage if the circumstances warrant.

The City has the right to require detailed inspections by an independent consultant or by City inspectors on any structures or properties located in the vicinity of the blasting, both before and after the blasting activity. The cost for such inspections shall be the responsibility of the developer and contractor.

### **1.2.5.5. 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, bitumens, 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 approved 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.

## **1.2.6 WORK IN PUBLIC RIGHT-OF-WAY**

### **1.2.6.1. Permit Required -- Right-of-Way Permit**

It shall be unlawful for any person to perform work within a public way of the City of Northglenn without first obtaining a permit from the City of Northglenn.

The Contractor is responsible for obtaining all construction permits, licenses, governmental charges and inspection fees necessary for the prosecution of the Work. Construction permits are issued by the Department of Public Works. An application for work done under a specific permit shall be submitted to the City on a form provided by the City for each job. The application shall be submitted at least 48 hours prior to the commencement of any work to allow for review and approval by the City. Permittees may be required to increase this time up to 10 days when the work consists of more than a single spot excavation. An application form (when approved) shall constitute a valid "right-of-way permit." Incomplete permit applications will not be reviewed or processed by the City.

The City may require submittal of plans and specifications. No work shall commence until the City has approved the plans and specifications and/or permit application, except in emergency conditions. A permit application shall be required for emergency conditions within 72 hours after the performance of the work and all conditions of a right-of-way permit shall apply.

Permits will only be issued to those registered contractors who have completed the following items:

- a. Received Public Works Director or designee's approval of project to be undertaken.
- b. Provide Certificate of Insurance to hold City harmless in the event of any damage to person or property, listing the City of Northglenn as an additional named insured, as more fully described hereof.
- c. Furnish a financial guarantee to the Department of Public Works for any main extensions in the City of Northglenn.
- d. Pay the Permit fees.
- e. Reviewed the latest version of the "City of Northglenn Public Right-of-Way Standards and Specifications".



**1.2.6.2. Issuance of Permits**

The City may grant permits to work in, construct, or excavate within the public way or to close traffic lanes or work in connection with a City utility system. All permits shall be issued according to the provisions of the Municipal Code.

Permits will not be issued to contractors with outstanding financial obligations to the Department. Permits shall be valid only during dates listed thereon. No work shall commence without a permit. The Inspector shall have the right to issue a stop work order to all projects not having a valid permit.

**1.2.6.3. Liability for Damage**

Any person who shall undertake work pursuant to a permit issued under the provisions of this chapter, perform work under contracts with the City, or perform work under the terms of a Public Improvements Agreement, or by virtue of permission obtained from the Council in accordance with the provisions adopted by the said Council, shall be answerable for any damage or injury to persons, animals, or property as a result of any circumstances of such work. Prior to any excavation within the public right-of-way, the contractor shall contact UNCC, the City of Northglenn's Public Works Department and any other affected utility company for field location of any utility lines which may be in the vicinity of the work.

**1.2.6.4. Suspension or Revocation of Permits -- Stop Work Order**

Any permit may be revoked or suspended by the City and a stop work order may be issued after notice to the permittee for:

- a. Violations of any condition of the Public Improvements Agreement, or of the approved construction drawings or specifications; or
- b. Violation of any provision of these STANDARDS AND SPECIFICATIONS; or
- c. Violation of any other ordinance of the City, state law, or federal law pertaining to the work; or
- d. Existence of any condition or the occurrence of any act which may constitute or cause a condition endangering health, life, or safety, or serious damage to property.

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 City.



**1.2.6.5. Application Form**

Application for a permit to work in the public right-of-way shall be made on an original form or electronically as provided by the City and shall recite specifically and illustrate by sketch or plan the exact location, depth, extent, nature, and purpose of the excavation to be made and the duration of the time required for the work. The application shall include the name of the applicant requesting the permit and the applicant's business address, registration number, business phone number, after business hours phone number, and contact person. The application will include other pertinent information such as application date, the start and finish dates of work within the public way, the completion date, the permit fee, a City contact phone number for inspection requests, a traffic control plan if required, and any other relevant information required by the terms of the right-of-way permit.

Applicants shall pay a fee to the City before issuance of such permit. The amount of that fee shall be established by the City and displayed on the permit.

**1.2.6.6. Exhibition of Permit**

All required permits shall be kept at the site of the excavation while the work is in progress and shall be exhibited upon request to any police officer or other authorized representative of the City. Failure to comply with this provision shall be grounds for a revocation of the permit and the issuance of a stop work order.

**1.2.6.7. Guarantee**

The permittee, by acceptance of the permit, expressly guarantees complete performance of the work therein described and guarantees all work done by him for a period of two years after the date of completion as shown on the permit form. The permittee agrees upon demand to maintain and to make all necessary repairs during the two-year warranty/maintenance period, and to hold harmless the City of Northglenn for any and all claims arising from such work.

If repairs are required during the subsequent two-year warranty period, those repairs need only be guaranteed until the end of the initial two-year period starting with the date of initial completion. However, in the event the City deems that the repairs are severe enough to constitute a reconstruction it may require that a new two-year guarantee be provided for subsequent repairs after the completion of the reconstruction.

The permittee shall be responsible for providing materials and construction methods complying with these STANDARDS AND SPECIFICATIONS. If the permittee defaults in completion or conformance with these STANDARDS AND SPECIFICATIONS, the City shall submit a letter to the permittee describing the default or non-conformance at least 10 days prior to authorizing City personnel to perform suitable repairs and reconstruction. City personnel shall be authorized to remove and replace non-conforming work and/or materials to a reasonable distance beyond the limits of the non-conforming work as required to produce a suitable repair. The permittee shall be responsible for all costs incurred by the City to accomplish the work in a safe and timely manner.



**1.2.6.8. Performance**

***1.2.6.8.1 Inspection***

There shall be a minimum of two inspections for each permit. The first shall occur upon notification by the contractor that 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 City may notify the permittee of any needed repairs. Such repairs shall be completed within 24 hours if the defects are determined by the City to be an imminent danger to the public health, safety, and welfare. Non-emergency repairs shall be completed within 10 days after notice.

***1.2.6.8.2 Barricading and Traffic Control***

All work within a traveled public roadway area shall be protected at all times by safety devices as prescribed by the MUTCD and in such manner as to minimize the disruption of the flow of traffic in the vicinity of the work. Normally, only one side of a street may be closed at any given time. Traffic must be provided a minimum lane width of 10 feet in the construction area.

Any plan for traffic control during construction must be approved by the Traffic Engineer prior to issuance of permit. Plans that indicate complete closures must show detour routes and must be approved by the Traffic Engineer at least one week prior to the issuance of the permit. The City reserves the right to require longer lead times if it deems necessary.

All work within the roadway shall take place between 8:30 a.m. and 3:30 p.m. for arterials and 8:30 a.m. and 5:30 p.m. for collector and residential streets unless otherwise stipulated on the right-of-way permit.

As directed by the City, street excavations must be backfilled prior to leaving the site at the end of the work day, even if the work has not been completed.

No person shall dig or cause to be dug any hole, drain, ditch, or any other excavation in any street, alley, sidewalk, or other public place within the City without providing sufficient amber lights to be placed with a suitable barricade or temporary fence around such hole, drain, or other excavation in order to prevent persons, animals, and vehicles from sustaining injury. During the daytime the barricades shall be maintained but warning lights are not required. All barricades and lights shall be left in place until a permanent patch or temporary cold-mix patch can be made to the excavation.

***1.2.6.8.3 Removal of Safety Devices or Barricades.***

No person shall damage, displace, remove, or interfere with any barricade warning light or any other safety device which is lawfully placed around or





about any street, alley, sidewalk, or other excavations or construction work in the City.

## **1.2.7 OTHER PERMITS**

This section discusses only those permits and agreements which may be required by the City of Northglenn as part of the construction of the public improvements or private improvements in areas of common ownership (for example; landscaping, parking lots, etc.). It does not address other City permits (for example; building permits, tap permits, etc.) or permits which may be required by other government entities (for example; CDOT, FEMA, EPA, etc.).

### **1.2.7.1. Land Disturbance Permit**

The fee for this permit shall be as established by the Municipal Code. This permit is required if any owner/developer wishes to begin overlot grading within a particular development before the public improvements agreement is executed and good and sufficient surety is provided to the City. It should be noted that the City is under no obligation to issue a land disturbance permit prior to the execution of the public improvements agreement. However, if the City has approved the Official 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 City may issue a land disturbance permit. In addition, the owner/developer will be required to sign a letter acknowledging that he is doing the overlot grading at his own risk, and that any subsequent changes to that grading that may be required as a result of additional review comments will be his sole responsibility. Prior to the issuance of a land disturbance permit, all provisions of Section 1.2.8.2 of these standards and specifications shall be complied with.

### **1.2.7.2. Temporary Water Service Permit**

All water used in the City for construction purposes is to be metered and charged to the user. The application for temporary water service shall be made with the Right-of-Way Inspector. The application and fee for each temporary meter shall be in accordance with the Municipal Code. A deposit must be made to the City 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 City to estimate water usage.

## **1.2.8 IMPROVEMENTS AGREEMENT**

### **1.2.8.1. Definition**

An improvements agreement is a written contract between the developer/owner and the City of Northglenn for installation of all public improvements and/or private improvements in areas of common ownership, related to a particular project. Two agreements are required. One agreement addressing “public improvements”. and an agreement addressing “private improvements”. These agreements specify the nature of



all public and/or private improvements, the time frame for construction and, in standard format, identifies the obligations of the developer/owner and the City. In addition, these agreements will identify any outstanding obligations of the developer/owner to any adjacent property developers/owners or to the City. This contract binds the owners of property being developed and any successors, assignees with interest to that property.

The improvements agreement is a mandatory part of the development process and must be executed before construction activities can commence and before a final plat can be recorded. The agreement will be prepared by the City with the information provided by the developer/owner after the final construction package has been approved and will be forwarded to the developer/owner for their signatures.

### **1.2.8.2. Surety**

The improvements agreement cannot be executed nor the final plat executed and recorded until good and sufficient surety is provided by the owner/developer to the City. The surety represents 100 percent of the total estimated cost of all public improvements and private improvements in areas of common ownership with respect to a specific project.

#### ***1.2.8.2.1 Types of Surety.***

There are three types of surety that the City will accept:

1. A letter of credit from a financial institution acceptable to the City that guarantees the monies stated in the letter of credit.
2. A payment, performance, warranty and maintenance bond.
3. Cash.

#### ***1.2.8.2.2 Expiration of Surety.***

The expiration date on the surety should coincide with the expiration date on the improvements agreement. Once the project is accepted into the warranty period, the surety shall be amended so that the expiration date coincides with the end of warranty period date.

At least fourteen (14) calendar days prior to the expiration date of any surety, Owner shall provide the City an amended form of surety with a term sufficient to cover the time for completing any remaining obligations of the Owner pursuant to this Agreement. The Owner's failure to provide such an extended form of surety prior to said fourteen (14) day period shall constitute a failure to perform in accordance with Agreement and shall give the City the right to proceed immediately to liquidate the existing surety.



## **1.2.9 CONSTRUCTION DRAWING SUBMITTAL REQUIREMENTS**

Construction drawings shall contain the information and be in the format outlined in the separate document titled “Plan Submittal Document Guidelines”, available from the Engineering Division of the City.



## **CHAPTER 2     EARTHWORK, EROSION CONTROL, AND SEEDING**

### **2.1. INTRODUCTION**

This chapter contains minimum criteria to be met on all earthwork, erosion control and seeding constructed in the City, both by private land developers and by the City.

### **2.2. EARTHWORK AND GRADING**

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 + 3 percent of optimum moisture in areas to be eventually turfed or planted and compaction to minimum 95 percent Standard Proctor density at + 2 percent 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.

#### **2.2.1 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.

##### **2.2.1.1. 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, Urban Drainage and Flood Control District publication known as the Urban Storm Drainage Criteria Manual, Volumes 1 through 3, and Municipal Code.

**2.2.1.2. Permit Required**

No person shall clear or grade land without first obtaining a Land Disturbance Permit from the Department of Public Works in accordance with the requirements of Municipal Code.

**2.2.2 EROSION AND SEDIMENT CONTROL PLANS**

**2.2.2.1. Review and Approval**

- a. 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 Land Disturbance Permit.
- b. 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, Urban 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.
- c. The City may impose such conditions thereto as may be deemed necessary to ensure compliance with the provisions of these STANDARDS AND SPECIFICATIONS, Urban Storm Drainage Criteria Manual, Volumes 1 through 3, and the Municipal Code for the preservation of public health and safety.
- d. The erosion and sediment control plan shall not be considered approved without the inclusion of the signature and date of signature of the Director of Public Works or their designee.
- e. Approved plans may remain valid for one year from the date of approval unless renewed by the City.
- f. Approved plans will become an exhibit to the City's Land Disturbance Permit.

**2.2.2.2. 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 Urban Storm Drainage Criteria Manual, Volumes 1 through 3, and Municipal Code.



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

### **2.2.3 GRADING AND 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:

#### **2.2.3.1. 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.

**2.2.3.2. Land Disturbance Permits and Construction Observation**

Before construction begins, the applicant shall apply for a Land Disturbance Permit to the City of Northglenn. A permit shall be issued if a grading plan and an erosion control plan have been previously submitted and approved.

The Public Works Director or designee shall monitor all overlot grading and other earth disturbance activities for compliance with the Land Disturbance 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.

**2.2.3.3. Modification of Approved Plans**

All proposed modifications of the approved grading plan must be submitted along with all supporting materials to the Director of Public Works. No work in connection with the proposed modifications shall be permitted without prior approval of the Director of Public Works, 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.

**2.2.3.4. 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.

**2.2.3.5. Standard Erosion Control Details**

Erosion control measures shall comply with the details included in the Appendix of these STANDARDS AND SPECIFICATIONS, however these may be revised or updated as necessary in compliance with the latest requirements of Urban Drainage and Flood Control District as applicable.

**2.3. LANDSCAPING**

For the purpose of this chapter, the term “landscaping” refers to ground cover only. “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.



## 2.3.1 SOIL PREPARATION

### 2.3.1.1. 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 2.1 - 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.

### 2.3.1.2. 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.

## 2.3.2 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.





**2.3.2.1. 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 2.2 - 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.

**2.3.2.2. 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.

**2.3.3 FERTILIZATION**

A booster fertilizer with the chemical analysis of Nitrogen-12, Potash-12, Phosphorous-4 with 4 percent iron and 8 percent sulphur 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.

**2.3.4 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:

- A. 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.
- B. 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.

- C. 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.
- D. Jute netting, enkamat, and similar approved materials shall be installed according to the manufacturer's recommendations.
- E. Excelsior mat shall be installed according to the manufacturer's recommendations.

### **2.3.5 SEEDING - GENERAL**

Seeding of grasses or ground cover plants is required for either of two purposes:

- A. Temporary erosion control.
- B. Permanent seeding for erosion control and appearance

Temporary seeding for erosion control shall be in accordance with Sections 0 and 2.3.6 of these STANDARDS AND SPECIFICATIONS.

### **2.3.6 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.

#### **2.3.6.1. 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:

- a. Hand Broadcast and Incorporation
- b. Mechanical Broadcast and Incorporation
- c. 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 untiltable.



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 resowing 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.



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## **CHAPTER 3     WATER SYSTEM**

### **3.1. 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-design meetings, as determined necessary by the City.

In the case of water mains larger than 12 inches, the owner or his representative shall submit construction specifications to the City for review and approval prior to the City's approval of the construction drawings.

#### **3.1.1 INTERRUPTION OF SERVICE**

The Public Works Department 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 shut-down shall only be performed between the hours of 1:00 a.m. and 5:00 a.m. No line in service will be shutdown for more than a four-hour period at one time. Prior approval by the City is required for all shutdowns.

#### **3.1.2 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 contractor shall also contact the Public Works Department and Fire District in reference to this emergency shutdown within one hour.

#### **3.1.3 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.

### **3.2. DESIGN CRITERIA**

#### **3.2.1 SCOPE**

It is the intent of this "design criteria" section to provide sufficient detailed information to enable the Engineer for the Owner/Developer to correctly and efficiently design the overall water system for a particular development. If there is a question or a concern regarding the design of any portion of the water system that is not adequately answered within this chapter, the



owner/developer or his representative shall call the City to get all issues resolved prior to design. Any deviation from these STANDARDS AND SPECIFICATIONS must be approved in writing by the City.

### 3.2.2 GENERAL

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."

#### 3.2.2.1. Study

The Study shall include the following information and shall be bound in an 8-1/2-inch x 11-inch report binder:

- a. 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.
- b. 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.
- c. The estimated population densities and total population, based on land use projections, to be served by the new water line.
  - a. Design flow rates, minimum and maximum system residual pressures, and headloss in the distribution main.
  - b. 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.



### 3.2.3 DESIGN FLOW

The flows used to design the water system for a particular development vary depending on the type of development. There are two general categories of development for which flow rates are given: residential development and commercial/industrial development. 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:

#### Utility Study Criteria

##### Residential

Assume 2.9 people/unit for all single family residential units\*

Assume 1.8 people/unit for all multi-family units, including apartments

Average demand -- 151 gallons/capita/day\*\*

Peak day factor -- 2.5 \*\*

Peak hour factor -- 4.0 \*\*

##### Commercial/Industrial

Average demand for planning purposes only use 1,000 gallons per day per acre

Average demand -- 300 gallons/day/1,000 square foot floor area (gross) \*\*\*

Peak day factor -- 2.5 \*\*

Peak hour factor -- 4.0 \*\*

##### Fire Flows

To be determined by the Fire District

Analyze system for whichever is greater of the following:

1. Max day plus fire flow, or
2. Peak hour

Minimum residual pressure plus fire flow -- 20 PSI \*\*\*\*

\* 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.

\*\* From "Evaluation of Potable Water Storage Distribution and Pumping System", 1998.



\*\*\* From "Water Supply and Sewerage - Fifth Edition," E.W. Steel and Terence J. McGhee

\*\*\*\* Exceeds the minimum requirements of the latest adopted International Building Code.

### **3.2.4 HYDRAULIC DESIGN**

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

### **3.2.5 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.

### **3.2.6 PRESSURE REGULATING STATIONS**

Pressure reducing valve (PRV) installations are used to control pressure between distribution zones. When main extension plans are submitted for review, the need for a pressure regulating valve installation shall be determined by the developer's engineer and shall be 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 City for review. A PRV will be required at the direction of the City.

### **3.2.7 SIZING OF MAINS**

#### **3.2.7.1. 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 headloss 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. No dead-end lines, except lines extending into cul-de-sacs serving not more than 12 single-family residential units will be permitted.

Over sizing 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.



### **3.2.7.2. Transmission Mains**

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

## **3.2.8 SYSTEM LAYOUT**

### **3.2.8.1. General**

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. Under no circumstances should waterlines be installed parallel to and directly below any concrete such as sidewalks, curbs, or gutters. Lines shall normally be located 5 feet north or west of street centerline, or 5 feet north or west of a curbed median, unless otherwise approved, in writing, by the City.

The minimum depth of cover for water mains from the final approved grade of the surface to the top of the water main shall be 5 feet. Where final grades have not been established, mains shall be installed to a depth great enough to ensure 5 feet of cover below the approved future grade. The maximum depth of cover for water mains shall be 6 feet below the final approved grade of the surface unless approved otherwise, in writing, by the City.

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). Upon written approval by the City, 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 18 inches above the crown of the sewer main and, in addition, PVC C-900 is used for the sewer main (refer to section 4.5.4.2 for pressure class and wall thickness). Water mains shall be designed such that they extend the entire frontage of the property to be served or as approved by the City.

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 detail drawing in the Appendix. The steel casing shall extend the entire width of the right-of-way or easement of the crossing structure or as directed by the City. In all cases, valves shall be located such that the water main at such crossings can be completely isolated without interruption of any services.

### **3.2.8.2. Waterline Crossing Over A Sanitary Sewer Line**

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.





**3.2.8.3. Waterline Crossing Over A Storm Sewer Line**

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 City.

**3.2.8.4. Sanitary Sewer Line Crossing 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.

**3.2.8.5. Storm Sewer Line Crossing Over A Waterline**

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.

**3.2.8.6. Limits On Vertical Separation**

Under no circumstances shall the vertical clearance between any lines involving a waterline, sanitary sewerline, or storm sewer be less than 24 inches without written approval from the City.

**3.2.9 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. 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. All easements shall be for the exclusive use of the City of Northglenn. 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.

**UTILITY MAINTENANCE STATEMENT**

All public water, storm sewer and sanitary sewer mains and appurtenances located in public ROW 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.

**3.2.10 FUTURE CONNECTIONS**

A blow-off, in accordance with the detail drawing in the Appendix, 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 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.

**3.2.11 SERVICES**

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. 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. All service lines and meters connected to these will be the same size, unless otherwise approved and/or required by the City. If the tap and meter are of different sizes, the fee shall be paid for the larger, unless a larger tap is approved and/or required by the city in which case the fee for the meter size shall be paid.

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. The following adapters shall be used:

1 ½” meter on 2” line	- 1 pair Ford A67 adapters
1” meter on 2” line	- 1 pair Ford A47 adapters
1” meter on 1 ½” line	- 1 pair Ford A46 adapters
5/8” X ¾” meter on 1” line	- 1 pair Ford A24 adapters
Other sizes	- Contact Public Works Department

Water taps cannot be issued prior to a building and/or tap entitlement approval. Exceptions must be approved by the Public Works Director; i.e., conversion from well water to the City water system.

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. Services shall have a minimum of 5 feet of cover and be laid as shown on the detail drawing in the Appendix.



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 approved by the City.

### **3.2.12 TRANSMISSION MAINS**

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

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 in accordance with the detail drawing in the Appendix. The 2" sizing shown in the detail must be confirmed by an engineer.

All transmission mains shall have blow-off assemblies installed at all low points on the line, constructed in accordance with the detail drawing in the Appendix.

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 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.

### **3.2.13 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.

### **3.2.14 APPURTENANCES**

#### **3.2.14.1. Valves**

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 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. Under no circumstances shall a valve be located in concrete areas other than concrete pavement, such as sidewalks, crosspans, aprons, curbs, or gutters. Valves located on water mains in easements shall be located at the connecting tee, cross, or elbow. Butterfly valve operators shall be located on the north or east side of the water



main. Any valve located in a greenbelt area shall have a 6-inch-wide by 6-inch thick concrete collar around the valve box.

#### **3.2.14.2. Fire Hydrants**

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 unless approved otherwise by the City. 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. If 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. The fire hydrant shall be located within the right-of-way and on the same side of the street as the water main unless otherwise approved by the City. Fences, landscaping, etc., shall in no way hinder the operation of the fire hydrant. In addition, clear distances to the fire hydrant shall be in accordance with Section 3.2.4 of these STANDARDS AND SPECIFICATIONS.

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.

#### **3.2.14.3. 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. 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, Waterlines larger than 12" will must be designed by an engineer and will require approval of the Public Works Director or designee. Refer to the detail drawings in the Appendix.

#### **3.2.14.4. Meters**

All water taps, service lines and meters connected to the meter will normally be the same size, unless otherwise approved and/or required by the City. If the tap and meter are of different sizes, the fee shall be paid for the larger, unless a larger tap is approved and/or required by the city in which case the fee for the meter size shall be paid. Water taps cannot be issued prior to a building and/or tap entitlement approval. Exceptions must be approved by the Public Works Director or designee; i.e., conversion from well water to the City water system.. Public water meter installations inside any buildings are prohibited unless otherwise approved, in writing, by the City. Meters shall be located within publicly owned right-of-ways or easements.

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 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 connections shall be made downstream from the meter and a minimum of five feet from the meter pit or vault.



For any installation where special or unusual conditions might exist, detailed drawings, accompanied by a letter of explanation, shall be submitted to the City for review and approval.

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. The Public Works Department shall be contacted prior to design for meter requirements.

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 approval prior to construction.

There shall be no electrical wiring allowed in any water meter pit or vault unless authorized, in writing, by the City.

Inspections of all residential pits and commercial pits or vaults shall be conducted by the City. Locations and details for commercial pits or vaults shall be reviewed and approved by the City.

All meter sizes for residential, commercial or industrial use shall be determined by a professional engineer registered in the State of Colorado and calculations submitted to the City for review and approval.

#### **3.2.14.5. Fire Protection Service Line**

Valves on newly constructed fire lines shall be located on the tee at the main line. The owner shall maintain all private fire lines beginning at and including this valve. 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. A property requiring a domestic service line and a fire protection service line will have separate taps for each.

#### **3.2.14.6. Valve Vaults**

All valves larger than 24 inches shall be installed in a vault in accordance with the detail drawings in the Appendix. 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.

Vaults shall be made water proof 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 the Appendix.



**3.2.14.7. Manholes**

Manholes shall be installed on all pressure regulating valves, permanent blow-off installations, and air release valves in accordance with the detail drawing in the Appendix.

**3.2.14.8. 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 would result in a higher pressure downstream of the water meter than exists in the main line that could allow backflow or backsiphonage of polluted or contaminated water or other substances from the water user's system. 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. 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.

**3.3. CONSTRUCTION SPECIFICATIONS**

**3.3.1 EXCAVATION, TRENCHING AND BACKFILLING**

Excavation, trenching and backfilling shall be performed in accordance with Chapter 9 of these STANDARDS AND SPECIFICATIONS.

**3.3.2 BEDDING**

Bedding shall conform and be installed in accordance with Chapter 9 of these STANDARDS AND SPECIFICATIONS.

**3.3.3 PIPELINE INSTALLATION**

**3.3.3.1. General**

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. 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.

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.

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.

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.

### **3.3.3.2. Pipe**

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. 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 9 and the detailed drawings in the Appendix.

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, as approved, in writing, by the City.

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 detail drawing in the Appendix.

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.

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.

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.

In addition to the metallic-coated tape mentioned above, 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 in accordance with the detail drawing in the Appendix. The tracer wire shall be tested by the City for continuity prior to acceptance.

### **3.3.3.3. 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.





### **3.3.4 VALVE AND VALVE BOX INSTALLATIONS**

In addition to the jointing requirements mentioned in Section 3.3.3 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. 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 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.

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.

### **3.3.5 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 7 of these STANDARDS AND SPECIFICATIONS

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 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.

### **3.3.6 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.



### 3.3.7 FIRE HYDRANT INSTALLATION

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

- A. The hydrant shall be thoroughly inspected for any defects or damage.
- B. The hydrant interior shall be thoroughly cleaned.
- C. 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.

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.

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. All hydrants shall stand plumb and shall be connected to the street main by a minimum 6-inch lateral line. The fire hydrant base shall be adjusted to not more than 3 inches nor less than 2 inches above the approved finished grade. 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.

Depending upon hydrant location, the use of bollards may be required for protection, as specified by the City. Hydrant gate valves shall have a restrained connection directly to the tee at the main.

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. All other requirements shall be as shown on the detail drawing in the Appendix.



### 3.3.8 TAPS

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

**Table 3.1 - Requires service tap sizes based on the diameter and type of pipe.**

Size of Pipe (Inches)	Ductile Iron				PVC			
	3/4"	1"	1-1/2"	2"	3/4"	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.

All existing AC waterlines shall be tapped using a saddle.

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.

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.

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

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



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

### **3.3.9 METER INSTALLATION**

All meter installations shall be in accordance with the detail drawings in the Appendix.

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

All water meters one inch and larger shall be tested by the City before installation. The contractor shall contact the Public Works Department prior to purchasing meters to verify the type and brands that are required. The contractor shall also contact the Public Works Department to make an appointment for delivery of said meter(s) to the Shop. The location of installation and manufacturers information shall accompany the meter when delivered. The meter will be tested and a schedule set for picking up the meter within two working days by the contractor. In addition, the following specific criteria shall apply:

#### **3.3.9.1. 3/4-Inch and 1-Inch Meter Installations**

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.

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.

No meters shall be set in streets, sidewalks, driveway alignments, or concrete areas without prior approval of the City. Meter pits shall be constructed of modified hi-density polyethylene. The size shall be as specified in the detail drawing in the Appendix. 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 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.

#### **3.3.9.2. 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.



**3.3.9.3. 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.

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

**3.3.10 TESTS**

**3.3.10.1. General**

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. All thrust blocks or other bracing facilities shall be in place at least 48 hours before the initial filling of the line. All tests will be administered by the City.

**3.3.10.2. Filling and Venting Lines**

All existing valves will be operated by the City. 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. 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. The rate of filling the line shall not exceed the venting capacity of the vent.

**3.3.10.3. Pressure Test**

After the pipe and appurtenances have been laid, the line has been backfilled, and all field-place concrete has cured in accordance with Section 3.3.5 of these STANDARDS AND SPECIFICATIONS, 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:

$$L = \frac{ND}{P}$$

and

$$7400$$

Polyvinyl Chlorine Pipe:

L = Allowable Leakage in gallons per hour

N = Total number of joints

D = Nominal diameter of pipe in inches

P = The square root of the average test pressure in PSI



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 in Section 3.3.10.4 of these STANDARDS AND SPECIFICATIONS and retested as described in this section until it meets the test requirements and is accepted by the City.

#### **3.3.10.4. 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.

#### **3.3.10.5. 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.

#### **3.3.10.6. Bacteriological and 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.



### 3.4. MATERIALS

#### 3.4.1 GENERAL

Only polyvinyl chloride PVC is approved for water main installations. Any other material proposed must be approved by the City, in writing, prior to construction. 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 mean the latest edition of the Engineering Standards of the Board of Water Commissioners of Denver, Colorado.

#### 3.4.2 PIPE

##### 3.4.2.1. Ductile Iron Pipe (DIP)

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")
Special Class 51	(4", 20" and 24" diameter)
	(>24" Class as determined by The City)

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.

Pipe shall have normal laying length of either 18 feet or 20 feet. Random lengths are not acceptable.

Iron used in the manufacture of pipe shall have 60/42/10 physicals in accordance with AWWA C-151.

Pipe shall have standard thickness cement mortar linings in accordance with AWWA Standard C-104.



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.

#### **3.4.2.2. Polyvinyl Chloride Pipe (PVC)**

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 (DR25 30" and larger).

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.

Standard laying lengths shall be twenty feet (20') for all sizes. Random lengths shall not be acceptable.

Each length of pipe shall bear the date manufactured, type, grade, length, manufacturer's name, and NSF seal of approval.

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 are strictly prohibited.

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.

#### **3.4.2.3. Steel Pipe**

The use of steel pipe will be restricted to transmission mains 16 inches or larger only. The pipe shall meet AWWA C-200 standards and installed accordingly. Detailed specifications will be approved on a case-by-case basis.

### **3.4.3 FITTINGS**

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

- A. C-104, "Cement Mortar Lining for Cast-Iron and Ductile Iron Pipe and Fittings for Water"
- B. C-153, "Gray Iron and Ductile Iron Fittings"
- C. 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.

### **3.4.4 VALVES**

#### **3.4.4.1. 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.

#### **3.4.4.2. 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 Section 3.3.4 of these STANDARDS AND SPECIFICATIONS.



### **3.4.4.3. Butterfly Valves**

All butterfly valves shall be installed in a vault in accordance with the detail drawings in the Appendix. 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.

### **3.4.4.4. Valve Boxes**

Valve box parts for 3" and larger valves shall be Tyler type, series 6860 conforming with ASTM A48 Class 20A, and made of gray cast-iron, buffalo-type with No. 160 large, oval base. A 5-1/4-inch screw-type shaft shall be adjustable from 45 inches to 60 inches. 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 shall be marked with the word "WATER," and shall have a lip or flange extending into the valve box shaft. 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.

## **3.4.5 FIRE HYDRANTS**

Hydrants will be Mueller Model Super Centurion 250 with the following options:

- A. Bronze to bronze seating.
- B. Oil cup reservoir.
- C. Bronze "safety sleeve" stem coupling.
- D. Bronze operating nut.
- E. Epoxy-coated upper and lower washer assembly.

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.

Fire hydrants shall open right (clockwise). 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. 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. 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.

### **3.4.6 BLOW-OFFS**

Blow-offs shall be fabricated from 2-inch brass pipe with a 2-inch stop and waste on the connecting pipe. The valve shall be iron-bodied bronze mounted with a 2-inch square operating nut complete with valve box. 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.

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 Section 3.4.4 of these STANDARDS AND SPECIFICATION and a manhole meeting the material requirements of Section 3.57.00 of these STANDARDS AND SPECIFICATIONS. This blow-off shall also conform to the detail drawing in the Appendix of this chapter.

### **3.4.7 MANHOLES**

#### **3.4.7.1. General**

Manholes, reducing sections, ladder rungs, and traffic lids shall be precast and conform to ASTM Standard Designation C-478. All traffic lids shall be designed for AASHTO H-20 traffic loading. All ladder rungs or manhole steps shall be cast into the manhole barrel when the manhole barrel is poured unless approved otherwise, in writing, by the City. Concentric reducing sections shall not be used. Concrete extension collars shall be used to adjust the manhole ring and cover to approved street or ground surface elevation. All manholes not within the right-of-way shall have locking lids. All valves in manholes shall be operable from above ground. Concrete used in the manufacturing or construction of manholes shall be a minimum of 4,000 psi concrete in accordance with Chapter 7 of these STANDARDS AND SPECIFICATIONS.

#### **3.4.7.2. Manhole Rings and Covers**

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.

Manhole frame or ring dimensions shall be 24" diameter for manholes and 36" diameter for valve vaults, 8" tall or as otherwise approved.



Cast iron ring and covers shall have a combined weight of not less than 365 pounds.

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 #240568 (water vault only).

#### **3.4.7.3. Manhole Base Slabs and Base Beams**

When required, manhole base beams shall be precast, reinforced concrete. The beams shall be 12 inches wide by 9 inches deep by 8 feet long. The reinforcement shall consist of three No. 5 bars longitudinally and No. 4 bars at 12-inch centers transversely.

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 detail drawings in the Appendix.

#### **3.4.7.4. 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

#### **3.4.7.5. Mortar**

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. Hydrated lime or masonry cement shall not be used. Portland cement shall meet the requirements of ASTM C-250, 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. 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.

### **3.4.8 VAULTS**

All vaults requiring electricity shall have 110/120 volt, watertight outlets and light fixtures. 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:



- A. 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.
- B. Ventilation fans shall be Dayton Model Number 2C889 or 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.
- C. Dehumidifiers shall be EBCO Model 00-200-1 or approved equal rated at 13 pints per 24 hours and designed to run on 115 volts.
- D. Concrete floors shall have 12-inch diameter by 18-inch deep sump holes in the opposite corner from the manhole opening.

The design 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.

### **3.4.9 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.

### **3.4.10 SERVICE CONNECTIONS**

#### **3.4.10.1. 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.

- a. Seamless copper tube designated as "Type K" (soft) in the industry shall be used for service lines 3/4-inch through 2 inches.
- b. Ductile iron pipe conforming to Section 3.4.2.1 of these STANDARDS AND SPECIFICATIONS shall be used for 3-inch service lines and all service lines larger than 4 inches.

#### **3.4.10.2. 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.



### **3.4.10.3. 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.

### **3.4.10.4. Tapping Sleeve and Valve**

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

- a. 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")
- b. 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
- c. Steel Pipe  
Weld on Saddles only. Application specific.  
No coated carbon steel saddles will be allowed.
- d. Tapping Valves  
Resealant 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.

### **3.4.10.5. 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. All corporation stops shall be tested at the factory and shall meet the following minimum physical requirements:

- |    |                         |                    |
|----|-------------------------|--------------------|
| a. | Tensile strength        | 30,000 PSI minimum |
| b. | Yield Strength          | 14,000 PSI minimum |
| c. | Enlongation in 2 inches | 20 percent minimum |

Acceptable corporation stops are:

3/4" Ford: F10003G

McDonald: 6100Q

Mueller: H-15008

Jones: J3401SG

McDonald - Q series compression end

1" Ford: F10004G

McDonald: 6100Q

Mueller: H-15008

Jones: J3401SG

Mueller – 110 compression end

1-1/2" Ford: FB0006G

McDonald: 6100Q

Mueller: H-15013

Jones: J1937SG

Ford – Quick Joint compression end

2" Ford: FB0007G

McDonald: 6100Q

Mueller: H-15013

Jones: J1937SG

**3.4.10.6. Stop and 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.

**3.4.10.7. Compression Couplings**



Compression couplings where allowed shall be either:

Ford: C44

McDonald: 4758-Q

Mueller: H-15403

Jones: J2609SG

### **3.4.11 ENCASEMENT**

#### **3.4.11.1. Concrete**

All concrete shall be a minimum of Class A and shall conform to City standards for Portland cement concrete work as specified in Chapter 7 of these STANDARDS AND SPECIFICATIONS. All concrete encasements shall be a minimum of 6 inches thick from outside of pipe to outside of encasement.

#### **3.4.11.2. Polyethylene Wrap**

Polyethylene encasement material shall be a minimum of 8 mils thick and shall be Scotchrap No. 50 (polyvinyl), or approved equal. 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.

### **3.4.12 METERS**

#### **3.4.12.1. General**

All water meters shall be Badger or 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.

#### **3.4.12.2. Magnetic Drive Displacement-Type Water Meters**

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

#### **3.4.12.3. Compound and Turbine Meters**

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

#### **3.4.12.4. 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.

#### **3.4.12.5. Meter Check Valves**





Swing-check valves shall be manufactured in accordance with AWWA Standard C-508, "Swing-check Valves for Ordinary Waterworks Service". Valves shall be iron body and the disc shall be swing type. 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.

**3.4.12.6. Valves for Use with 1-1/2 Inch and 2 Inch Meters**

Gate 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 Section 3.2.14 of these STANDARDS AND SPECIFICATIONS.

**3.4.12.7. Meter Yokes (Line Setters)**

A yoke is a metal pipe frame attached to the inlet and outlet sides of the meter providing support and conveying water to and from the meter. Meter yokes shall conform to the Denver Water Board Material Specifications. Copper setters 12" x 3/4" w/locking nut, 3/4" conductor compression connection ends;

Acceptable Setters are: Ford V83W-44-33G

McDonald 31-312WXTT33

Mueller H-1474

**3.4.12.8. Valve and Meter Supports**

Meter supports shall be in conformance with the detail drawings in the Appendix.

**3.4.12.9. Meter Pits**

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  $-76^{\circ}$  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.

### **3.4.13 PRESSURE REDUCING VALVE**

All pressure reducing valves shall be Clay-Val or 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.

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. 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. The needle valve shall be all bronze and included with the main valve to control the speed of piston travel.

### **3.4.14 COMBINATION AIR VACUUM /RELEASE VALVES**

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

### **3.4.15 RESTRAINING SYSTEM**

#### **3.4.15.1. 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.

#### **3.4.15.2. Mechanical Joint Restraint**

Mechanical joint restraint can be accomplished by the use of a Megalug restraining system, Uniflange joint restraints, or approved equal. 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. The mechanical joint restraint device shall have a working pressure of at least 250 PSI, with a minimum safety factor of 2:1.



### **3.4.16 CONCRETE REINFORCEMENT**

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

### **3.4.17 BACKFLOW PREVENTION DEVICE**

Backflow prevention devices shall conform to the requirements of AWWA C510 and C511.

### **3.4.18 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. Repair clamp design and make shall be submitted to the City for written approval prior to the installation.



## **CHAPTER 4     SANITARY SEWER SYSTEM**

### **4.1. INTRODUCTION**

All sanitary sewer systems shall comply with the requirements of these STANDARDS AND SPECIFICATIONS and may include special criteria established by the City for overall hydraulics of the sanitary sewer system. Special criteria shall be outlined at pre-design meetings, as determined necessary by the City.

#### **4.1.1 USE OF SANITARY SEWER**

The use of sanitary sewers within the City of Northglenn shall be in accordance with applicable sections in Chapter 16, of the Municipal Code.

### **4.2. DESIGN CRITERIA**

#### **4.2.1 SCOPE**

It is the intent of this "design criteria" section to provide sufficient detailed information to enable the Engineer for the Owner/Developer to correctly and efficiently design the overall sanitary sewer system for a particular development. 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 his representative shall contact the City to get all issues resolved prior to design. Any deviation from these STANDARDS AND SPECIFICATIONS must be approved in writing by the City.

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 criteria 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.



## 4.2.2 GENERAL

The sanitary sewer 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. We are also aware of the provisions of the Municipal Code and Chapter 4 of the City Standards and Specifications of the City of Northglenn.

### 4.2.2.1. Study

The study shall include, as a minimum, the following information and shall be typed and bound in an 8-1/2-inch x 11-inch report binder:

- a. 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.
- b. The area, in acres, which could be served by gravity by the new sewer, shown on a topographic map which delineates the basin boundaries as stated in (G) below.
- c. The estimated population densities and total population based on land use projections to be served by the new sewer.
- d. The estimated quantity and quality of any industrial wastes to be discharged to the system.
- e. Design flow rates, minimum and maximum flow velocities, minimum and maximum pipe slopes, and infiltration allowances.
- f. The impact of the additional flows on the existing sanitary sewer system at all critical points between the proposed site and the major interceptor.
- g. 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.

### **4.2.3 DESIGN FLOW**

The flows used to design the sanitary sewer system for a particular development vary depending on the type of development. There are three general categories of development 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 City Wastewater Treatment Facility Master Plan and the Northglenn Collection System Modeling Report.

### **4.2.4 HYDRAULIC DESIGN/SIZING OF SEWER LINES**

#### **4.2.4.1. General**

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

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.

Oversizing of mains may be required by the City, 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.

The minimum diameter for sanitary sewer service lines shall be 4 inches.



**4.2.4.2. Sanitary Sewer Mains**

- a. The following table gives the minimum and maximum allowable slopes for sanitary sewer mains:

**Table 4.1 - Sanitary Sewer Main Slope Criteria**

Diameter (Inches)	Minimum Slope (Foot/Foot)	Maximum Slope (Foot/Foot)
8	0.00500	0.190
10	0.00500	0.140
12	0.00220	0.110
15	0.00150	0.082
18	0.00120	0.064

Note: 21 inch or larger as approved by the City

- b. 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.

Hydraulic design of pressure sanitary sewers shall be in accordance with chapter 3 of these standard specifications.

**4.2.4.3. Sanitary Sewer Service Lines**

The following table shows the minimum and maximum allowable slopes for sanitary sewer service lines:

**Table 4.2 - Sanitary Sewer Service Slope Criteria**

Diameter (Inches)	Minimum Slope (Foot/Foot)	Maximum Slope (Foot/Foot)
4	.0208	.0800
6	.0104	.0600

**4.2.5 SYSTEM LAYOUT**

**4.2.5.1. General**

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, unless otherwise approved, in writing, by the City. Sanitary sewer mains shall be straight between manholes, both in horizontal and vertical alignment.



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.

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.

Sanitary sewer mains shall be laid a minimum of ten feet horizontally from any existing or proposed utility. Upon written approval by the City, a sanitary sewer main may be laid closer than ten feet to a parallel water main if it is laid in a separate trench and if the elevation of the invert of the water main is at least eighteen inches above the crown of the sewer main and, in addition, polyvinyl chloride pressure pipe is used for the sewer main.

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 the detail drawing in the Appendix. The steel casing shall extend the entire width of the right-of-way or easement of the crossing structure or as directed by the City.

Refer to Section 3.2.8 for minimum vertical clearances for utility crossings.

#### **4.2.6 EASEMENTS**

Utility easements shall be attained in accordance with Section 3.2.9 of these STANDARDS AND SPECIFICATIONS.

#### **4.2.7 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.

#### **4.2.8 SERVICES**

Each structure shall be served by a separate service line. Sanitary sewer service lines shall be located a minimum of ten feet away from all water services (measured horizontally). 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. Typical installations should locate the sanitary sewer service line five feet downstream of the centerline of the lot. Six inch service lines and larger shall require connection to the main with a manhole. Any service line tying into a main line larger than 8" shall also be made in a manhole. Pressure line must be connected to a manhole prior to entering the City's sanitary sewer line.

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

#### **4.2.9 TAPS**





All sanitary sewer service connections to the sanitary sewer main shall be made using "wye" fittings, unless otherwise approved by the City.

#### **4.2.10 UNLAWFUL CONNECTIONS**

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

#### **4.2.11 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 shall install a sewer-monitoring facility in accordance with the Detail Drawing in the Appendix 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 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.

#### **4.2.12 APPURTENANCES**

##### **4.2.12.1. Manholes**

The maximum spacing between manholes shall be four hundred 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 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.

At the termination of a force main, outside drop manholes, or other locations at which hydrogen sulfide gases (H<sub>2</sub>S) is deemed to be a problem, a chemical and or gas resistant manhole lining will be required.



#### **4.2.12.2. Outside Drop Manholes**

Drop manholes will only be allowed when the design engineer proves that alternates are not feasible and when approved, in writing, by the City. Outside drop manholes will be required whenever a sewer entering a manhole is at an elevation twenty-four inches or more above the manhole invert, C-900 piping, and physically constrained connection. Outside drop manholes shall be in accordance with the Detail Drawing in the Appendix.

#### **4.2.12.3. Underdrains**

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

### **4.3. CONSTRUCTION SPECIFICATIONS**

#### **4.3.1 EXCAVATION AND TRENCHING**

Excavation, trenching and backfilling shall be done in accordance with Chapter 9 of these STANDARDS AND SPECIFICATIONS.

#### **4.3.2 BEDDING**

Bedding shall conform and be installed in accordance with Chapter 9 of these STANDARDS AND SPECIFICATIONS.

#### **4.3.3 PIPELINE INSTALLATION**

##### **4.3.3.1. General**

The City shall be notified at least 48 hours in advance of any pipe installation. No sewer main 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, 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 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.

#### **4.3.3.2. 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. The pipe shall then be secured in place by installation of bedding material and backfill, in accordance with Chapter 9 and the detailed drawings in the Appendix.

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.

### **4.3.4 MANHOLE CONSTRUCTION**

#### **4.3.4.1. Cast-in-Place Base**

Manhole bases shall be constructed per ASTM C-478 and C-858 with Class A concrete, placed on undisturbed ground and in conformance with the detail drawing in the Appendix. 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. The floor of the manhole outside of the channel shall be finished to a brushed surface.



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. Wherever grade and alignment permit, the sewer shall be laid continuously through the manhole and the manhole built later. In such cases, the foundation shall be placed as mentioned above and once the manhole is constructed, the upper half of the pipe shall be sawed out and the rough edges smoothed with cement mortar. Breaking out the top of the pipe is not permitted

Where it is not practicable to use split pipe through manholes due to breaks in alignment, grade, or elevation of intersecting sewers, the sewer invert shall be made of concrete deposited between forms. The shape of the invert shall conform to the lower half of the pipe it connects. Side branches shall be constructed with as large a radius of curvature as possible. Inverts shall be plastered with cement mortar and left smooth and clean. Where called for on the plans, a pipe bell shall be stubbed out and plugged. The bell shall be placed as close to the manhole wall as possible, unless showing otherwise on the approved plans.

Reinforcement will be required in all manhole bases. Precast base must be used in all cases except when approved by the Public Works Director or designee. Manholes deeper than 15 feet may require additional reinforcement. Reinforcement shall be approved by the City prior to installation.



#### **4.3.4.2. Precast Base/Inverts**

Precast bases will be allowed by the City and shall be in conformance with this section.

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.

The precast base shall also conform to the requirements of Section 4.43.01 of these STANDARDS AND SPECIFICATIONS.

#### **4.3.4.3. Precast Barrel**

Precast manhole sections shall not be placed on the foundation until it has reached sufficient strength to provide support without damage. 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.

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 4.5.5, and detail SS5 of these STANDARDS AND SPECIFICATIONS.

#### **4.3.4.4. Manhole Grouting Treatment**

The horizontal joints between precast manhole sections shall be plastered and troweled smooth, inside and out, with cement mortar. 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.

All smooth surface pipes, such as PVC or VCP 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 wall shall be filled with cement mortar.

#### **4.3.4.5. 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. 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. 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. 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.

#### **4.3.4.6. Cleanouts**

Cleanouts shall be installed next to the manhole base in conformance with the detail drawing in the Appendix where an underdrain is installed with the sanitary sewer system.

### **4.3.5 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.

### **4.3.6 UNDERDRAINS**

#### **4.3.6.1. General**

Where excessive ground water is encountered, the City will require construction of a piped underdrain, to reduce infiltration. Underdrains shall be daylighted to the nearest suitable point as approved by the City. Cut-off walls may also be required.

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 approved by the City.

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 before the Public Improvements Agreement is approved.

#### **4.3.6.2. System Layout**

Underdrain shall be placed in its own trench approximately 1-1.5 feet below sanitary sewer main, unless otherwise approved by Public Works Director.

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.

#### **4.3.6.3. Materials**

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.



A minimum of 6 inch PVC pipe shall be used for all underdrain mains and services.

Underdrains shall be lined in filter fabric prior to installation only if perforated.

#### **4.3.6.4. Mapping**

As-built mapping and address plats should be provided to the City prior to date of acceptance. All maps must provide adequate details of the underdrain prior to being accepted by the City.

#### **4.3.6.5. Inspections**

Underdrain mains will be thoroughly inspected by the Public Works Director or designee prior to backfill.

Underdrain cleanouts must be located outside of sanitary sewer manholes, as detailed in the Construction Drawings.

Underdrain daylightings shall be placed to avoid being covered by dirt. An engineering drawing of all proposed daylightings shall be submitted prior to City approval.

Public Works Director or designee shall have the authority to halt construction when these specifications or standard construction practices are not adhered to. Whenever any portion of these specifications is violated, the City may order further construction to cease until all deficiencies are corrected.

#### **4.3.6.6. 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.)

Backfill must be placed in lifts not exceeding 12 inches.

#### **4.3.6.7. Compacting Ordinary Backfill**

All trenching, backfilling and compaction of underdrain shall be done in accordance with Chapter 9 of these STANDARDS AND SPECIFICATIONS.

### **4.3.7 PRESSURE SEWERS**

All requirements of Chapter 3 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.



#### **4.3.8 SANITARY SEWER SERVICE LINE CONSTRUCTION**

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

The contractor shall place wyes, stubs, and risers where required by the approved plans. Wyes shall be angled upwards so that the upper invert of a one eighth bend connected to the fitting will have an elevation equal to or higher than the inside crown of the sewer main. 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 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 as-built plans furnished to the City prior to acceptance.

All installation work shall conform to applicable portions of ASTM D-2321 (latest revision) and to the pipe manufacturer's installation instructions. 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.

Trenches shall be kept free of water during laying and jointing. Lines longer than fifty feet shall be laid with batter boards, a laser, or other means approved by the City.

Clean-outs are required at a minimum interval of one hundred 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 shall be extended at least 10' into the property and be plugged with a compression stop.

Backfilling shall be in accordance with Chapter 9 of these STANDARDS AND SPECIFICATIONS.

#### **4.3.9 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 City. 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.

### **4.4. TESTS**

#### **4.4.1 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 City. 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 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 the City shall perform a television 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 City. Alternate testing methods include water infiltration test, deflection test and additional television 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.

#### **4.4.1.1. 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 below:



**Table 4.3 - Minimum allowable minutes for pressure to drop from 3.5 to 3.0 psi**

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.

**4.4.1.2. Deflection Test:**

The maximum vertical deflection for PVC pipe shall not exceed manufacture's recommendations. The City 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 City. 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.



#### **4.4.1.3. 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:

$$L = \frac{ND}{7400} / P$$

L = Allowable Leakage in Gallons Per Hour

N = Number of Joints in Length of Pipeline Tested

D = Nominal Diameter of Pipe in Inches

P = Average Test pressure during the Test, PSIG

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.

#### **4.4.1.4. Manhole Leakage Test**

Manholes shall be tested for leakage separately from the pipe when required. The sewer pipe in the manhole shall be plugged. If the ground water table is below the invert, the manhole shall be filled with water to a depth five feet above the invert. 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.

#### **4.4.1.5. TV Inspection**

The Contractor will perform TV 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 TV inspection, the Contractor shall provide a DVD 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 sufficient to allow for detailed inspection.

#### **4.4.1.5.1**      **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 40GPM 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 reinspected at the contractor's expense.

## **4.5. MATERIALS**

### **4.5.1 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 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 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.



#### 4.5.2 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.

- A. Pipe length varying more than two inches from the specified length. Pipe shall not be ordered in random lengths.
- B. Pipe having a deviation from straight which exceeds the following:  
  
(Length of Pipe in Feet)/(32) = Maximum Deviation in Inches
- C. 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.
- D. Pipe which has been patched or repaired without written approval of the City.
- E. Exposure of the reinforcement.
- F. Pipe damaged during shipment or construction.
- G. Any deficiencies noted in applicable ASTM Specifications

#### 4.5.3 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, may be required by the City prior to final acceptance of the work.

#### 4.5.4 PIPE

##### 4.5.4.1. 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 twenty feet.

**Table 4.4 - 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	0.536

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.

**4.5.4.2. 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 4.5 - 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
15	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 Sections 3.52.02 and 3.53.0 of these STANDARDS AND SPECIFICATIONS.



**4.5.4.3. Reinforced Concrete Pipe (RCP)**

Reinforced concrete pipe in sizes twenty-one inches or larger shall conform to the requirements of the standard specifications for reinforced concrete sewer pipe, ASTM Designation C-76 for Classes II, III, IV, and V and as modified in this Section.

All RCP shall be constructed with Type II modified cement. The absorption of the pipe shall not exceed 5.5 percent of volume.

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.



## 4.5.5 MANHOLES

### 4.5.5.1. General

Manholes, reducing sections, ladder rungs and traffic lids shall be precast and conform to ASTM Standard Designation C-478. All traffic lids shall be designed for AASHTO H-20 traffic loading. All ladder rungs or manhole steps shall be cast into the manhole barrel when the manhole barrel is poured unless approved otherwise, in writing, by the City. Concrete reducing sections shall not be used. Concrete extension collars shall be used to bring the manhole ring and cover up to approved street or ground surface elevation. All manholes not within the right-of-way shall have cast-iron locking lids.

Concrete used in the manufacturing or construction of manholes shall be a minimum of Class A concrete in accordance with Chapter 7 of these STANDARDS AND SPECIFICATIONS.

### 4.5.5.2. Manhole Rings and 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).

### 4.5.5.3. 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 eight inches below bottom of the pipe and 2-inches above the top of the pipe. The minimum reinforcement required in all base slab shall conform to the detail drawings in the Appendix.





**4.5.5.4. Joint Material**

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

**4.5.5.5. Mortar**

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 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. 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.

**4.6. INDUSTRIAL PRETREATMENT DEVICES**

**4.6.1 GENERAL**

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

**4.6.2 GREASE INTERCEPTORS**

**4.6.2.1. General**

The requirements established in the Municipal Code shall apply to facilities subject to the Fats, Oil and Grease (FOG) Sector Control Program established by the City. Non-domestic dischargers where preparation, manufacturing, or processing of food occurs include but are not limited to, restaurants, cafes, fast food outlets, pizza outlets, delicatessens, sandwich shops, coffee shops, schools, nursing homes and other facilities that prepare, service, or otherwise make foodstuff available for consumption. These users shall install and maintain a gravity grease interceptor as directed by the City

All facilities subject to this section must comply with the requirements in the FOG Sector Control Program which includes both the requirement for installation and operation of a grease interceptor and the Best Management Practices.

**4.6.2.2. Control Requirements**

- a. A gravity grease interceptor shall be required when, in the judgment of the City, it is necessary for the proper handling of liquid wastes which may be harmful to, or cause obstruction in the wastewater collection system or cause or contribute to Interference or Pass Through.
- b. It shall be the responsibility of the industrial/commercial user and/or owner of the property, business or industry or an Authorized Representative of the Industrial/Commercial User to contact the City for the purpose of obtaining a plan review.



The plan review shall determine the need, size, location, and other requirements of the interceptor required to control discharges into the Publically Owned Treatment Works (POTW). Written approval from the City must be obtained prior to installation of the interceptor. The review of such plans and operating procedures shall in no way relieve the industrial/commercial user from the responsibility of modifying or replacing such facilities as necessary to produce a discharge acceptable to the City under the provisions of this Article.

- c. The design and sizing of gravity grease interceptors shall be in accordance with the FOG Sector Control Program in this Section. The gravity grease interceptor shall be designed, sized, installed, maintained and operated so as to accomplish their intended purpose of intercepting pollutants from the industrial/commercial user's wastewater and preventing the discharge of such pollutants to the City's wastewater collection system. (worksheet). Minimum size for a grease interceptor is 750 gallons (1000 gallons with a dishwasher).

Sizing of interceptors is determined will be based on the following chart:

Fixture Type:	Quantity:	Fixture Surge Flow Rate (gpm):	Flow (gpm) = Quantity x Fixture Surge Flow Rate:
Single Compartment Sink		20	
Double Compartment Sink		25	
Triple Compartment Sink		30	
Wok Range (1-5 Wok Stations)		15	
Wok Range (5+ Wok Stations)		20	
Dishwasher (0-30 gallons)		15	
Dishwasher (30-50 gallons)		25	
Dishwasher (50-100 gallons)		40	
Other _____			
Total Flow (gpm)			
Loading Factor			
Coffee Shop = 0.5			
Other Users = 1.0			
Retention Time (min)			30
GI Size = Total Flow x Loading Factor x Retention Time			



- d. Bedding for gravity grease interceptors is required. Bedding shall follow a geotechnical engineer's recommendations with an six minimum.
- e. Upon change of ownership or tenant of any existing facility which would be required to have an interceptor under this Section, the applicant for sanitary sewer service shall have the burden to demonstrate that a properly sized and functioning grease interceptor is installed.
- f. Hydromechanical grease interceptors shall not be permitted in lieu of a gravity grease interceptor to comply with the requirements of this Article.
- g. Toilets, urinals and similar fixtures shall not waste through a gravity grease interceptor. Such fixtures shall be plumbed directly into the building sewer and waste system.
- h. All fixtures not equipped with a garbage disposal (garbage grinder) which are connected to a gravity grease interceptor shall be equipped with a fixed or removable mesh or screen which shall catch garbage and food debris and prevent it from entering the gravity grease interceptor.
- i. The industrial/commercial user must ensure interceptors are easily accessible for inspection, cleaning, and removal of FOG.
- j. The industrial/commercial user must maintain interceptors at their expense and keep in efficient operating condition at all times by the regular removal of accumulated FOG.

#### 4.6.3 SAND INTERCEPTORS

##### 4.6.3.1. General

The requirements established in this Section shall apply to facilities subject to the Petroleum, Oil, Grease, and Sand (POGS) Program requirements established by the City. 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 generates sand, petroleum oil, grease or other petroleum product, grit, gravel or other aggregate that may discharge into a wastewater collection system. Access to the wastewater collection system is often via floor drains located inside shop areas that are not limited to non-polluting wastewater sources; such drains must be connected to a sand/oil interceptor and must be approved.

All facilities subject to this section must comply with the requirements in the POGS Sector Control Program which includes both the requirement for installation and operation of a sand/oil interceptor and the Best Management Practices.



**4.6.3.2. General Control Requirements**

- a. A sand/oil interceptor shall be required when, in the judgment of the City, it is necessary for the proper handling of liquid wastes which may be harmful to, or cause obstruction in the wastewater collection system or cause or contribute to Interference or Pass Through.
- b. It shall be the responsibility of the industrial user and owner of the property, business or industry or an authorized representative of the Industrial User to contact the City for the purpose of obtaining a plan review. The plan review shall determine the need, size, location, and other requirements of the interceptor required to control discharges into the POTW. Written approval from the City must be obtained prior to installation of the interceptor. The review of such plans and operating procedures shall in no way relieve the industrial user from the responsibility of modifying such facilities as necessary to produce a discharge acceptable to the City under the provisions of this Article.
- c. The design and sizing of sand/oil interceptors shall be in accordance with the POGS Sector Control Program. The sand/oil interceptor shall be designed, sized, installed, maintained and operated so as to accomplish their intended purpose of intercepting pollutants from the industrial user's wastewater and preventing the discharge of such pollutants to the City's wastewater collection system. City must approve the design, size and location of the sand/oil interceptor.
- d. Bedding for sand/oil interceptors is required. Bedding shall follow a Geotechnical engineer's recommendations with a minimum of six inches below the vault.
- e. Upon change of ownership of any existing facility which would be required to have an interceptor under this Section, the applicant for sanitary sewer service shall have the burden to demonstrate that a properly sized and functioning sand/oil interceptor is installed.
- f. Toilets, urinals and similar fixtures shall not waste through a sand/oil interceptor. Such fixtures shall be plumbed directly into the building sewer and waste system.
- g. The industrial user shall ensure interceptors are easily accessible for inspection, cleaning, and removal of POGS.
- h. The industrial user shall maintain interceptors at their expense and keep in efficient operating condition at all times by the regular removal of POGS.



## **4.7. LIFT STATIONS SPECIFICATIONS**

### **4.7.1 GENERAL**

Lift stations will be allowed only in accordance with City's Standards. In those locations that cannot be served by gravity into the existing City system, the City may approve the construction of a sewage lift station.

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 City requirements. The requirements set forth in this section are minimum requirements and additional requirements may be applied. The City will require that the Developer's engineer and/or contractor prepare the "Application for Site Approval" for the submittal to the Colorado Department of Health and a set of as-built drawings of the sewage lift station in accordance with these Standards and Specifications. The Owner/Developer will be responsible to acquire approval through the applicable agencies and must keep the City involved in the process. Upon completion of the lift station, the Contractor shall also provide the City with four copies of an "Operation and Maintenance Manual" for the lift station. All lift stations must be approved before installation.

Typically new lift stations will be duplex station, where each of the two pumps will be capable of meeting 110% the station design flow. All hardware exposed metal surfaces to sewage or are outside must be 316 stainless steel. Lift stations greater than 100 gallons per minute shall not have submersible pumps. Submersible pumps shall be a grinder pumps and all pumps shall pass a minimum 2 inches diameter solids. 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. All lift stations shall discharge to a manhole prior to gravity flowing to a sewer main. All lift stations have unique sites and/or characteristics requiring review and approval on a case by case basis.



## **CHAPTER 5     STORM SEWER SYSTEM**

### **5.1. INTRODUCTION**

All storm sewer systems shall comply with the requirements of the Urban Drainage and Flood Control District publication known as the *Urban Storm Drainage Criteria Manual, Volumes 1 through 3* and these STANDARDS AND SPECIFICATIONS. Special criteria shall be outlined at pre-design meetings and in the approved construction plans, as determined necessary by the City.

#### **5.1.1 USE OF STORM SEWER**

The use of storm sewers within the City of Northglenn shall be in accordance with the Municipal Code.

### **5.2. DESIGN CRITERIA**

The *Urban Storm Drainage Criteria Manual, Volumes 1 through 3* shall be the design criteria for the analysis and design of storm drainage facilities within the City of Northglenn. All subdivisions, re-subdivisions, planned unit development, 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 the requirements of the *Urban Storm Drainage Criteria Manual, Volumes 1 through 3*.

#### **5.2.1 SCOPE**

It is the intent of this "design criteria" section to provide sufficient detailed information to enable the Engineer for the Owner/Developer to correctly and efficiently design the overall storm sewer system for a particular development. If there is a question or a concern regarding the design of any portion of the storm sewer 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. Any deviation from these STANDARDS AND SPECIFICATIONS must be approved in writing by the City, prior to construction.

#### **5.2.2 GENERAL**

The storm sewer system shall be design 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 *Urban Storm Drainage Criteria Manual, Volumes 1 through 3*, and construction drawings for review and approval 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. We are also aware of the provisions of the Municipal Code and Chapter 5 of the City Standards and Specifications of the City of Northglenn.



### **5.3. SYSTEM LAYOUT**

#### **5.3.1 GENERAL**

All mains shall be installed in dedicated right-of-ways or public easements. Under no circumstances should storm sewer mains be installed parallel to and directly below any concrete such as sidewalks, curbs or gutters. Storm sewer mains shall be straight between manholes, both in horizontal and vertical alignment.

Storm sewer mains shall be laid a minimum of ten feet horizontally from any existing or proposed utility. Upon written approval by the City, a storm sewer main may be laid closer than ten feet to a parallel water main if it is laid in a separate trench and if the elevation of the invert of the water main is at least eighteen inches above the crown of the storm sewer main and, in addition, polyvinyl chloride pressure pipe is used for the storm sewer main.

When the storm 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 the detail drawing in the Appendix. The steel casing shall extend the entire width of the right-of-way or easement of the crossing structure or as directed by the City.

Refer to Section 3.2.8 for minimum vertical clearances for utility crossings.

#### **5.3.2 EASEMENTS**

Utility easements shall be attained in accordance with Section 3.2.9 of these STANDARDS AND SPECIFICATIONS.

#### **5.3.3 UNLAWFUL CONNECTIONS**

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.

### **5.4. CONSTRUCTION SPECIFICATIONS**

#### **5.4.1 EXCAVATION AND TRENCHING**

Excavation, trenching and backfilling shall be done in accordance with Chapter 9 of these STANDARDS AND SPECIFICATIONS.

#### **5.4.2 BEDDING**

Bedding shall conform and be installed in accordance with Chapter 9 of these STANDARDS AND SPECIFICATIONS.

#### **5.4.3 PIPELINE INSTALLATION**

##### **5.4.3.1. General**

The City shall be notified at least 48 hours in advance of any pipe installation. . No storm sewer 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 storm sewer line material. Under no circumstances shall storm sewer 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.

#### **5.4.3.2. 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 and the detailed drawings in the Appendix.

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.

#### 5.4.4 MANHOLE CONSTRUCTION

##### 5.4.4.1. Cast-in-Place Base

Cast-in-Place base shall conform and be installed in accordance with Section 4.3.4.1 of these STANDARDS AND SPECIFICATIONS.

##### 5.4.4.2. Precast Base/Inverts

Pre-cast bases and inverts shall conform and be installed in accordance with Section 4.3.4.2 of these STANDARDS AND SPECIFICATIONS.

##### 5.4.4.3. Precast Barrel

Pre-cast bases and inverts shall conform and be installed in accordance with Section 4.3.4.3 of these STANDARDS AND SPECIFICATIONS.

##### 5.4.4.4. Inlets

Inlets shall be constructed with Class A concrete, placed on undisturbed ground and in conformance with the detail drawings in the Appendix. The top portion of inlets shall be constructed concurrently with the adjacent curb and gutter to ensure proper alignment of grades unless otherwise permitted in writing by the Public Works Director or designee.

##### 5.4.4.5. 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.

##### 5.4.4.6. Adjustment Rings

Adjustment rings shall conform and be installed in accordance with Section 4.3.4.5 of these STANDARDS AND SPECIFICATIONS.



## **5.4.5 CONNECTIONS TO EXISTING MANHOLES**

Storm 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 storm sewer 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.

## **5.5. TESTS**

### **5.5.1 GENERAL**

All storm sewer mains and appurtenances shall be cleaned and tested after backfill 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 storm sewer line until such time as the storm sewer line meets the test specifications. Once the storm sewer line is completed and before a "Release for Service" letter is issued, the City 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.

#### **5.5.1.1. TV Inspection**

Refer to Section 4.4.1.5 for TV Inspection and Cleaning requirements and procedures for storm sewer lines.

## **5.6. MATERIAL SPECIFICATIONS**

### **5.6.1 GENERAL**

Only those pipeline materials described in this section are approved for storm 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 storm 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 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 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.



## 5.6.2 DEFECTS

Pipe shall be free of defects in accordance with Section 4.5.2 of these STANDARDS AND SPECIFICATIONS.

## 5.6.3 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, may be required by the City prior to final acceptance of the work.

## 5.6.4 PIPE

### 5.6.4.1. 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.

### 5.6.4.2. 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 storm sewer system within the right-of-way in the City of Northglenn shall conform to the following specifications:

- a. Pipe – ASTM C76 – Reinforced Concrete Culvert, Storm Drainage and Sewer Pipe for Class II, III, IV, and V.
- b. Joints – ASTM C443 – Joints for Circular Concrete Sewer and Culvert Pipe, using Rubber Gaskets.
- c. O-Ring/Profile Rubber Gaskets – AASHTO M198
- d. All RCP shall be constructed with Type II modified cement. The absorption of the pipe shall not exceed 5.5 percent.
- e. 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.
- f. The following shall be clearly marked on the exterior surface of all pipe with waterproof paint:



- 1) ASTM Specification.
- 2) Class and Size.
- 3) Date of Manufacture.
- 4) Name or Trademark of Manufacturer.

**5.6.4.3. HDPE**

- a. 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.
- b. High Density Polyethylene (HDPE) Corrugated and Smooth Lined Pipe shall be manufactured from virgin PE compounds which conform with the requirements ASTM D 3350.
- c. Minimum Pipe Stiffness shall be in compliance with ASTM F 2306, and tested in accordance with ASTM D 2412.
- d. Installation shall be in accordance with ASTM D 2321.

**5.6.5 MANHOLES**

Manholes, reducing sections, ladder rungs, base slabs, joint material, mortar and traffic lids shall conform with Section 4.5.5 of these STANDARDS AND SPECIFICATIONS.



## **CHAPTER 6     ROADWAY**

### **6.1. INTRODUCTION**

#### **6.1.1 APPLICABILITY**

This chapter contains minimum criteria to be met on all streets and parking lots designed and constructed in the City, both by private land developers and by the City.

#### **6.1.2 VARIANCES**

Where any particular minimum requirements contained in this chapter can be shown to be inappropriate when applied to an “out-of-the-ordinary” situation, variances to said minimum requirements will be considered and may be authorized by the Public Works Director where the proposed variance in minimum requirements will result in a level of safety, service, and quality equal to or greater than that intended by the application of the minimum requirements.

#### **6.1.3 PRIVATE STREET SYSTEMS AND PARKING LOTS**

Private street systems and parking lots shall be subject to all minimum requirements of these STANDARDS AND SPECIFICATIONS except that variances will be allowed subject to the review and approval of the Public Works Director.

#### **6.1.4 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 Public Works Director 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.

### **6.2. ROADWAY DESIGN AND 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, "AASHTO "Green Book" refers to "A Policy on Geometric Design of Highways and Streets" as published by the American Association of State Highway and Transportation Officials (Latest Edition).

#### **6.2.1 REPORTS**

##### **6.2.1.1. Submittal Format**

All reports shall be bound in an 8-1/2" x 11" 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."

**6.2.1.2. Traffic Analysis Report**

All subdivision, Planned Unit Development (PUD), and commercial developments or redevelopments may require a traffic analysis report giving information and details as may be required by the Public Works Director and as specified in Chapter 8 of these STANDARDS AND SPECIFICATIONS.

**6.2.1.3. 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 Chapter 6 of these STANDARDS AND SPECIFICATIONS.

**6.2.1.4. Pavement Evaluation Report**

After installation of the concrete pavement or bituminous surface course except for the final two inches (2") on residential streets, the developer may be required to furnish the Public Works Director with a copy of a report prepared by a Professional Engineer registered in the State of Colorado utilizing non-destructive deflection testing to access 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 past history and knowledge in performing these tests. Qualifications of Professional Engineers shall be submitted to the Public Works Director 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:

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

The report shall evaluate the existing condition of the base and binder course by performance of deflection tests at one-hundred-foot (100') spacing per traffic lane. Spacing will be staggered in each lane. The report shall determine whether or not 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 Public Works Director will evaluate the results of the report and inform the developer of the acceptable solution mentioned in the report.

**6.2.2 LOCAL STREET**



### 6.2.2.1. Local

The City of Northglenn determines the classification of its city streets. For new development and redevelopment, a local street is a general term denoting a roadway designed or operating with the following characteristics:

- a. Posted Speed Limit. Between 25 and 30 miles per hour. Posted or prima facia speeds for the various street classifications are normally five (5) to ten (10) miles per hour less than the design speed of that street.
- b. Traffic Volumes. Less than 2,500 vehicles per day.
- c. Limited Continuity.
- d. Safety. Designed for the safety of pedestrians and bicyclists and the ease of access to adjacent parcels of land.
- e. 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 engineer and the City's Transportation Engineer.
- f. Driveways. Back-out drives permitted.
- g. Function. Local streets provide direct access to adjacent property. Traffic carried by local streets should have an origin or a destination with the neighborhood. Local streets are utilized in single family residential areas. Utility line easements should be available.
- h. Right-of-Way. Sixty feet (60') with detached walk. Attached walks to be used only with written permission from the Public Works Director.
- i. Number of Moving Lanes. Two.
- j. Access Conditions. In accordance with Chapter 8 of these STANDARDS AND SPECIFICATIONS.
- k. Planning Characteristics. Local streets should not intersect major arterial streets.
- l. Type of Curb and Gutter. Six inch (6") combination curb, gutter and walk, with attached walk; six inch (6") vertical with detached walk.
- m. Sidewalk Width. Five foot (5') minimum, attached or detached from curb.
- n. Cul-de-sacs. In accordance with Chapter 6 of these STANDARDS AND SPECIFICATIONS.
- o. Street Widths. Thirty (30') minimum paved width plus two (2) two and a half foot (2.5') curb and gutter pans.

### 6.2.3 COLLECTOR STREET



### **6.2.3.1. Collector**

The City of Northglenn determines the classification of its city streets. For new development and redevelopment, a collector is a general term denoting a roadway designed or operating with the following characteristics:

- a. Posted Speed Limit. Between 25 and 35 miles per hour. Posted or prima facia speeds for the various street classifications are normally five (5) to ten (10) miles per hour less than the design speed of that street.
- b. Traffic Volumes. Generally less than 12,000 vehicles per day.
- c. Continuous. For less than two (2) miles.
- d. Safety. Designed to handle traffic volumes loading from and onto local, other collector, and arterial roadways.
- e. Traffic Control. Regulation of traffic accomplished through the use of stop signs and channelization. Traffic signals normally use only at intersections with major collectors and arterial streets.
- f. Driveways. No back-out drives permitted.
- g. Function. 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.
- h. Right-of-Way Width. Seventy-feet (70') minimum, eighty-foot (80') average.
- i. Number of Moving Lanes. Two (2).
- j. Access Conditions. In accordance with Chapter 8 of these STANDARDS AND SPECIFICATIONS.
- k. Planning Characteristics. 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.
- l. Type of Curb and Gutter. Six (6) inch vertical.
- m. Sidewalk Width. Five feet (5') minimum. Detached from curb.
- n. Street Widths. Thirty seven foot (37') to forty nine foot (49') paved with two (2) two and a half foot (2.5') gutter pans.

## **6.2.4 ARTERIAL STREET**

### **6.2.4.1. Arterial**





The City of Northglenn determines the classification of its city streets. For new development and redevelopment, an arterial street is a general term denoting a roadway designated or operating with the following characteristics:

- a. Posted Speed Limit. Between 40 and 45 miles per hour. Posted or prima facie speeds for the various street classifications are normally five (5) to ten (10) miles per hour less than the design speed of that street.
- b. Traffic Volumes. Twelve thousand (12,000) vehicles and up per day expected minimum traffic volume when the land which the arterial serves is fully developed.
- c. Access. In accordance with Chapter 8 of these STANDARDS AND SPECIFICATIONS.
- d. Continuity. Several miles, generally connecting with inter-city routes.
- e. Traffic Control. 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.
- f. Function. 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.
- g. Right-of-Way Width. One hundred feet (100') minimum.
- h. Number of Moving Lanes. Four (4) minimum.
- i. Planning Characteristics. 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.
- j. Type of Curb and Gutter. Six (6) inch vertical.
- k. Sidewalk Width. Eight-foot (8') minimum, detached from curb, or as required by the Public Works Director.
- l. Street Widths. 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 Public Works Director.

## 6.2.5 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.

**6.2.5.1. Crosspans**

Crosspans shall be constructed in accordance with the detail drawing. Crosspans are not permitted across collector or arterial roadways, nor are they allowed on roadways with storm sewer systems. Double crosspans may be used parallel to collectors or arterial roadways to convey storm runoff across residential roadways. The use of double crosspans 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.

**6.2.5.2. Inlets**

Inlets shall be located to intercept the curb flow at the point curb flow capacity is exceeded by storm runoff. Refer to the UDFCD 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 handicap 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.



**6.2.5.3. 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 UDFCD Criteria Manual (Latest Edition). Sidewalk chase sections shall be constructed in accordance with the detail drawing.

**6.2.5.4. 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 2 of these STANDARDS AND SPECIFICATIONS.

**6.2.6 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.

**6.2.7 SIDEWALKS, CURB AND GUTTERS, RAMPS, AND DRIVEWAYS**

- A. Roadway typical sections shall be as specified by these STANDARDS AND SPECIFICATIONS.
- B. Sidewalks or bicycle paths shall be constructed on both sides of all roadways unless specifically deleted by action of City of Northglenn.
- C. All sidewalks used in conjunction with vertical curb and gutter shall have a minimum width of five feet (5'). Variation from the 5' minimum width must be approved by the Public Works Director.
- D. Combination curb, gutter, and walk are approved for use on local roadways only where right of way restrictions exist and must be approved by the Public Works Director. Vertical curb, gutter, and detached walk shall be used on all other roadways.
- E. State law requires that handicap ramps be installed at all intersections and at certain mid-block locations for all new construction of curb and sidewalk [CRS 43-2-107(2)]. Handicap ramps shall be constructed in accordance with the detail drawings in these STANDARDS AND SPECIFICATIONS. Handicap 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 a handicap ramp, call out the specific detail drawing to construct that ramp. Handicap 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 detail drawings.



- F. Drainage structures shall not be placed in line with handicap ramps. Location of handicap ramps shall take precedence over location of the drainage structure.
- G. 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.
- H. 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.
- I. Curb cuts and driveways shall be constructed in accordance with the detail drawings in these STANDARDS AND SPECIFICATIONS.

#### **6.2.8 CUL-DE-SACS**

The following criteria shall be used for cul-de-sac horizontal geometry:

- A. The minimum property line radius shall be fifty feet (50').
- B. The minimum flowline radius shall be forty feet (40'). See the detail drawing.
- C. 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.

#### **6.2.9 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).

#### **6.2.10 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.

#### **6.2.11 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:

$$L = WS^2 / 60$$

Where:

L = Length of Transition in Feet

W = Width of Offset in Feet

S = Speed Limit or 85th Percentile Speed

The City of Northglenn Public Works Department should be contacted to establish unusual transition criteria. This contact is the responsibility of the applicant.

#### **6.2.12 BARRICADES**

Whenever roadways terminate due to project phasing, subdivision boundaries, etc., barricades are required. 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.

### **6.3. PAVEMENT DESIGN AND TECHNICAL CRITERIA**

#### **6.3.1 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 Chapter 6 of these Standards and Specifications. This pavement design serves as a justification of the roadway structural requirements.

#### **6.3.2 SUBGRADE INVESTIGATION**

All subgrade investigations shall be in accordance with the procedures outlined in the "Manual" with the more specific criteria as follows:

The field investigation shall consist of borings or other suitable methods of sampling subgrade soils to a depth of at least three feet (3') below the proposed subgrade elevation at spacings of not more than two hundred and fifty feet (250') unless otherwise accepted by the Public Works Director. Samples shall be taken after grading is completed and the subgrade is rough cut.



The treatment of expansive soils shall be in accordance with Section 2.3 of the “Manual” unless approved otherwise, in writing, by the Public Works Director.

The “Subgrade Resilient Modulus” (MR) shall be correlated to the Resistance Value (R-value) using the formulas in the “Manual”. 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”.

**6.3.3 PAVEMENT DESIGN CRITERIA**

**6.3.3.1. 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 6.1 lists these minimum thicknesses for each roadway classification.

**Table 6.1 - Minimum Pavement Sections**

	Composite Section <sup>(2)</sup>		Full Depth	Portland Cement <sup>(1)</sup>
	Asphalt	Aggregate Base Course	Asphalt	Concrete
Classification	(Inches)	(Inches)	(Inches)	(Inches)
Cul-de-sac <sup>(3)</sup>	--	--	6.0	6.0
Local	4	8	6.0	6.0
Major Collector	4	8	8.0	7.0
Arterial	6	8	10.0	9.0

(1) Concrete streets are only allowed with specific written approval of the Public Works Director.

(2) “Full Depth Asphalt” is required on all “Public Streets”. Composite sections will only be allowed when specifically approved by the Public Works Director.

(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.

**6.3.4 PAVEMENT DESIGN PROCEDURE**

**6.3.4.1. Flexible Pavements**

Flexible Pavement shall be designed per the “Manual” to meet the required structural number (SN).

**6.3.4.2. Rigid Pavement**

If rigid pavement is allowed by the Public Works Director, the procedures in the “Manual” should be followed.



### **6.3.4.3. Subgrade Investigation and 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:

- a. Vicinity map to locate the investigated area.
- b. Scaled drawings showing the location of borings.
- c. Scaled drawings showing the estimated extent of subgrade soil types and ESAL for each street.
- d. Pavement design alternatives for each street on a scaled drawing.
- e. 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.
- f. R-value test results of each soil type used in the design.
- g. Pavement design nomographs properly drawn to show soil support -- ESAL - SN. A computer printout may be used if the DARWin™ program is used.
- h. Design calculations.
- i. A discussion regarding potential subgrade soil problems including, but not limited to:
- j. Swell or settlement-prone soil.
- k. Frost-susceptible soils.
- l. Ground water.
- m. Drainage considerations (surface and subsurface).
- n. Cold-weather construction (if appropriate).
- o. Other factors or properties which could affect the design or performance of the pavement system.

Recommendations to alleviate or mitigate the problems discussed in Items 1 through 6 above.

## **6.4. STREET CONSTRUCTION STANDARDS**

### **6.4.1 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.

### **6.4.2 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.

### **6.4.3 EXCAVATION AND EMBANKMENT**

#### **6.4.3.1. 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 approved 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 Public Works Director.

#### **6.4.3.2. 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 Public Works Director. The contractor shall be required to replace any materials lost from improper storage methods or damaged by negligence.

#### **6.4.3.3. 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 Public Works Director may require the contractor to furnish written permission from the property owner on whose property the materials will be placed.

#### **6.4.3.4. 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 Public Works Director 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 Public Works Director.

### **6.4.4 SUBGRADE PREPARATION AND GRADING**





#### **6.4.4.1. 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 approved 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 recompacted and brought up to the density as specified in Chapter 9, Trenching, Backfilling and Compaction.

#### **6.4.4.2. 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 Public Works Director 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 Public Works Director. No paving, subbase, or base shall be placed on soft, spongy, or frozen unstable subgrade which is considered unsuitable by the Public Works Director.

The contractor shall, when requested by the Public Works Director, 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.

#### **6.4.4.3. 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.

### **6.4.5 SUBBASE CONSTRUCTION**

#### **6.4.5.1. 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 approved plans.



**6.4.5.2. Placement and 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.

**6.4.5.3. Subbase Surface Tolerance**

The prepared surface of the subbase shall not vary from the approved grade by more than a half inch (1/2").

**6.4.6 BASE CONSTRUCTION**

**6.4.6.1. 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 overly. 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 approved plans or as directed by the Public Works Director.

**6.4.6.2. 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 approved pavement design. The composite base course material shall be free from vegetation and lumps or balls of clay.

**6.4.6.3. Placement and 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 recompactd.

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.

#### **6.4.6.4. Base Surface Tolerance**

The prepared surface of the base shall not vary from the approved grade by more than one-half inch (1/2").

### **6.4.7 BITUMINOUS CONSTRUCTION**

#### **6.4.7.1. Hot Bituminous Pavement**

All pavements shall be hot bituminous pavement of the plant mix type unless otherwise approved in writing by the Public Works Director. 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 approved construction plans or required by the Public Works Director, all materials and construction shall be in accordance with the CDOT Standard Specifications for Road and Bridge Construction (Latest Edition).

#### **6.4.7.2. 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 Public Works Director.

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 Public Works Director.



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.

## **6.4.8 PORTLAND CEMENT CONCRETE PAVEMENT**

### **6.4.8.1. 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 Public Works Director.

### **6.4.8.2. Curing**

Finishing and consolidation shall be performed per CDOT 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.

#### **6.4.8.2.1 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.

**6.4.8.2.2 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 (32° F) unless heated enclosures are provided.

**6.4.8.2.3 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.

**6.4.8.2.4 Waterproof Paper Curing:**

The procedures used for plastic sheet curing shall be used when waterproof paper is used in curing concrete.

**6.4.8.2.5 Insulation Pad:**

Insulation pads or other thermal devices may be used to protect concrete in cold weather.



**6.4.8.2.6 Other:**

Other acceptable curing methods may be used upon review and acceptance by the Public Works Director.

**6.4.8.3. Curing in Cold Weather**

When the air temperatures may be expected to fall below thirty-five degrees Fahrenheit (35° F), the contractor's written, detailed proposal for protecting the concrete must be accepted by the Public Works Director 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 (40° 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 (35° 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 Public Works Director.



**6.4.8.4. Clean-Up**

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.

**6.4.8.5. 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 Public Works Director, 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.

**6.4.8.6. 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 modulus 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.

**6.4.8.7. 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 Public Works Director.



## 6.4.9 APPURTENANT CONCRETE STRUCTURES

### 6.4.9.1. Curb and Gutter Section

The section to be constructed shall be as identified on the approved plans or as shown on the detail drawings.

### 6.4.9.2. Sidewalks

Sidewalks shall be six inches (6") thick and detached or six inches (6") thick and attached and constructed to the dimensions shown on the approved construction plans. All areas of sidewalk that will be crossed by driveways will be constructed with six-inch (6") thick concrete in residential areas and eight-inch (8") thick concrete in commercial areas.

### 6.4.9.3. Crosspans and Curb Return Fillets

Crosspans and curb return fillets shall be constructed eight inches (8") thick with six by six/ten-ten (6x6/10-10) wire mesh. Typical crossspan sections are shown on the detail drawings. Where unusual conditions prevail, additional reinforcing steel and special joints may be required by the Public Works Director.

### 6.4.9.4. Curb Cuts and Driveways

Curb cuts shall be provided at all driveway locations and at additional locations, as shown on the approved plans. Construction of curb cuts shall be as shown on the detail drawings. Spacing will be as shown on the approved plans or as approved by the City Traffic Engineer.

### 6.4.9.5. Curb Ramps

Curb ramps for the handicapped shall be installed at locations designated by the Public Works Director or his designee and at all intersections unless approved otherwise by the Public Works Director. Curb ramps will be constructed as shown on the detail drawings.

### 6.4.9.6. 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 Public Works Director.

### 6.4.9.7. 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.





#### **6.4.9.8. Connections with Existing Concrete Curb, Gutter, and 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.

### **6.5. BRIDGES AND MAJOR DRAINAGE STRUCTURES**

#### **6.5.1 GENERAL**

All culvert pipe, box culverts, and bridges which will ultimately be maintained by the City of Northglenn shall conform to the following:

- A. AASHTO "Standard Specifications for Highway Bridges," latest edition, and applicable interims.
- B. Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction," latest edition.
- C. Colorado Department of Transportation's "Bridge Manual," Volumes I and II.
- D. All structures shall be designed to an HS-20 loading.
- E. All box culverts and bridges shall have the year of construction permanently indented 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 headwall face.
- F. 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.

### **6.6. CONSTRUCTION TRAFFIC CONTROL**

#### **6.6.1 GENERAL**

Traffic control devices shall be maintained in a safe operating condition at all times. The contractor shall provide for approval by the Public Works Director or his designee, a traffic control plan, and shall comply with Chapter 8 of these STANDARDS AND SPECIFICATIONS.

If the Public Works Director finds the construction area to be inadequately barricaded, he has the authority to stop work and direct that corrective measures be taken prior to proceeding with work.

#### **6.6.2 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. Flagmen shall be provided for guidance as necessary.

- A. 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.

- B. 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 Public Works Director.
- C. Unless otherwise authorized by the Public Works Director, pedestrians shall not be channeled to walk on the traveled portion of the roadway.
- D. 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.
- E. Facilities satisfactory to the Public Works Director shall be provided for pedestrian crossing at corners, pedestrian crossovers, and public transportation stops.

### **6.6.3 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 Public Works Director 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 and, thus, the construction traffic control removed without the approval of the Engineering Construction Inspector and the City Traffic Engineer.

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 other 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.



## 6.7. MATERIAL SPECIFICATIONS

### 6.7.1 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 6.2 - 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

### 6.7.2 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 6.3 - 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

### 6.7.3 BITUMINOUS MATERIALS AND PAVEMENTS

#### 6.7.3.1. Prime Coat

Materials shall be in accordance with the requirements of the Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction."

#### 6.7.3.2. Hot Bituminous Pavement

All pavements shall be hot bituminous pavement of the plant mix type unless otherwise approved in writing by the Public Works Director. 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:

- a. 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:
  - 1) 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.
  - 2) 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 PG 64-22.
- b. 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 Public Works Director. The minimum layer thickness shall be 1.5 inches and each layer should be a minimum of two times the maximum aggregate size.



- c. Hot bituminous pavements shall not contain any recycled or reclaimed asphalt pavements (RAP) in the mix.

**6.7.3.3. Tack Coat**

When is specified on the approved plans or required by the Public Works Director, 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.

**6.7.3.4. 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 approved construction plans.

**6.7.3.5. Rejuvenating Agent**

When a rejuvenating agent is specified on the approved construction plans or required by the Public Works Director, 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 approved construction plans or as specified by the Public Works Director.

**6.7.3.6. 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 of these STANDARDS AND SPECIFICATIONS.

**6.7.3.7. 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 Public Works Director.

**6.7.4 PORTLAND CEMENT CONCRETE PAVEMENT -- MATERIALS**

**6.7.4.1. General**

Concrete materials, including fine aggregates, course 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 shall not be used unless prior approval is given by the Public Works Director.

**6.7.4.2. Test Specimens**



The contractor shall furnish the concrete necessary for casting test cylinders. See Table 6.1 for the cylinders test requirements.

**Table 6.4 - 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 Public Works Director 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.

**6.7.5 PORTLAND CEMENT CONCRETE PAVEMENT -- EQUIPMENT**

**6.7.5.1. 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 Public Works Director 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.

**6.7.5.2. 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 Public Works Director. The use of rubber-tired rollers is encouraged.

#### **6.7.5.3. 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 sufficient spacing to maintain stability. The planer shall be of sufficient weight to maintain contact with the forms during planing 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.

#### **6.7.5.4. 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 Public Works Director, 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.

#### **6.7.5.5. 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 as a means to cause concrete to flow or run into position in lieu of placing and shall not be prolonged to the point where segregation occurs.

#### **6.7.5.6. 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 screeding 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.

#### **6.7.5.7. 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 be maintained at the site of the work at all times 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.

### **6.7.6 PORTLAND CEMENT CONCRETE PAVING -- MIXING**

#### **6.7.6.1. 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 Public Works Director.

#### **6.7.6.2. 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.

#### **6.7.6.3. 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 Public Works Director.) Batch tickets shall provide the following information:

- a. Weight and type of cement
- b. Weights of fine and coarse aggregates
- c. Volume (in gallons) of water, including surface water on aggregates
- d. Quantity (cubic yards) per batch



- e. Times of batching and discharging of concrete
- f. Name of batch plant
- g. Name of contractor
- h. Type of mixture (mix designations code)
- i. Name and amount of admixture
- j. Date and truck number

**6.7.6.4. Mixing Proportions of Concrete Materials**

Proportioning shall conform to the requirements set forth in for the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction (Latest Edition).

**6.7.6.5. Limitations of Mixing**

Concrete shall be mixed, placed, and finished only when the natural light is sufficient unless an adequate and approved artificial lighting system is provided. Unless authorized in writing by the Public Works Director, 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 Public Works Director, 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 (70° 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.



## **CHAPTER 7    CONCRETE**

### **7.1. INTRODUCTION**

#### **7.1.1 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 Chapter 6 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.

#### **7.1.2 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 6 - Roadway. Design specifications for concrete pipe, manholes, inlets, and other drainage and wastewater concrete structures are in Chapter 3 - Water System, Chapter 4 - Sanitary Sewer and Chapter 5 - Storm Sewer. Design specification relative to traffic signals and traffic control items is in Chapter 8 - Traffic Control.

### **7.2. PLACING CONCRETE**

#### **7.2.1 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 Public Works Director. 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 6 – Roadway.

#### **7.2.2 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. Retempered concrete will not be allowed.



### **7.2.3 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.

### **7.2.4 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 Public Works Director. Delays in excess of thirty (30) minutes may require removal and replacement of that pour, as determined by the Public Works Director.

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 Public Works Director 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 backup vibrator must be onsite.

### **7.2.5 WORKABILITY**

The consistency of concrete shall be kept uniform for each class of work and shall be checked by means of a slump tests. The workability of the concrete will be varied as directed by the Public Works Director. 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 PUBLIC WORKS DIRECTOR** 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.

## 7.2.6 WEATHER RESTRICTIONS

### 7.2.6.1. 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).

### 7.2.6.2. 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 Public Works Director.

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 7.1 - Concrete placement Temperature Protection Requirements**

Forecast Low Temperature (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.

## 7.2.7 JOINTING

### 7.2.7.1. Expansion Joints:

Expansion joint material shall be provided at the following locations and shall be in place prior to the placing of concrete:

- a. Between new concrete and existing masonry buildings
- b. As shown on the drawings
- c. As directed by the Public Works Director

### 7.2.7.2. 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:

- a. Not more than ten feet (10') nor less than six feet (6') apart in curb and gutter and combination curb-walk.
- b. Not more than the walk width in non-monolithic concrete sidewalk.
- c. At least two joints equally spaced at not greater than ten-foot (10') intervals as applicable in driveways.
- d. As approved and shown on the plans for special concrete structures.

## 7.2.8 FINISHING AND 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 Public Works Director. 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 surfaces 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 Public Works Director. 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 Public Works Director.

**7.2.8.1. 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.

**7.2.8.2. 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.

**7.2.8.3. Waterproof Paper Curing:**

The procedures used for plastic sheet curing shall be used when waterproof paper is used in curing concrete.

**7.2.8.4. 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.



**7.2.8.5. 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.

**7.2.9 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 Chapter 5 of these STANDARDS AND SPECIFICATIONS.

The contractor shall furnish the concrete necessary for casting test cylinders. See Table 7.2 for the cylinders test requirements.





**Table 7.2 - 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 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

The degree and frequencies of all concrete testing beyond normal specified frequencies, if necessary to assure quality control, shall be determined by the Public Works Director at the time of concrete construction. All concrete testing necessary shall be paid for by the Contractor/ Developer.

**7.2.10 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 Public Works Director 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 Public Works Director. 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 Public Works Director before the repair filling is placed.

Bolt holes, tie-rod holes, and minor imperfections as approved by the Public Works Director 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 Public Works Director 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 Public Works Director, 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.

### **7.3. MATERIAL SPECIFICATIONS**

#### **7.3.1 CONCRETE MIX DESIGN**

Concrete shall be classed according to the Colorado Department of Transportation's Standard Specifications for Road and Bridge Construction (Latest Edition).

#### **7.3.2 CONCRETE MATERIALS**

Concrete shall be composed of Portland cement and aggregate and water and shall be reinforced with steel bars, steel strands, or steel-wire fabric where required. All concrete and steel components shall conform to the requirements of the Colorado Department's of Transportation's Standard Specifications for Road and Bridge Construction (Latest Edition). No admixture other than air-entraining agents shall be used without written permission of the Public Works Director.

#### **7.3.3 CURING MATERIALS**

Curing materials shall conform to the applicable section of the AASHTO standards (Latest Edition). Straw used for curing shall consist of threshed straw of oats, barley, wheat, or rye. Clean field or marsh hay may be substituted when approved by the Public Works Director. Old dry straw or hay which breaks readily in the spreading process will not be permitted.



#### **7.3.4 FORM WORK**

Whenever necessary, forms shall be used to confine the concrete and shape it to the required lines. Forms shall have sufficient strength to withstand, without deformation, the pressure resulting from placement and vibration of the concrete. Forms shall be constructed so that the finished concrete will conform to the shapes, lines, grades, and dimensions indicated on the approved plans. Any form which is not clean and has not had the surface prepared with a commercial form oil that will effectively prevent bonding and that will stain or soften concrete surfaces shall not be used. Plywood forms, plastic coated plywood forms, or steel forms shall be used for all surfaces requiring forming which are exposed to view, whether inside or outside any structure. Surfaces against backfilled earth, interior surfaces, of covered channels, or other places permanently obscured from view may be formed with forms having substandard surfaces.

Forms shall not be disturbed until the concrete has hardened sufficiently to permit their removal without damaging the concrete or until the forms are not required to protect the concrete from mechanical damage. Minimum time before removal of forms after placing concrete shall be one (1) day for footings and two (2) days for all other concrete except curbs, gutters, and sidewalks.

#### **7.3.5 JOINTING MATERIAL**

Joint materials, according to type, will conform to the applicable AASHTO specifications (Latest Edition).

#### **7.3.6 BATCHING AND MIXING**

##### **7.3.6.1. General**

All concrete shall be thoroughly mixed in a batch mixer of an approved type and capacity for a period of not less than two (2) minutes after all the materials, including the water, have been placed in the drum. During the period of mixing, the drum shall be operated at the speed specified by the manufacturer of the equipment. The entire contents of the mixer shall be discharged before recharge, and the mixer shall be cleaned frequently. The concrete shall be mixed only in such quantities that are required for immediate use. No retempering of concrete will be permitted. Hand-mixed concrete will not be permitted except by written approval of the Public Works Director and then in only very small quantities or in case of an emergency.

##### **7.3.6.2. Proportioning the Mix**

Proportioning the dry constituents of all concrete mixtures shall be accomplished by weighing. The supplier shall provide adequate and accurate scales for this work. There shall be no variance permitted in the minimum cement factor (sacks per cubic yard) as specified for the classes of concrete. The total quantity of mixing water per sack of cement, including free water in the aggregate, shall not exceed the minimum specified herein. The supplier shall be responsible for developing the proper proportions of aggregates, cement, and water that will conform to the various requirements of these STANDARDS AND SPECIFICATIONS.



**7.3.6.3. 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 shall conform to all requirements of these STANDARDS AND SPECIFICATIONS and applicable ASTM standards (Latest Edition).

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 shall collect delivery or batch tickets from the driver for all concrete used on the project and deliver them to the Public Works Director or his designee. Batch tickets shall provide the following information:

- a. Supplier's name and date
- b. Truck number
- c. Project number and location
- d. Concrete class designation
- e. Cubic yards batched
- f. Time batched
- g. DOH mix design number
- h. Type, brand, and amount of cement and fly ash
- i. Brand and amount of any admixture
- j. Weights of fine and coarse aggregates
- k. Moisture content of fine and coarse aggregates
- l. Gallons of batch water (including ice)
- m. Gallons of water added by truck operator.

Provide the following titles with blank space to record information:

- 1) Discharge time
- 2) Water-cement ratio
- 3) Air content



## **CHAPTER 8     TRAFFIC CONTROL**

### **8.1. INTRODUCTION**

#### **8.1.1 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 adequate, coordinated, modern development 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 which are not constrained by already existing improvements. This chapter is not to be applied without qualification to in-fill development. In-fill development in an urban area is often constrained by existing improvements. To the extent deemed possible by the City, in-fill developments shall be required to conform to these STANDARDS AND SPECIFICATIONS. The City may allow modification of these STANDARDS AND SPECIFICATIONS when necessary to allow private and public construction which is compatible with surrounding in-place improvements.

#### **8.1.2 GLOSSARY OF TERMS**

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.

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.

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 main stream 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.

Divided Highway -- A highway with separated roadways for traffic in opposite directions, such separation being indicated by depressed dividing strips, raised curbing, traffic islands, other physical separations, or by standard pavement markings and other traffic control devices.

Fire Trucks -- Must be considered as a WB40 truck with a minimum forty-five-foot (45') radius for design purposes.

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.

Grade -- Rate or percent of slope, either ascending or descending from or along the highway. It is usually measured along the centerline of the highway or access.

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.



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.

MUTCD -- Manual on Uniform Traffic Control Devices and the Colorado Supplement.

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.

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.

## **8.2. DESIGN STANDARDS**

### **8.2.1 RESPONSIBILITIES FOR TRAFFIC STUDIES**

Traffic studies may be required by the City in order 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.

Unless waived by the Public Works Director, a written study meeting the criteria contained in this chapter shall be required for a development proposal when trip generation during the AM or PM peak hour is expected to exceed one hundred (100) vehicles, as determined by the Public Works Director. 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 Public Works Director 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 approved by the Public Works Director before acceptance. The following submittals may require traffic studies:



- A. A rezoning application or an application for annexation into the City.
- B. 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 fifteen percent (15%) compared to trip generation estimates made for the traffic study at the time of rezoning.
- C. 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.
- D. 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 fifteen percent (15%), or the land use is changed so that trip generation is increased by more than fifteen percent (15%).

All previous traffic studies relating to the development that are more than two (2) years old shall be updated, unless the Public Works Director 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 Public Works Director 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.

## **8.2.2 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.

### **8.2.2.1. Introduction:**

The introduction portion of the report must contain the following:

- a. 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.”





- b. 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 Public Works Director. A vicinity map that shows the site and the study area boundaries in relation to the surrounding transportation system shall be included.
- c. 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.
- d. 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.
- e. 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.

**8.2.2.2. Trip Generation and 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. In the event that 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:



- a. Peak hour trip generation rates as published in the ITE Trip Generation Summary or other applicable sources.
- b. Traffic volume counts for similar existing uses if no published rates are available.
- c. Additional sources from other jurisdictions, if acceptable to the Public Works Director.

Use of reduction factors to account for passerby traffic may be considered upon approval of the Public Works Director. Internal trip reductions and modal split assumptions will require analytical support to demonstrate how the figures were derived and will require approval by the Public Works Director.

**8.2.2.3. 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.

**8.2.2.4. 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 Public Works Director. 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.

**8.2.2.5. Existing and Project Traffic Volumes:**

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

- a. A.M. peak-hour site traffic (in and out), including turning movements.
- b. P.M. peak-hour site traffic (in and out), including turning movements.
- c. 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 twenty (20) year projections or build-out, whichever is specified by the Public Works Director.
- d. 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 twenty (20) year



- projections or build-out, whichever is specified by the Public Works Director.
- e. 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.
  - f. Actual counts of existing total daily traffic for the street system in the study area at the time the study is being prepared.
  - g. 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 obtained in Item 6 above. 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.
  - h. Projected total daily traffic for the street system in the study area based on traffic from the proposed development, counts of existing daily traffic obtained in Item 6 above, traffic projections based on build-out of land use within the study area, or a twenty (20) year projection, whichever is specified by the Public Works Director.

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 Public Works Director or, alternatively, a method for determining these volumes will be recommended by the Public Works Director. 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.

**8.2.2.6. 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 twenty (20) years following construction and include volumes generated by build-out of the study area or a twenty (20) year projection in background traffic, whichever is specified by the Public Works Director. 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.

#### **8.2.2.7. 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 twenty- (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.

#### **8.2.2.8. 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 fifty percent (50%) 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 sixty percent (60%) mainline, forty percent (40%) 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 ban 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.

**8.2.2.9. Traffic Accidents:**

Traffic accident data for affected street corridors may be required for the study. The study period will normally be three (3) years. Such locations will be specified by the Public Works Director. 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.

**8.2.2.10. 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 Fundamentals and Abatement of Highway Traffic Noise Textbook, FHWA, September 1980.

**8.2.2.11. 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 future roads and laneages in an analysis will require approval from the Public Works Director. In general, the recommendation section should include:

- a. 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.
- b. 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.
- c. 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.

**8.2.2.12. Revisions to Traffic Study:**

Revisions to the traffic study shall be provided as required by the Public Works Director. 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.

**8.2.2.13. Summary of Typical Study Contents**

- a. 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)
- b. Trip Generation and Design Hour Volumes (provide table)
- c. Trip Distribution (provide figure)
- d. Trip Assignment (provide figure)
- e. 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
- f. Level of Service
- g. Capacity Analysis (provide analysis sheets in appendices)
- h. Traffic Signals (provide analysis sheets in appendices)
- i. Traffic Accidents (optional) (provide collision diagrams and accident rates)
- j. Noise Attenuation
- k. Conclusions
- l. Recommendations:
  - 1) Proposed Recommended Improvements (provide sketches of improvements)
  - 2) Volume/Capacity Analysis at Critical Points (provide analysis sheets in appendices)
  - 3) Traffic Volume Proportions

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

## 8.2.3 ACCESS REQUIREMENTS AND CRITERIA

### 8.2.3.1 General

New access to City streets and roadways is approved through one of the two mechanisms:

- a. For new developments, access is granted through the Planning Commission approval of the Final Development Plan; Planned Unit Development (PUD) or subdivision plat.
- b. To obtain access to City streets from existing developed property, the mechanism is dependent upon zoning.

For property classified as a standard zoning district (other than Planned Unit Development), 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 Unit Developments, new or altered access shall be obtained through the Planned Unit Development (PUD) amendment process. This involves applying through the Planning and Development Department for an amendment to the appropriate PUD. 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.



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.

**8.2.3.2. State Highways**

- a. Access to state highways is governed by the State Highway Access Code.
- b. The City of Northglenn has delegated its authority to administer the State Highway Access Code to the Colorado Department of Transportation who is, therefore, responsible for the review of issuance of access permits to State Highways in the City of Northglenn.

**8.2.3.3. Arterials**

- a. A right of way permit shall be obtained from the Public Works Department for any public or private access constructed in the City's Right of Way.
- b. Private, direct access to arterials shall be permitted only:
  - 1) When the property in question has no other reasonable access to the general street system; or
  - 2) 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.
- c. When direct private access must be provided, the following shall be considered:
  - 1) 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.
  - 2) 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 highway and is necessary to the safe and efficient use of the property.
  - 3) 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.
- d. 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.
  - e. Spacing and Signalization:
    - 1) 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'), in order to achieve good speed, capacity, and optional signal progression.
    - 2) 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.

#### **8.2.3.4. Collectors**

Private access to collectors shall be governed by the following 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).

#### **8.2.3.5. Local Streets**

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).

#### **8.2.3.6. Basic Principles for Curb Openings and Driveways**

Certain control values for curb openings and driveways require minimum dimensions in some instances and maximum values for other dimensions. The design of curb openings and driveways within the range of these 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.

The opening or driveway width should be adequate to handle properly 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.

To the greatest extent possible, 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.

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.

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.

#### **8.2.3.7. Definition of Terms**

Several terms are used herein which have a somewhat distinct meaning. For the purpose of clarity, the definition of some of these terms are listed below:

- a. Width of Curb Opening (W) -- The width of curb opening measured at the curb line.
- b. 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.
- c. 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 opening.
- d. Distance Between Double Drives (D) -- The distance measured along the curb line between the inside edges of two adjacent curb openings.
- e. 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.
- f. 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.
- g. Residential -- Property used primarily for residential purposes such as single-family, two-family, and multi-family units.
    - 1) Single-Family (SF) Residential: Single, detached family dwelling units, double bungalows, or duplexes.
    - 2) Multi-Family (MF) Residential: Three or more attached dwelling units including townhouses, condominiums, and apartments.
  - h. Commercial -- Establishments where the buying and selling of commodities, entertainment, or services is carried on, excluding service stations. Included are such uses as office buildings, restaurants, hotels, motels, banks, grocery stores, theaters, parking lots, trailer courts, and public buildings.
  - i. 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.
  - j. Industrial or Warehouse -- Any establishment that manufactures or stores an article or product.
  - k. Radius Curb Returns -- 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.

### **8.2.3.8. General Requirements**

#### **8.2.3.8.1 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 Public Works Director'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.

**8.2.3.9. 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 curb openings.

**8.2.3.10. 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).

**8.2.3.11. 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.



**8.2.3.12. 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.

**8.2.4 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.

**8.2.4.1. Width of Curb Opening (W)**

The total width of curb opening for properties on various function street classifications shall be in conformance with the detail drawings in Chapter 5 of these STANDARDS AND SPECIFICATIONS.

Curb openings of thirty-five feet (35') or more shall be constructed as radius curb returns.

**8.2.4.1.1 Residential.**

No edge clearance is required for residential access. However, the drive shall not extend beyond the property line extended.

**8.2.4.1.2 Commercial.**

Access onto an Arterial -- 75 Feet Minimum

Access onto a Local -- 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.

**8.2.4.1.3 Service Stations.**

Access onto an Arterial -- 5 Feet Minimum

Access onto a Local -- 5 Feet Minimum

**8.2.4.2. 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.



**8.2.4.3. Sight Distance:**

Sight distance for curb openings to private property shall be in accordance with Chapter 5 of these STANDARDS AND SPECIFICATIONS.

**8.3. STREET LIGHTING**

**8.3.1 STREET LIGHTING PROCEDURE**

The developer 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 Public Works Director 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.

**8.4. PARKING**

**8.4.1 PARKING**

Parking layout dimensions are provided in the Municipal Code. Other angled parking layouts meeting the approval of the Public Works Director will be permitted where possible.

**8.4.2 MAXIMUM ALLOWABLE GRADES PERMITTED IN PARKING LOTS**

Maximum grades permitted in parking lots must not exceed eight percent (8%).

**8.4.3 HANDICAPPED PARKING POSTING**

In general, each handicapped parking stall should be between twelve feet (12') and fourteen feet (14') in width, must have a stall depth of at least eighteen feet (18'), and be located near buildings and handicap ramps. However, handicap parking design must conform to the latest Americans with Disabilities Act guidelines. A handicapped parking space will be required to be identified by an official "Handicapped Reserve Parking" (Manual on Uniform Traffic Control Devices, R7-8) sign with the handicapped person logo.

In order for handicapped parking spaces to function as intended, they will be required to be designed and signed in a uniform manner to allow for a clear understanding of the parking zone and to make enforcement possible. Signing of one, two, or three spaces for handicapped parking spaces must be done by using one sign for each space placed at the center of each end line.

**8.4.4 PARKING STRUCTURES**

For design details and optimum layout of parking structures, reference to Parking Garage Planning and Operation, by the Eno Foundation for Transportation, Inc., (Latest Edition), or the Urban Land Institute Standards is recommended. The City will evaluate designs for such structures on an individual case basis.



## 8.5. CONSTRUCTION STANDARDS

### 8.5.1 TRAFFIC SIGNALS

#### 8.5.1.1. General Requirements

The work specified in this section describes the installation of necessary material and equipment to complete traffic signals and/or other electrical systems as specified on the drawings, in the special contract provisions, or herein.

#### 8.5.1.2. Traffic Control and Street Closure

The contractor will be required to maintain access to all private drives throughout the period of construction for this project. The contractor shall be required to erect and maintain all barricades, traffic control signs, cones, and other traffic control items necessary to provide proper traffic control during construction. The contractor shall submit three (3) copies of the traffic control plan to the Public Works Director for approval 72 hours prior to beginning construction. At the completion of the project the contractor shall remove all barricades, traffic control signs, cones and other necessary construction traffic control items and return all areas or permanent traffic control devices damaged during construction to their original condition at no cost to the City. Traffic control signs and devices shall be in accordance with "Manual on Uniform Traffic Control Devices for Streets and Highways", Latest Edition, published by the Federal Highway Administration, and as directed by the Engineer.

#### 8.5.1.3. Testing

The City may at its option and cost retain the services of an independent testing lab to perform all testing consultation and to assist in the review of the work and equipment.

#### 8.5.1.4. Intersection Power

The contractor shall notify the engineer three (3) weeks prior to the signal turn-on so that orders may be issued for power connection to the intersection on the specified turn-on date.

#### 8.5.1.5. Equipment Salvage

All traffic signal equipment that is deemed salvageable by the City 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 Public Works Department.

#### 8.5.1.6. Existing Traffic Signals

When existing traffic signal installations are modified or completely rebuilt, the contractor shall avoid disturbing existing traffic signal equipment until the new or modified traffic signal system has been installed and put into operation. If the existing traffic signal equipment must be removed to accommodate the new construction, the contractor shall, with the engineer's approval and at the contractor's sole expense, install temporary overhead traffic signal equipment. The contractor shall at all times maintain a



minimum of two (2) three-section (red, yellow, and green) traffic signal heads for each roadway approach.

**8.5.1.7. Signal Heads**

Signal heads installed on standards or poles at new signal locations which are not ready for actual electrical operation shall be bagged.

**8.5.1.8. Field Location**

All loops, poles, control cabinets, pull box locations, and pole foundations shall be field located by the engineer. Traffic signal poles and mast arms shall not be ordered until field verification of pole foundations is complete.

**8.5.1.9. Utilities**

All utilities shall be shown on the maps to the extent that they can, based upon utility records, surface field indications and proposed installations. During the progress of the work, all utility locations and elevations will necessarily require field verification in cooperation with the affected companies and public agencies. The contractor shall be responsible for locating all valve boxes, manholes, etc., and insuring that they are properly protected and/or adjusted.

**8.5.1.10. Notification of Work**

The contractor shall work only on weekdays as set forth in approved Right of Way permits. The contractor must receive written approval from the engineer to work at any other time.

**8.5.1.11. Regulations and 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 mean the code, rule, or standard that is in effect at the date of bidding.

**8.5.1.12. Equipment list and Drawings**

The contractor shall submit a list of equipment and material which he proposes to furnish within five days of the execution of the owner-contractor agreement. The submittal shall include all equipment and material as identified on the plans or in the specifications by the manufacturer's name which is necessary or customary in the trade to identify such equipment and material. The list shall be complete as to name of manufacturer, unit size,





material composition and shall be supplemented by such other data as may be required by the Public Works Director.

Inspection or sampling of any materials, other than those already approved, according to the material specifications must be made by the engineer or his designee prior to installation. If the contractor proposes a substitution of equipment called for in the plans or specifications, he shall provide additional information to prove the substitution item is of equal or superior quality. Any material and/or equipment installed by the contractor that is not in conformance with the City of Northglenn specifications will be removed or changed at the contractor's expense. Upon completion of the work, the contractor shall submit an "as-built" or corrected plan showing, in detail, all construction changes including, but not limited to, wiring, cable, and location and depth of conduit.

#### **8.5.1.13. Excavating and Backfill**

Excavations for the installation of conduit, foundations, and other traffic signal items shall be performed in such a manner as to cause the least possible injury to the streets, sidewalks, and other improvements. The trenches shall not be excavated wider than necessary for the proper installation of the electrical appliances and foundations. Excavating shall not be performed until immediately before installation of conduit and other appliances. The material from the excavation shall be removed as the trenching progresses.

Trenches in existing or proposed roadways shall be backfilled with concrete or approved flow-fill material. After backfilling all trenches shall be kept well filled and maintained in a smooth and well-drained condition until permanent repairs are made.

Excavations in streets or highways shall be performed in such a manner that one (1) lane of traffic in each direction shall be open to public traffic. All lane closures shall be approved by engineer prior to closure. At the end of each day's work and any other time construction operations are suspended, all construction equipment and other obstructions shall be removed from that portion of the roadway open for use by public traffic.

When excavations must remain open overnight, they shall be properly marked to warn motorists and/or pedestrians according to guidelines established in the "Manual on Uniform Traffic Control Devices for Streets and Highways" latest edition.

#### **8.5.1.14. Removing and Replacing Improvements**

The contractor shall at his sole expense, replace or reconstruct sidewalks, curbs, gutters, rigid or flexible pavement, and any other City or privately owned property which is removed, broken, or damaged by him with material which conforms to current City STANDARDS AND SPECIFICATIONS. Whenever a part of a square or slab or existing concrete, sidewalk, or driveway is broken or damaged, the entire square or slab shall be removed and the concrete reconstructed as above specified.

The outline of all areas to be removed in Portland cement concrete sidewalks and in pavements shall be cut to a minimum depth of one-and-one-half inches (1-1/2") with an abrasive type saw prior to removing the sidewalk and pavement material. Cut for remainder of the required depth may be made by a method satisfactory to the engineer. Cuts shall be neat and true with no shatter outside the removal area.



## 8.5.2 UNDERGROUND FACILITIES

### 8.5.2.1. Foundations

- a. All foundations shall be Portland cement concrete conforming to the applicable requirements of construction specifications of the City of Northglenn, except as herein provided.
- b. 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.
- c. 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 engineer. 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.
- d. 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.
- e. 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.
- f. 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.

### 8.5.2.2. Conduit

- a. 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.
- b. All trenches excavated in roadways, including new construction areas, shall be backfilled with concrete or State of Colorado approved flow fill, and capped with six inches (6") of Grade E Asphaltic Pavement.
- c. Table 8.1 includes the conduit schedule.

**Table 8.1 - Conduit Schedule**

Run Type	Quantity	Size (Inches)	Use
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Street Crossings	1	3	120 voltage
Street Crossings	1	2	Low voltage
Street Crossings	1	2	Xcel use
Signal Pole	1	3	Signal cables
Signal Pole	1	2	Xcel use
Controller Cabinet	2	3	120 voltage
Controller Cabinet	2	2	Low voltage
Interconnect	1	2	Interconnect
Service Point	1	2	Xcel use

- d. The contractor, at his sole expense, may use larger conduit if desired. Where larger conduit is used, it shall be for the entire length of the run from outlet. No reducing couplings will be permitted underground.
- e. 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.
- f. 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.
- g. 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.
- h. 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.

- i. 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 to 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.
- j. Conduit shall always enter a foundation, pull box, or any other type structure from the direction of the run only.
- k. Conduits terminating in a pole shall extend approximately two inches (2") vertically above the foundation.
- l. 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.
- m. Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel or blown out with compressed air.
- n. Install a #12 locate wire inside the conduit throughout the length of the installation
- o. New conduit runs shown on the plans are for bidding purposes only and may be changed with approval of the engineer. The City may request the installation of spare conduits.

#### **8.5.2.3. Pull Boxes**

- a. 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 engineer. The contractor may install, at his own expense, any additional pull box that he may desire to facilitate the work.
- b. Special pull boxes which are required shall be fabricated and installed in general conformance with the size and details shown on standard drawings.
- c. 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.

- d. 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.
- e. Loop detector pull boxes installed in the street shall be placed according to the plans or as directed by the engineer. The lids shall have the word "Traffic" cast into them.

#### **8.5.2.4. Detector Loop Wire Installation**

- a. The use of detector loops instead of cameras must be approved by the Public Works Director. 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.
- b. 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.
- c. 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.
- d. 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.

#### **8.5.2.5. Conductor and Cable**

- a. Wiring shall conform to appropriate articles of the National Electric Code. Wiring within cabinets, junction boxes, etc., shall be neatly arranged.
- b. Powdered soap stone, talc, or other approved lubricant shall be used in placing conductors in conduit.
- c. 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.
- d. Splicing of cable will not be permitted in conduit or pull boxes or outside of signal heads, standards or foundations.



- e. 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.
- f. 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.
- g. 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.
- h. 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.



**Table 8.2 - Cable Schedule**

Phase/Tag	Tape Color
1. NBLT	Red/White
2. NB	Red
3. SBLT	Green/White
4. SB	Green
5. EBLT	Orange/White
6. EB	Orange
7. WBLT	Blue/White
8. WB	Blue
9. Pedestrian	Yellow

NOTE: This is a typical cable schedule and shall be used for the wiring of all signal installations. A new cable 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 for a pedestrian movement. This is in addition to directional tape for the phase. For cable size and number of conductors see traffic signal material specifications and/or standard drawings.

- i. Inboard and outboard heads, mounted on mast arms, are to be wired separately from head to base of pole. Seven conductor for outbound and side-of-pole signal heads required.

**8.5.2.6. Bonding and Grounding**

- a. 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.
- b. 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.
- c. 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.

#### **8.5.2.7. Maintenance**

The contractor shall have full maintenance responsibility of the traffic signal from the date of the written notification by the Public Works Director 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. 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 Transportation Engineer 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:

- a. all indications are out including bulbs and lenses, for any one traffic movement;
- b. signal heads give conflicting indications to any intersection approach;
- c. a signal has been knocked down;
- d. an overhead red indication is out

Contractor shall undertake each such emergency repair no later than one hour after Northglenn notifies Contractor of the emergency.

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.

Should the Contractor fail to perform any maintenance responsibilities within the prescribed time periods, the Public Works Director 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.

#### **8.5.2.8. 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 engineer or his designee.

- a. Each circuit shall be tested for continuity.
- b. Each circuit shall be tested for grounds.





- c. 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.

## **8.5.3 TRAFFIC CONTROL IN CONSTRUCTION AREAS**

### **8.5.3.1. General**

For any construction done on, in or to an existing City roadway and/or right-of-way or for the construction of a new City roadway, appropriate traffic control during construction shall be provided. For any such construction, a construction traffic control plan shall be prepared by the contractor and/or project engineer and shall be approved by the Public Works Director prior to issuance of a street cut permit or public improvement construction permit.

Where a roadway does not currently exist, it is presumed that there is no motorist expectation of a travel route. Therefore, a construction traffic control plan for construction of a new roadway should strive to do two things: alert the motorist that this is a construction area, and alert the motorist that the road is not open to traffic. Construction traffic control plans shall also be prepared for construction occurring on existing City roadways where the motorist has an expectation of accessibility and shall be warned, advised, guided or regulated through any construction activity.

### **8.5.3.2. Time of Submittal**

A construction traffic control plan shall be submitted to the Public Works Director at the earliest with the submittal of final construction plans and at the latest with the application for a right-of-way or public improvement construction permit(s). All final construction plans submitted to the City of Northglenn that entail construction on an existing City roadway or construction of a new City roadway must either:

- a. Be accompanied by a construction traffic control plan.
- b. Include a note stating a construction traffic control plan shall be submitted to the City of Northglenn for approval before any permit for construction is issued. No right-of-way or public improvement construction permit shall be issued without the approved construction traffic control plan.

### **8.5.3.3. Scope of Construction Traffic Control Plan**

For construction of new roadways, traffic control during construction should strive to keep the motorist from entering the facility. The primary means to accomplish this are by



use of temporary barricades located in advance of the point where new construction joins old and appropriate signing. New roadways shall not be opened to general traffic, nor the construction traffic controls remove, without the approval of the Engineering Construction Inspector and the Public Works Director. One precondition of such an opening is that permanent signage and striping be in place.

**8.5.3.4. Elements of Construction Traffic Control Plan**

- a. All construction traffic control plans shall contain the following information:
  - 1) Name of contracting firm and, if different, the name of the firm responsible for traffic control devices.
  - 2) Name and phone number(s) of 24-hour contact person responsible for traffic control devices.
  - 3) Description of location of activity (roadway names, north arrow, etc.)
- b. Projects identified as minor construction traffic control plans as determined by the Public Works Director shall include, in addition to items listed in (A) above, either one of the following:
  - 1) A neat sketch of the roadways and the proposed traffic control devices; or
  - 2) A copy of a typical drawing of traffic device layout from an accepted source approved by the City's Transportation Engineer.
- c. Projects identified as major construction traffic control plans as determined by the Public Works Director shall include, in addition to items in (A) above, the following: The proposed traffic control devices specifically identified as to type and explicitly noted and dimensioned on as-builts, construction plan drawings or other detailed drawings.

**8.5.3.5. Basis for Construction Traffic Control Plan**

The Manual on Uniform Traffic Control Devices shall be the basis upon which the traffic control plan is designed in concert with proper, prudent and safe engineering practice. All necessary signing, striping, coning, barricading, flagging, etc. shall be shown on the plan. Other acceptable documents may be consulted or referenced, such as Traffic Control in Construction and Maintenance Work Zone (FHWA) and the Flagging and Traffic Control Supervisor's Training Manual (CDOT).



#### **8.5.3.6. Restriction, Regulations and Opportunities**

In concept, City streets shall not be closed overnight and work shall not force road or lane closures before 8:30 a.m. or after 3:30 p.m for arterials and collectors. Residential streets shall not be closed overnight and work shall not force road or lane closures before 8:30 a.m. or after 5:00 p.m. If exceptions to this are required, this shall be noted on the construction traffic control plan and shall be approved by the Public Works Director. Travelway width may be restricted. Minimum travel lane width in construction areas shall be ten feet (10'), but proper controls, including flagging, shall be indicated. Prohibition of on-street parking should be considered and noted where applicable.

All traffic control devices necessary to provide for public safety at the work site shall be furnished and maintained by the contractor at his own expense. If the contractor does not provide the approved traffic control devices, the Public Works Director may install such devices, and the entire costs of such devices shall be borne by contractor.

#### **8.5.3.7. Approval**

Staff of the City's Public Works Department must approve (sign and date) all construction traffic control plans. All complete road closures and all partial road closures (removing one or more travel lanes) that are proposed for overnight shall be approved by the Public Works Director. One (1) copy of the approved plan shall remain with the Public Works Department for their verification that the traffic control plan has been adhered to in the field. One (1) copy shall be placed in the engineering project file. The contractor shall have one (1) approved copy of the traffic control plan on site at all times.

#### **8.5.3.8. Modifications**

Actual conditions in the field may necessitate modifications to the construction traffic control plan. Provided that the general intent of the original plan is satisfied, these modifications may occur without revision to the plan. The Engineering Construction Inspector shall be notified of any substantial changes and may refer these to the Public Works Department as needed for construction.

#### **8.5.3.9. Applicability**

The requirements of this chapter shall apply to any person, corporation, municipality, quasi-municipality agencies, mutual companies, electric, gas or communication utility (including cable TV) who for any reason cuts, disturbs or otherwise defaces any City road for the purposes of installing or repairing or for any reason pertaining to the presence of an underground utility or structure.

### **8.5.4 TRAFFIC SIGNING AND PAVEMENT MARKINGS**

#### **8.5.4.1. 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.



#### **8.5.4.2. 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 Public Works Director, the developer may install these traffic signs. Traffic signs shall be placed to conform to the drawing details.

#### **8.5.4.3. Traffic Control Devices on Private Property**

- a. 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.
- b. Placement: A signage and striping plan specifying the various types and combinations of traffic control devices shall be submitted to the Public Works Director for approval.

#### **8.5.4.4. Pavement Markings**

All Pavement Markings required to be installed as a result of new construction or developments shall be THERMOPLASTIC as per CDOT 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 Public Works Director 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 Public Works Director.

### **8.6. MATERIAL SPECIFICATIONS**

#### **8.6.1 SIGNAL HEADS**

##### **8.6.1.1. Traffic Signal Unit Specifications**

- a. All signal units shall be of the individual section, adjustable type, black polycarbonate or approved equivalent. Unless otherwise noted on the plans, all signal and pedestrian displays shall be ITE approved Light Emitting Diodes (LED) and conform to the appropriate sections below. All southbound overhead red and southbound overhead red-arrows shall be incandescent type and conform to sections B through F below.
- b. Visors shall be detachable, of the twelve-inch (12") tunnel type, open at the bottom; be black in color on the outside and flat black on the inside.
- c. Reflectors shall be silvered glass or Alzak type units.
- d. Lenses shall be in accordance with Institute of Traffic Engineers Specifications.



- e. Sockets shall be fixed focus.
- f. Doors on the signal heads for the installation of lamps and lens replacement or other maintenance shall not require use of any tool whatsoever to be opened. Doors and lenses shall be equipped with neoprene weatherproof gaskets to ensure 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 properly insulated. All openings, top and bottom, shall be for one-half-inch (1/2") pipe or pipe mounting brackets. Gaskets shall be supplied for top and bottom openings.

#### **8.6.1.2. Pedestrian Signal Units**

Sixteen-inch (16"), one-way, ICC or equal countdown with audible chirp pedestrian signal head as specified on the plans. "Walk/Don't Walk" indications shall be symbolized and side by side. Visors shall be egg crate type and heads shall be black.

#### **8.6.1.3. Backplates**

- a. Where shown on the plans, black back plates shall be furnished and installed on signal faces. No background light shall show between the back plates and the signal face or between sections. All back plates are to be of aluminum or plastic construction and shall be the louvered type. Back plates shall provide a five-inch (5") border for all twelve-inch (12") signal heads.
- b. Traffic signal heads requiring backboards shall be drilled for three-sixteenths-inch diameter by one-half-inch (3/16" x 1/2") pan head bolt with nut and lock washer. If the manufacturer fails to supply as described, it will then be the contractor's responsibility to do so. When installing backboards on the traffic signal head, the contractor will furnish three-sixteenths-inch (3/16") fender washers between bolt head and backboard
- c. The manufacturer will fabricate all backboards with a three-sixteenths-inch (3/16") washer on both sides of each rivet which is used to hold each section of backboard together.

#### **8.6.1.4. Traffic Signal Lamps**

- a. Traffic signal lamps shall meet the requirements of the latest version of the ITE Standard "Traffic Signal Lamps." All lamps shall have 8,000-hour minimum rating. Lamp manufacturers shall be limited to General Electric, Sylvania,



Phillips. Size of lamps to be used in traffic signal units shall be as follows:

- b. 69 watt, 125 volt, lamps for all peds.
- c. 150 watt or 1950 lumens minimum, 125 volt, lamps for all twelve-inch (12") traffic signals.
- d. If the manufacturer recommends a lower rating, the City of Northglenn will be advised of this recommendation and will have the option to decide which rating will be used.

## 8.6.2 ELECTRICAL CABLE

### 8.6.2.1. Signal Cable

14 AWG multi-conductor, stranded, copper wire manufactured to meet IMSA 19-1 specifications or approved equivalent. Each conductor in the cable will be individually insulated and rated at 600 volts. There shall be a minimum of four (4) and a maximum of nine (9) strands per conductor. There shall be a separate 19-conductor cable installed from the controller cabinet to the bottom handhold of each signal pole. From that point, a separate 5 or 7-conductor cable for each overhead signal shall be spliced to the 19-conductor cable.

### 8.6.2.2. Interconnect Cable

- a. At locations specified by the Public Works Director or where multiple traffic signals are to be constructed in close proximity, interconnection of the traffic signals through copper interconnect may be required. The telephone hardwire interconnect wire shall be #19 AWG, 6 twisted pairs, shielded cable, with petrolatum-polyethylene gel filling compound. The cable shall meet R. E. A. Specification PE-39 (Clifford of Vermont Catalog #6P19-B1-BJFC or approved equal).
- b. No splicing of the interconnect cable will be allowed. The cable shall be installed between two adjacent controller cabinets in continuous runs.
- c. All telephone interconnect cable pairs will be connected to either active or spare terminal points provided in the controller cabinet. The Contractor shall identify and label all terminal points.
- d. All interconnect wires shall be checked after installation to determine their resistance and resistance to ground. Each pair shall be shorted together at one end and a resistance check will be made at the other end or wherever a splice exists. Resistance will be checked between each conductor and ground. All resistance readings shall be recorded showing value, color and location or wire. Data is to be supplied to the City's Public Works Department within 30 days of completion of the project.



At the terminal points, the jackets shall be stripped and the ends taped. Gel filling compound shall be removed using filled cable cleaner.

**8.6.2.3. Service Cable**

Two (2) No. TRW-8, seven (7) strands, tinned, soft-drawn copper wire, one-sixteenth-inch (1/16") neoprene insulation, black and white in color.

**8.6.2.4. Loop Wire**

Detect-A-Duct Cable consisting of single conductor No. 14, stranded THHN with an outer protective sleeve.

**8.6.2.5. Pedestrian Push-Button Cable**

Two (2) conductor No. 14, seven (7) strands, tinned, soft-drawn copper wire, one-sixteenth-inch (1/16") neoprene insulation. Conductors to be twisted. Color coded one (1) white and one (1) black.

**8.6.2.6. Loop Lead-In Cable**

Detector loop lead-in cable shall be a four conductor .25 inch diameter, shielded and jacketed cable suitable for installation in a pavement sawslot, conduit or direct burial. Conductors shall be AWG No. 18 stranded copper with polypropylene insulation. The conductors shall be twisted at least six turns per foot. Color rotation shall be black, red, white, green. The interior of the cable shall be filled with an amorphous material which prevents water penetration. Aluminized polyester shielding shall be applied around the conductors to prevent electromagnetic interference. The Cable jacket shall consist of black high density polyethylene. The jacket shall not be degraded by prolonged exposure to typical pavement runoff components. The cable shall be suitable for operation at temperatures of -60oC to +80oC. (Canoga 30003 43#18 AWG shielded loop detector lead-in cable or approved equal.)

**8.6.2.7. Ground**

Single conductor, AWG No. 8, soft-drawn bare copper wire.

**8.6.2.8. Optical Detector Lead-In Cable**

The lead-in cable for the Emergency Vehicle Optical Detectors shall be GTT Type 138 or approved equal.



### 8.6.3 VEHICLE DETECTORS

#### 8.6.3.1. General

- a. Unless otherwise noted, all traffic signal vehicle detection systems shall be accomplished through a video camera system. All camera systems shall be 100 percent compatible with the City's existing equipment. The remaining portions of this section reference roadway imbedded inductive loop systems and are applicable when specified. This specification defines the minimum design operational and performance requirements for multiple channel, digital self-tuning inductive loop detectors, detector units shall be card rack mounted plug-in type and operate from an external 24 VDC power supply. Detector units shall be in full compliance with the environmental and size requirements of NEMA standard TS1-Section 15 and meet the design, operation, electrical and functional performance requirements of both TS1 and TS2 specifications.
- b. The front panel shall include an erasable, write-on channel identification area and clearly indicated switch operating position. I.D. area one centimeter square per channel minimum.
- c. All component part and test points shall be clearly identified by permanent marking of circuit referenced on the P. C. Board. Integrated circuit devices having 16 or more leads shall be socket-mounted to facilitate repair and maintenance of units. Detectors supplied to this specification shall be warranted by the supplier to be free of defects in materials and workmanship for a period of five years from date of shipment from manufacturer.
- d. Each detector unit shall include two or four complete detector channels. Each channel shall sequentially energize its loop inputs to eliminate crosstalk (mutual coupling) between large, very closely spaced adjacent loops connected to the same unit. The sequential time sharing and digital processing of loop inductance data shall be accomplished on a single LSI microcircuit per unit for maximum reliability. The method of measuring shall be crystal reference digital period counting, multi-channel scanning. Only one channel input per unit shall be active at any point in time.
  - 1) Sequential scanning shall fully prevent crosstalk between channels of a detector connected to closely spaced or overlapped loops for directional detection.
  - 2) Sequential scanning shall allow two detection channels to operate with full performance using a common home-run cable.





- 3) Sequential scanning shall allow two or more detection channels to be connected to a single detection amplifier with full operating performance, including separate mode and sensitivity selection capability on each channel.
  - e. Each channel of the sensor unit shall automatically self tune to any loop and lead-in inductance from 20 to 2500 microhenries within 2 seconds with full sensitivity after application or interruption of supply voltage. Units shall also track changes in loop/lead-in electrical characteristics, as might reasonably be expected to occur in undamaged loops, properly installed in sound pavements, without producing false indications or changes in sensitivity.
  - f. Each detector unit shall be provided with a loop test switch position to verify loop system integrity and reduce maintenance costs. The "open loop test" position shall indicate a previous fault via the front panel indicator. The memory shall remain intact and can be queried repeatedly. Existing detections shall not be reset and the memory shall only be reset by power interruption as by removing and re-inserting the plug-in detector units.
  - g. Each channel shall include a 16-position Push type wheel switch to allow selection of 8 pulse sensitivities, 7 presence levels and a "Reset" and an "Off" position. Each detector unit shall include 8 sensitivity selections in 2:1 steps that can be correlated to the relationship of the number of turns of wire in a loop versus the sensitivity required to detect a specified vehicle. The selections shall be designed to allow detection of licensable vehicles in loops of two or more turns electrically in series, parallel or series/parallel configuration in non-reinforced or reinforced pavements with lead-in/homerun combinations from 50-feet to 1000-feet. The number of turns in a loop, electrical configuration of multiple loops and pavement type will dictate the sensitivity required for proper, predictable detection.
  - h. If specified, channel presence time shall be modified if delay or extension time is selected. The timing switch shall select delay or extension or "Off", if no timing is desired. Internal DIP switches shall provide for selection of "Delay" time of 0 to 31 seconds in 1.0 second increments and "Extension" time of 0 to 7-3/4 seconds in .25 second increments.
  - i. Presence indicators shall be wide angle, high brightness type Led's suitable for sunlight visibility. When timing is selected and a channel is active that channel's indicator shall flash at 4 Hz during Delay and at 16 Hz during Extension to indicate timing is in progress. Further, the timing shall be aborted when the vehicle is no longer present and/or the channel control input shall become inactive. The Delay timer shall be



reset when a vehicle leaves the loop prior to time out and shall abort when the control input becomes inactive. The Extension timer shall operate and reset when a vehicle leaves the loop and be aborted when the control input becomes inactive. Each timer (Delay and Extension) shall be provided with buffer circuitry to enable or disable the timer based on an external input (green gate) signal. Circuit shall be designed for AC or DC input control on AC powered units and for DC control on DC powered units.

- j. Each detector unit shall utilize a  $\Delta L = (\text{Delta-L})$  thresholding technique to provide a more constant, predictable vehicle detection sensitivity with series added inductance, i.e., many loops connected in series and/or long lead-in/homeruns will generally require the same sensitivity setting as would be required for a single loop with short lead-in, to simplify setup.
- k. Each channel shall automatically recover from intermittent opens or multiple shorts to ground. Each channel shall tolerate and continue to operate with no change with a single point short to ground on the loop or lead-in system. Each channel shall provide a continuous, non-resettable (fail-safe) output and indication in response to an open loop/open lead-in system. The open loop indication and output shall not be resettable as long as the open exists, except that they shall be defeated when the channel "Off" position is selected.
- l. Extended features shall include: Two serial ports (front panel RS232 and Edge connector Xmit/Recve), TS1 and TS2 compatible from manual or software switch, microloop occupancy detection, Traffic counting capable to include long-loop presence count from 15 minute to infinite intervals all accessible from either serial interface, Dual Detect and Fault LED indicators per channel, External inputs to control Timing functions and enable Remote Reset, Extended diagnostics, programming and Live status available via serial interface utilizing windows compatible software.

#### **8.6.4 EMERGENCY VEHICLE DETECTORS**

OPTICAL COMMUNICATION Detectors for emergency vehicle pre-emption shall be the GTT Model 711, 712 or 722 Optical Detector or approved equal as specified in the construction plan notes. Placement of the Detectors shall be determined by the Public Works Director. Optical phase selector modules for emergency vehicle pre-emption shall be GTT Model M752 or approved equal.

#### **8.6.5 DETECTORS (PEDESTRIAN PUSH-BUTTON)**

##### **8.6.5.1. General**

- a. Pedestrian push-buttons shall be of the direct push-button contact type. They shall operate on a voltage not to exceed 18 volts AC. They shall be of tamper-proof design and



- equipped with a push-button instruction sign as shown in the Standard Details.
- b. The assembly shall be weatherproof.
  - c. 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 when required. Pedestrian signs shall be installed as shown on the Standard Details.
  - d. At all times, detector standards must comply with current ADA codes and requirements.

### **8.6.6 TRAFFIC SIGNAL POLES, PEDESTALS AND MAST ARMS**

Traffic signal poles, pedestals, and mast arms shall be of the general configuration shown on standard drawings. All traffic signal poles and mast arms shall be designed to meet the requirements outlined in the latest edition of "Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals," published by AASHTO, for a wind velocity of 90 mph.

### **8.6.7 CONTROLLER CABINET**

#### **8.6.7.1. General**

- a. All controllers and auxiliary equipment shall be housed in a factory wired, weatherproof, metal cabinet following NEMA specification TS2 type 2. The cabinet shall be of sufficient size to accommodate all equipment as approved by the Public Works Director.
- b. The cabinet shall be constructed of 0.125 minimum thickness bare aluminum. Cabinets shall be braced internally or by folded seams in order to provide sufficient rigidity to withstand normal handling and transport to the field location without deforming.
- c. The main door shall have a self locking, keyed, tumbler lock with two keys. Hinges shall be mounted on the cabinet in such a way that interchange-ability of doors is possible between cabinets of like size and manufacturer. Hinge pins shall be stainless steel. Doors shall have neoprene gaskets of sufficient thickness to provide a rain tight and dust tight seal.
- d. The engineer will provide, during the construction period, an additional external lock for the controller cabinet to maintain security of the controller cabinet.
- e. A police or auxiliary door shall be provided. It shall be constructed so that no sharp edges protrude from the main door and shall provide access to a panel with labeled switches for automatic to flashing operation and signal power on/off.



- f. The cabinet shall be equipped with a thermostatically controlled, ball bearing fan with a capability of at least 100 cubic feet per minute. The fan shall be mounted in a weatherproof housing attached to the top of the cabinet. The thermostat shall be adjustable to turn on between 90o F and 150o F and be so mounted as to be easily accessible for adjustment from the front of the cabinet. An internally mounted incandescent lamp socket shall be provided with 150 watt capability and switched "on" only when the main door is open.
- g. The cabinet shall have two shelves each capable of supporting 75 pounds. Shelves shall be supported on brackets which provide for height adjustments. Each cabinet shall contain a 10 mil thick plastic envelope with side opening. It shall be a minimum size of 10" x 12" and be attached to the door by screws.
- h. Assembly wiring - All cabinet wiring shall be neatly arranged and laced or enclosed in plastic tubing. No harness or wire shall be attached to any shelf rack or other point where it may be damaged by movement of shelves or doors.
- i. Terminal Facilities - Terminal facilities (load bays) shall be firmly attached in a position not less than 6 inches from the bottom of the cabinet so as to provide easy access and maximum convenience to the user.
- j. Side mounted auxiliary panels should be firmly installed with the forward edge not more than 4 inches from the door sill and not less than 6 inches from the bottom of the cabinet in all cabinets.
- k. The load bay and it's associated equipment, harness, switches, etc., shall be grouped on removable panels. Each panel or group of receptacles and connecting cables shall be arranged to permit so that work can be performed on panel backs or cables.
- l. A load switch bay and flash transfer capability is required for each phase. Load switches shall be provided for only the phases shown on the plans.
- m. The load bay shall be protected by a main circuit breaker. A gas tube surge arrester with MOV and a suitable radio interference filter shall be supplied. The arrester shall be a three electrode type with the following ratings:
  - 1) Impulse Breakdown - less than 1,000 volts in less than .1 microseconds at 10 KV per micro-second.
  - 2) Standby Current - less than 1 milliampere
  - 3) Striking Voltage - greater than 212 VDC



- 4) Energy Capability - capable of withstanding pulses of peak current each of which will rise in 8 microseconds and fall in 20 micro-seconds to one-half the peak voltage at 3 minute intervals.
  - 5) Peak Current Ratings shall be 20,000 amps. The MOV shall have ratings equal to or better than a General Electric type VI50LA20A. The RFI filter shall have a current rating equal to or greater than the main circuit breaker capacity.
- n. Field terminals shall be screw type, capable of accommodating at least three number 12AWG wires. All terminals in the load bay shall be permanently identified by engraving, silk screening or contrasting plastic labels. Terminal blocks shall be the barrier type and no live parts shall extend above the barrier.
  - o. A convenience outlet with a ground fault interrupter fused at 15 amps shall be provided. It should be located in a position which is convenient and safe for service personnel.
  - p. All AC power busses, switch or relay lugs and/or similar activity connection points which extend more than 1-1/2 inches from the panel are to be protected by insulation for safety. The locations of these items shall provide reasonable protection for service personnel.
  - q. Signal power relays shall be mercury wetted, equal to or greater than circuit breaker capacity. Flash transfer relays shall be as manufactured by Midtex Model 136-62 T 3A1, 120 VAC, DPDT, 30 amp with Jones Plug base and dust cover or approved equal.
  - r. Flasher. The cabinet shall be equipped for flashing operation of signal lights with a 2 circuit solid state flasher in accordance with the latest NEMA specifications (15 amps per circuit). Flashing operation shall be set for flashing yellow on all main street approaches and red on all other approaches. Pedestrian and turn signals shall be extinguished during flashing operation. The flashing mechanism shall remain in operation during shutdown or removal of controller.
  - s. Load Switches. The cabinet shall be equipped with solid state load switching assemblies in accordance with the latest NEMA specification. Each load switch to be equipped with a 3 input LED indicator. Load switches shall contain 3 separate cube type solid state relays, which use a solid state switch which is capable of operations at 240 VAC and 25 amps when properly heat sunked but derated to 10 amps when used in load pack assembly.
  - t. Conflict Monitor. The cabinet shall have provision for conflict prevention in accordance with the latest NEMA TS2 specification. Conflict prevention shall be provided by a



conflicting display monitor unit that monitors all green, yellow and walk displays and detects absence of reds to cause flashing operation and stop timing if conflicting indications are detected. Removal of the monitor from the cabinet shall cause flashing operation. Conflict monitors shall be as manufactured by Eberly Designs, 12 LEP or approved equal.

- u. Emergency Vehicle Preemption. The cabinet shall be equipped and wired with an Opticom Card rack mount for 3M Model 562 or approved equal. All equipment shall be capable of accommodating a minimum of two modules with capability of four-channel operation.

## 8.6.8 ACTUATED CONTROLLERS

### 8.6.8.1. General

- a. Compatibility - THE LOCAL CONTROLLER AND CABINET SHALL BE 100% COMPATIBLE WITH THE CITY OF NORTHGLENN'S EXISTING COMPUTERIZED SIGNAL SYSTEM WHICH UTILIZES ECONOLITE EQUIPMENT OR NECESSARY MODIFICATIONS OF THE SOFTWARE AND HARDWARE SHALL BE INCLUDED TO MAKE BOTH SYSTEMS FULLY COMPATIBLE.
- b. An actuated controller shall be completely solid state, electronic device capable of selecting and timing traffic movements. It shall provide timing and load switch control of each major vehicular phase, including concurrent associated pedestrian movements. The controller shall conform to the latest NEMA specifications and shall provide for complete and full operation of eight phases from within either a TS1 or TS2 type 1 cabinet.
- c. The controller shall have all electronic components easily accessible and arranged in functional groupings on the printed circuit boards. Printed circuit boards shall be designed to facilitate identification of components for maintenance purposes. Printed circuit design shall be of NEMA specification quality and designed so that components may be removed and replaced without permanent damage to the board or track.
- d. Timing shall be adjustable on the controller face by keyboard programming. A security code or other means shall be provided to prevent unauthorized or accidental entry.
- e. Timing shall be readable from a display which is sufficient to make certain that all register positions can be easily and definitely recalled. Every keyboard controller shall have an easily followed legend silk screened on the face of the controller or on a metal or plastic card or placard which is securely attached by screws or rivets.



- f. All circuitry components shall be available on the open market and the original manufacturer's part number shall be shown on the part's list.
- g. Overlap programming shall be provided by NEMA standard overlap board and/or keyboard.
- h. An entry mode to any single phase parameter of a keyboard controller shall not affect any other parameter or the same parameter on another phase, unless programmed by specific keyboard instructions, such as, "copy" sequences or other prescribed methods of rapid program entry.
- i. Every controller supplied shall be the manufacturer's latest, first line production model tested and delivered by a domestic manufacturer who is regularly engaged in the construction of such equipment.
- j. Each controller shall be supplied with a complete set of operational and service manuals, wiring schematics and part's layout up to a maximum of ten sets per order. Any controller for which these documents are not available is not a production model within the meaning of these specifications.
- k. Each controller shall have a removable data module.
- l. Pre-emption. All actuated controllers shall be equipped to accommodate four E.V.P. inputs and one railroad preemption input.

**8.6.8.2. Coordination Unit**

- a. The coordination unit shall be an internal function within each local controller and shall meet, as a minimum, the following functional requirements.
- b. The coordinator shall provide for at least four cycle lengths adjustable from 30 to 255 seconds, three offsets adjustable from 0 to 99 percent with offset correction by dwelling in coordinated phase or smooth transition, and four splits per cycle.
- c. Standard NEMA functions shall be used to control the intersection timing.
- d. The coordinator shall be capable of changing the controller's phase sequence upon command and telemetry failure.
- e. The coordinator shall be capable of setting the intersection free by loss of system sync, cycle/offset false commands, free command and telemetry failure.
- f. The coordinator shall be capable of setting the intersection into a flashing operation in accordance with the Manual on Uniform Traffic Control Devices, latest edition.



- g. The coordinator shall be capable to operate with telemetry module without additional hardware or software.
- h. Time-base coordination mode shall be provided as a backup with all standard coordination features available. At least two 7-day programs shall be available with at least 36 additional holiday programs in the event of a master controller or communications failure. Time-base standby mode shall be programmable for an entire year with automatic daylight savings and leap-year changes.

**8.6.8.3. System Telemetry**

- a. Telemetry equipment shall be an internal plug-in module to a local controller with easy access for removal. Master controller or stand-alone chassis may contain standard plug-in module. Each telemetry unit shall be capable of transmitting data to and from local controller, local detectors and system detectors (8 per intersection). A provision shall be made to reject invalid messages. The system command shall be transferred each second to maintain time sync.
- b. The telemetry equipment shall be designed so that all communications among intersections in one system can be accomplished over no more than two pairs of hard wire interconnect or leased phone lines. Dedicated pairs from the master to each local intersection are not permitted.

**8.6.9 ON-STREET MASTER**

**8.6.9.1. General**

- a. Cabinet Assembly - The master controller shall be wired into a cabinet assembly which also includes a local intersection equipment configuration. The cabinet shall be wired complete with master connecting cables in accordance with applicable portions of the local controller cabinet specifications. The incoming power service and interconnect terminals shall be adequately equipped with surge arrestors to protect against high energy transients.
- b. Incoming Sensor Data - The master shall have the ability to receive output data from at least eight sensors from each local intersection. It shall be possible to assign at least 32 of the incoming sensors to internal computational channels for pattern selection analysis.
- c. Traffic Pattern Selection. The program-in-effect shall be selected on a priority basis with the following priority arrangements:





- 1) Manual entry from keyboard
  - 2) External command from a master
  - 3) Time-of-day/day-of-week schedule
  - 4) Traffic responsive -based on sampling sensor analysis
- d. The master shall select one of six different cycle lengths or "free" operation based on inbound or outbound volume levels. It shall be possible to program segments in the volume range levels to change to the next higher or lower cycle lengths.
- e. The master shall be able to select any of five different offset plans per cycle. Offset plans shall be chosen based on the differential between inbound and outbound volume levels. The five offset plans shall be designated as follows:
- 1) Heavy inbound
  - 2) Inbound
  - 3) Average
  - 4) Outbound
  - 5) Heavy outbound
- f. When balanced flow occurs, the master shall select the Average Offset plan. When the volume in one direction exceeds the volume in the other direction by the programmed amount, a standard preferential offset shall be implemented. If the volume differential exceeds a second (higher) programmed amount, a heavy preferential offset must be implemented. It shall also be possible to reserve the heavy preferential offset plans for special pattern implementation only. Programmable settings must be provided for both entering and leaving each offset.
- g. Split plan selection shall be identical to offset plan selection except that arterial traffic volume levels must be compared to side street volume levels. Three different split plans shall be provided:
- 1) Heavy arterial
  - 2) Average
  - 3) Heavy side street
- h. The master shall call for the average split plan during normal conditions. If the arterial volume exceeds the side street volume by the programmed amount, the heavy arterial split shall be selected. In the same manner, if side street volume exceeds arterial volume by a programmed amount, the heavy side street split shall be called.



- i. Crossing Artery Synchronization - The master controller shall have capability to coordinate with a separate master controller of the crossing artery through the common intersection for both systems.
- j. System Diagnostics - Diagnostic tests shall be performed on system detectors, telemetry communications and intersection operation.
- k. Sampling sensors shall be monitored for absence of calls or constant calls. If a sensor fails, it shall be automatically disconnected from the calculations for traffic responsive plan selection. If normal sensor operation resumes, the sensor shall be automatically reinstated.
- l. Telemetry communications diagnostics shall monitor readbacks for no response condition including local telemetry and telemetry channels.
- m. Intersection diagnostics shall be available to display intersection status condition. All fault conditions shall be reported and logged.
- n. Count storage - The master shall have the ability to tabulate and store 15 minute count data from up to 32 different sensors. The data shall be available for automatic transfer to the central office facility upon request.
- o. The selection of the sensors to be counted in any 24 hour period shall be completely programmable from the central office computer.
- p. Miscellaneous Data Storage. The master shall store all of the following data:
  - 1) The time of day and location of all sampling sensor failures. If normal operation resumes, this time shall also be recorded.
  - 2) The time of day, location and mode of all local intersection failures. The time that normal operation resumes must also be recorded.
  - 3) The time and mode of all pattern changes. Changes due to external override must be distinguished from normal pattern changes.
  - 4) The average volume or occupancy level for each 15 minute period for all computational channels.
- q. It shall be possible to transmit any of the data listed above to the central office computer automatically or upon demand.
- r. Downloading Local Coordination Settings. It shall be possible to download any local intersection coordination setting (offset, force off or permissive period) from the master via the unit's keyboard.



- s. Display. During normal operation, the timing patten in effect shall be displayed on the front panel, including the cycle, offset plan and split plans selected. Also, the unit shall indicate how the timing plan was selected - through normal volume calculations, by an occupancy channel or by manual or central computer override. The master shall also indicate when the time of day mode is in effect and show whether this mode was selected manually or because of sensor failures.
- t. External Override. The master controller shall have appropriate inputs to externally select any timing pattern and override the pattern selected through traffic analysis.
- u. Telemetry. The master shall include a telemetry module for two way communications between the master and local controllers. The equipment shall be compatible with the telemetry equipment specified for the local controllers

## **8.6.10 MISCELLANEOUS HARDWARE**

### **8.6.10.1. General**

- a. Aluminum pedestal mounts (Type III) shall be either of two (2) types, as called for in the plans and specifications. Center mount with two (2) side ports, plain or offset mount serrated with one (1) side port.
- b. Covers for water valve pull boxes shall have the word "Traffic" cast into them to avoid confusion with a water department pull box.
- c. Mast arm brackets shall be Astro brackets or City approved equivalent and shall be installed 90 degrees to the roadway.

## **8.6.11 PAINT - SIGNAL POLES**

### **8.6.11.1. New Structures**

- a. All new signal poles and mastarms shall be factory painted with an epoxy primer and Polyurethane top coat liquid coating. Surface preparation shall be blast cleaned to Steel Structure Painting Council Surface Preparation Specification No. 6 (SSPC-SP6) requirement utilizing cast steel abrasives conforming to the Society of Automotive Engineers (SAE) Recommended Practice J827.
- b. All accessible interior surfaces shall be coated with a lead and chromate free red oxide rust inhibitive alkyd primer to a minimum dry film thickness of 1.0 mils.
- c. All exterior surfaces shall be coated with a rust-inhibitive Epoxy-Polyamide Primer to a minimum dry film thickness of 2.0 mils. The top coat shall consist of one coat of Semi-Gloss High-Build Acrylic Polyurethane Enamel, Tnemec Endura Shield or approved equal, to a minimum dry film thickness of



2.0 mils. The top coat color shall be Federal Green No. 34108.

- d. Any surface areas damaged during handling or installation shall be repaired immediately with a spot coat of epoxy primer and a polyurethane finish as specified above. The paint manufacturer's application instructions shall be followed.
- e. The City will consider galvanized poles with painted top coat for improved rust protection as specified above and according to manufacturers painting recommendations.

#### **8.6.11.2. Existing Structures**

- a. All designated previously installed signal poles and mast arms shall be field painted. All exterior surfaces shall be cleaned and examined for damaged paint, and any such damage shall be given a spot coat of primer and the entire exterior surface re-painted. Previously painted surfaces whether finish or prime coats, shall be scuff sanded to yield 500 PSI of adhesion with particular attention paid to the lower eight feet (8') of the pole. Inspection of the poles prior to application of the finish coat is required.
- b. A finish coat of Sherwin Williams DTM (Direct to Metal) Acrylic Gloss or approved equal shall be applied over the primer or previously painted surfaces. Two coatings shall be applied leaving approximately 6 mils of dry film. The color shall be a dark green formula (Federal Green No. 34108).
- c. The painting shall be done in a neat and workmanlike manner and may be applied either by hand brushing or spraying. The engineer 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.
- d. All designated traffic and pedestrian signal heads shall be painted flat black unless otherwise specified.

#### **8.6.12 INSTRUCTIONS AND WIRING DIAGRAMS**

All equipment shall be provided with three sets of complete installation instructions, including a complete chart of field connections as well as a manual for the controller, containing service instructions, wiring diagrams, trouble-shooting procedures, etc. Each and every component used shall be clearly referenced in the service manual and its value, ratings and manufacturer part number shall be given.

#### **8.6.13 GUARANTEE**

The contractor shall include in his proposal all warrants and/or guarantees with respect to materials, parts, workmanship and performance of the product to be supplied. The minimum guarantee period for the product shall be two (2) years from the date of final acceptance of the contract. The contractor shall attach to the bid a statement that all material to be supplied is either



in exact accordance with the specifications or shall list in detail any and all deviations therefrom. The supplying of equipment that is not in accord with the specification and on which the contractor has indicated no exception shall be cause for rejection of the equipment and correction of the non-specification items entirely at the contractor's expense.



## 8.6.14 SIGN SPECIFICATIONS

### 8.6.14.1. Sign Face Materials

All stop signs, yield signs, and "Do Not Enter" sign faces shall be fabricated from Scotchlite reflective sheeting, high-intensity grade or approved equal. All other sign faces shall be fabricated from Scotchlite reflective sheeting, engineer grade or approved equal.

### 8.6.14.2. Sign Post Materials

All sign posts shall be fabricated from 12-gauge galvanized, perforated Telespar tubing or approved equal. The sign post assembly shall consist of a VLOC steel 2 foot anchor sleeve and a two inch by two inch by ten-foot (2" x 2" x 10') post. See detailed drawing in Appendix.

### 8.6.14.3. Fire Lane Sign Specifications

Size: 12 Inches by 18 Inches

Materials: Per Current MTCD standards at time of installation.

Colors: Sign Letters on White Background. The letter on the symbol sign shall be black.

Wording: "No Parking" (or)

"Fire Lane" (with appropriate arrow)

General: Letter size, border, hole locations, and corner radii shall be per the Manual on Uniform Traffic Control Devices specifications.



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## **CHAPTER 9 TRENCHING, BACKFILLING AND COMPACTING**

### **9.1. GENERAL**

#### **9.1.1 DESCRIPTION**

This section covers excavation and trenching including drainage, dewatering, preparation of subgrades, pipe bedding, backfilling, compacting, and finish grading for underground pipe lines, service lines, and appurtenances.

Reference detail drawing in the appropriate chapter of these STANDARDS AND SPECIFICATIONS.

#### **9.1.2 QUALITY ASSURANCE**

##### **9.1.2.1. Compaction**

Soil compaction tests shall be performed in accordance with:

- a. ASTM D 698, Standard Method of Test for Moisture Density Relations of Soils
- b. ASTM D 2049, Standard Method of Test for Relative Density of Cohesionless Soils

##### **9.1.2.2. Construction Staking**

- a. Construction staking shall be performed with qualified, competent personnel under the direction of a professional land surveyor registered in the State of Colorado.
- b. All survey notes and construction staking notes shall be entered into bound, hard cover field books.
- c. Staking of the work shall be at fifty-foot (50') stations (maximum).
- d. Offsets shall be staked so that vertical and horizontal alignment may be checked.
- e. All survey data which is developed by the contractor or the developer's surveyor in performing surveys which are required by the work shall be available to the City for examination throughout the construction period.



### 9.1.3 JOB CONDITIONS

#### 9.1.3.1. Drainage and Groundwater

- a. All excavations and trenches shall be kept free from excess groundwater during construction.
- b. Any water which is encountered in the trench shall be removed to the extent necessary to provide a firm subgrade to permit joints to be made in the dry and to prevent the entrance of water into the pipeline.
- c. Surface run-off shall be diverted as necessary to keep excavations and trenches free from water during construction.
- d. The excavation or trench shall be kept free from water until the structure or pipe to be installed therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
- e. Water shall be prevented from entering into previously constructed pipe.
- f. Except for storm drains, the pipe under construction shall not be used for dewatering.

#### 9.1.3.2. Sequencing

- a. Pipeline installation shall be performed within one hundred (100) linear feet of trench excavation. If construction is occurring in an open field, this distance may be increased at the Public Works Director's discretion.
- b. Initial trench backfill shall be performed within fifty (50) linear feet of pipeline installation. If construction is occurring in an open field, this distance may be increased at the Public Works Director's discretion.
- c. Where excavation is a hazard to automotive or pedestrian traffic, the amount of open trench and the duration of that opening is to be minimized. The contractor shall coordinate the amount and duration of road closures with the City's Traffic Department.

#### 9.1.3.3. Underground Obstructions

- a. The contractor/developer shall field verify all drawings of record information obtained from the City or other affected utility company.
- b. The contractor/developer shall notify each utility owner and request utilities to be field located by surface reference at least forty-eight (48) hours prior to trenching or excavation.
- c. In situations where conflicts may exist, the contractor shall expose and verify the size, location, and elevation of





underground utilities and other obstructions sufficiently in advance of construction. The Contractor shall use extreme caution during this work. All damage to existing utility lines or adjacent facilities shall be repaired promptly at the Contractor's expense.

- d. In the case of a conflict, the contractor shall notify the City and the affected utility company, the proposed work may then be modified by the Design Engineer and after the Public Works Director's approval.
- e. Existing improvements, adjacent property, utilities, trees, and plants that are not to be removed shall be protected from injury or damage resulting from the contractor's operations. If damage should occur, the contractor shall make repair such that damaged materials are restored in original or better condition, as directed by the Public Works Director, utility or property owner in question.
- f. If the contractor removes any underground obstructions, the following shall apply:
  - 1. Drainage culverts may be salvaged, stored, and reused in the original location if approval is obtained from the Public Works Director. All other underground obstructions shall be replaced with new materials.
  - 2. The area in which the underground obstruction was located shall be restored to original or better condition.

## 9.1.4 MAINTENANCE AND CORRECTION

### 9.1.4.1. Trench Settlement

The contractor/developer shall maintain and repair all trench settlement and make necessary repairs to pavement, sidewalks, or other structures which may be damaged as a result of backfill settlement. Contractor shall warrant work for a period of two (2) years after final completion and acceptance of the work.

### 9.1.4.2. Subcontractors

The contractor/developer may perform such maintenance and repairs by subcontract. If the contractor chooses to subcontract the warranty work, he shall submit to the Public Works Director a copy of the subcontract or the work authorization as evidence of the contractor's faithful intention to perform any repairs which may become necessary during the two (2) year warranty period.

## 9.2. CONSTRUCTION SPECIFICATIONS

### 9.2.1 PREPARATION



- A. Topsoil shall be stripped from areas which are to be disturbed by construction and stockpiled.
- B. Topsoil shall be segregated from non-organic trench excavation material and debris.

### 9.2.2 TRENCHING

- A. Trenches shall be excavated by open-cut methods, except where boring or tunneling is indicated, shown on drawings, or approved by the Public Works Director. Proper safety precautions such as trench slope-back or shoring may be required by the Public Works Director to protect workers entering trenches.
- B. Trench width shall be maintained to within three inches (3") of that specified on plans.
- C. Care shall be used when operating mechanical equipment in locations where it may cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground.
- D. Mechanical equipment shall be designed and operated in such a manner that the bottom elevation of the trench can be controlled with uniform trench widths and vertical sidewalls which extend from the bottom of the trench to an elevation one foot (1') above the top of the installed pipe.
- E. Trench alignment shall be sufficiently accurate to permit pipe to be aligned properly with an eight-inch (8") minimum clearance between the pipe and the sidewalls of the trench. The trench sidewall shall not be undercut in order to obtain clearance.
- F. Contractor shall over-excavate a minimum of six inches (6") below the bottom of the pipe wherever the trench bottom is rock, shale, or other unsuitable material. Over-excavation shall be backfilled and compacted with acceptable granular material. Granular material shall conform to Section 9.3.2 of these STANDARDS AND SPECIFICATIONS.
- G. Preparation of Trench Bottom:
  - a. Trench bottoms shall be graded uniformly to provide clearance for each section of pipe.
  - b. Loose material, water, and foreign objects shall be removed from the trench.
  - c. The contractor shall provide a firm subgrade which is suitable for application of bedding material.
  - d. Wherever unstable material is encountered in the bottom of the trench, said material shall be over-excavated to a depth suitable for construction of a stable subgrade. A minimum of one and one-half inch (1½") uniformly graded, washed rock shall be used for trench stabilization. The over-excavation



shall be backfilled with stabilization material and compacted as required by the Public Works Director.

H. Stockpiling Excavated Materials:

- a. Suitable material for backfilling shall be stockpiled in an orderly manner at a minimum of four feet (4') from the edge of the trench.
- b. Excess excavated materials not suitable or not required for backfilling shall be removed from the site and disposed.
- c. Excavated material shall not be stockpiled against existing structures or appurtenances.
- d. Excavated materials containing any hazardous materials shall be disposed of at an approved site in accordance with an abatement plan to be prepared by the developer/engineer or other qualified professional in accordance with all federal, state, and local ordinances.

I. Limiting Trench Widths:

- a. Trenches shall be excavated to a width necessary to provide an eight-inch (8") minimum and twelve-inch (12") maximum working space between the pipe and the trench walls for proper pipe installation, joining, and bedding.
- b. The maximum trench width at an elevation twelve inches (12") above the top of the installed pipe shall be the pipe diameter plus 24 inches. If the width of the trench, twelve inches (12") above the top of the pipe, exceeds the maximum allowable trench width, a higher strength pipe or special pipe bedding shall be provided as required by soil-loading conditions and as approved by the Public Works Director.

### 9.2.3 PIPE BEDDING

A. Placement and Compaction:

- a. Bedding material shall be distributed and graded to provide uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. Pipe shall not be supported by the bells.
- b. To prevent lateral displacement, granular bedding material shall be deposited and compacted uniformly and simultaneously on each side of the pipe.
- c. Granular bedding material shall be compacted in accordance with these STANDARDS AND SPECIFICATIONS.
- d. Bedding shall be placed to six inches below the bottom of the pipe and shall be placed around the sides of the pipe and to a minimum of 12 inches above the top of the pipe and in accordance with the detail drawing in the Appendix.



- B. Ground water barriers shall be constructed in such a manner to prevent passage of water through bedding material for the full depth of the granular bedding material and the full width of the trench.
  - a. Ground water barriers, if shown on the approved construction plans, shall be approximately four feet (4') long and spaced not more than four hundred feet (400') apart.
  - b. Material for ground water barriers shall be as specified by the ditch company which controls the irrigation ditch to be crossed. If there is no ditch company, the Public Works Director shall determine the material to be used.

C. Class A Bedding

Class A bedding is defined as that method of bedding in which the lower half of the pipe is set in a reinforced concrete cradle. The minimum thickness of concrete under the lowest part of the conduit shall be one-fourth of the outside pipe diameter but not less than six inches. The concrete shall extend around the pipe to the spring line of the pipe barrel. The width of the concrete cradle shall be at least equal to the outside pipe diameter plus eight inches. Granular material shall be placed around the sides of the pipe and to a minimum of twelve inches above the top of pipe. Granular material shall meet the requirements of Section 9.3.2 in these STANDARDS AND SPECIFICATIONS.

D. Class B Bedding (Granular II)

Class B bedding is defined as that method of bedding in which the pipe is set on granular material meeting the requirements of Section 9.3.2 in these STANDARDS AND SPECIFICATIONS. Bedding shall be placed to a depth below the bottom of the pipe equal to one-fourth of the outside pipe diameter but not less than six inches. In rock excavation this minimum depth shall be six inches. Granular material shall be placed around the sides of the pipe and to a minimum of twelve inches above the top of pipe.

**9.2.4 BACKFILLING AND COMPACTION**



- A. Trenches shall be backfilled promptly after the pipe has been installed and inspected. Backfill around manholes and valve boxes shall be compacted with hand-operated equipment.
- B. Backfill material shall be deposited in uniform horizontal layers which may not exceed eight inches (8") (compacted depth) in all areas. Other thickness may be used with the prior written approval of the Public Works Director.
- C. Methods and equipment which are appropriate for the backfill of material shall be employed. Backfill equipment or backfilling methods which transmit damaging shocks to the pipe shall not be used.
- D. Compaction shall not be performed by jetting or water settling.
- E. If compaction cannot be obtained with job excavated material, trench backfill material shall be imported.
- F. Topsoil shall be replaced to the depth of stripping over all areas which are to receive vegetation.
- G. Excess excavated materials and materials not suitable for backfill shall be removed from the site.

## 9.2.5 FIELD QUALITY CONTROL

### 9.2.5.1. Field Compaction Control

- a. Field tests will be conducted to determine compliance of compaction methods with specified density in accordance with ASTM D 2922 (Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods).
- b. Compaction tests shall be performed at a depth of one-and-one-half feet (1-1/2') above the top of the pipe and in one-foot (1') vertical increments up to the finish grade or as otherwise directed or approved by the Public Works Director.
- c. Compaction tests shall be performed at least once every one hundred (100) linear feet as measured along the length of the pipe.
- d. If the Public Works Director determines that reliable and uniform results are produced by the contractor's construction techniques, the frequency of testing may be changed.

### 9.2.5.2. Compaction

Compaction shall be to the following minimum densities (reference ASTM D 698 or AASHTO T 99 unless otherwise indicated):

- a. Barrier Material - 95 Percent of Maximum Standard Density.
- b. Pipe Bedding:



- 1) Compacted Granular Material - 80 Percent of Maximum Relative Density (ASTM D 2049).
  - 2) Carefully Compacted Select Soil - 95 Percent of Maximum Standard Density
  - 3) Barrier Material - 95 Percent of Maximum Standard Density
- c. Trench Backfill:
- 1) Paved roadways, sidewalks, and other areas - 95 Percent of Maximum Standard Density
  - 2) Gravel Roadways - 95 Percent of Maximum Standard Density
  - 3) Fields and All Other Areas - 90 Percent of Maximum Standard Density
  - 4) Under Footings, Foundations, Structures, 100 Percent of Maximum Standard Density or in Conformance with the Approved Soils Report and Recommendations

**9.2.5.3. Moisture Content:**

All compacted backfill shall be within two percent (2%) (plus or minus) of the optimum moisture content of the soil as determined by ASTM D 698.

Water shall be added to the material or the material shall be harrowed, disced, bladed, or otherwise worked to ensure a uniform moisture content, as specified.

**9.2.6 EXCAVATIONS AND REMOVAL WITHIN EXISTING PAVED SURFACES**

- A. Saw cutting of the existing pavement is required prior to final patching.
- B. Minimum patching depths are as follows;

ARTERIAL STREETS – 10” FULL DEPTH

COLLECTOR STREETS - 8” FULL DEPTH

LOCAL STREETS - 6” FULL DEPTH

In the event existing asphalt thickness exceeds these minimums, the patch depth shall match existing plus one (1) inch.

- C. ALL TRENCH BACKFILLING SHALL BE ACCOMPLISHED BY USING FLOW-FILL MATERIAL CONFORMING TO SECTION 9.24.00 OF THESE SPECIFICATIONS WITH THE FOLLOWING EXCEPTIONS:

**9.2.6.1. Arterial and Collector Streets**



- a. Excavations longer than fifty feet (50') in length or two hundred (200) square feet in surface area may use excavated materials with written approval from the Public Works Director or imported soil as described in Section 9.23.00 (B) 2.

#### **9.2.6.2. Local Streets**

- a. Excavations longer than twenty five feet (25') in length or one hundred (100) square feet in surface area may use excavated materials with written approval from the Public Works Director or imported soil as described in Section 9.23.00 (B) 2.
- b. No dimension of existing pavement less than 3 feet shall be left between the new patch and existing lip of gutter (5 feet for concrete). On Arterial or Collector streets, no side of a patch shall fall within 2 feet of the existing wheel path. Patches within 2 feet shall require the removal of additional pavement to meet this requirement.
- c. All patches will be 4 sided.
- d. ALL PATCHES WILL REQUIRE THE REMOVAL AND REPLACEMENT OF AN ADDITIONAL 2 FEET OF ASPHALT ON EACH SIDE OF THE TRENCH TO COMPENSATE FOR THE VERTICAL SHEAR OF THE TRENCH WALLS.
- e. Patches shall not be less than 4 feet in any direction unless previously approved.
- f. Patches in concrete pavement shall be from construction joint to construction joint.
- g. All existing traffic control devices, including traffic marking paint, thermoplastic markings, and traffic signal loop detectors shall be replaced prior to acceptance of the patching.
- h. Excavations that result in a patch that exceeds 8 feet in each direction shall require the use of a spreader box. Patches exceeding 12 feet in width and 200 feet in length shall require the use of a self- propelled paver.
- i. Patches in existing paved areas shall be warranted for a period of 1 year from the date of acceptance.
- j. Final surface tolerances shall not exceed ½ inch as measured with a 10-foot straight edge.

### **9.3. MATERIAL SPECIFICATIONS**

#### **9.3.1 STABILIZATION MATERIAL**



If the existing soil in the trench bottom is judged to be unsuitable by the Public Works Director, the top six inches (6") of the pipe subgrade shall be removed and replaced with a stabilization material.

Stabilization material shall conform to ASTM D 448 or CDOT No. 4, according to Table 9.1.

**Table 9.1 - Classification Table for Stabilization Material**

Sieve Size	% PASSING
2 Inch Screen	100
1-1/2 Inch Screen	90-100
1 Inch Screen	20-55
3/4 Inch Screen	0-15
3/8 Inch Screen	25-55

Geotextiles used for erosion control, drainage and silt fence shall conform to CDOT requirements of 712.08 in the Standard Specifications for Road and Bridge Construction.

**9.3.2 BEDDING MATERIALS**

**9.3.2.1. Granular Material.**

Uniformly-graded material conforming to AASHTO M6, according to Table 9.2.

**Table 9.2 - Classification Table for Bedding Material**

Sieve Size	% Passing
3/8 Inch Screen	100
#4 Mesh Sieve	95-100
#16 Mesh Sieve	45-80
#50 Mesh Sieve	10-30
#100 Mesh Sieve	2-10

Select Soil. Excavated material which is free from rocks, clods, and stones greater than one-and-one-half inches (1-1/2") in any dimension and which meets other requirements of trench backfill material.

**9.3.2.2. General**

In the event unstable trench conditions are found at pipeline grade, a minimum of one and one-half inch uniformly graded, washed rock shall be used for trench stabilization. Depth of stabilization shall be as approved by the City. Pipe bedding shall be done in





accordance with Sections 9.2.3C or 9.2.3D of these STANDARDS AND SPECIFICATIONS and the Detail Drawing in the Appendix.

**9.3.2.3. Barrier Material -- Soil Classification**

- a. GC -- Clayey gravel, gravel-sand-clay mixtures.
- b. SC -- Clayey sands, sand-clay mixtures.
- c. CL -- Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, clean clays.
- d. Material may be finely divided, suitable, job-excavated material free from stones, organic matter, and debris.

**9.3.3 TRENCH BACKFILL MATERIAL**

Trench backfill material shall be placed from a point twelve inches (12") above the pipe to twelve inches (12") below the ground surface or to the bottom of the pavement subgrade, whichever is greater.

Trench backfill material shall be either soil excavated from the trench or imported soil.

- A. Any soil used for trench backfill shall be free from frozen matter, stumps, roots, brush, other organic matter, cinders or other corrosive material, hazardous material, debris, and any rocks or stones which are larger than six inches (6") in any dimension. Rocks or stones which are larger than three inches (3") in any dimension shall not be placed within one foot (1') of pavement subgrade or within one foot (1') of the finished surface of unpaved areas or within one foot of the pipe.
- B. If imported soil is used for trench backfill it shall meet CDOT specifications for Class 1 or Class 2 structure backfill.

**9.3.4 FLOW-FILL BACKFILL MATERIAL**

**9.3.4.1. General**

When required or approved by the Public Works Director, and at the expense of the contract/developer, the following material may be used in lieu of structure backfill (Class 1 and Class 2) or to backfill culvert pipes, storm sewer pipes, and utility cuts.



**Table 9.3 - Flow-Fill Mix**

Ingredients	Quantity (Pounds/Cubic Yard)
Cement	50
Coarse Aggregate (AASHTO No. 57 or 67)	1700
Fine Aggregate (AASHTO M6)	1845
Water	325

Note: Water as needed for proper consistency.

**9.3.4.2. Compaction**

Compaction of flow fill will not be required if material meeting the above requirements is used.

The maximum layer thickness for flow fill shall be three feet. Additional layers shall not be placed until the flow fill has lost sufficient moisture to be walked on without indenting more than two inches. Damage resulting from placing flow fill in layers that are too thick or from not allowing sufficient time between placement of layers shall be removed and replaced.



## **CHAPTER 10 ACCEPTANCE REQUIREMENTS**

### **10.1. APPLICABILITY**

Before the City will assume ownership and maintenance responsibility for public improvements, the public improvements shall be formally accepted by the Public Works Director. The developer 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 of the responsibility to correct such defects at a later date. There shall be no partial acceptances of public improvements within new developments.

#### **10.1.1 ACCEPTANCE PROCEDURE**

##### **10.1.1.1. Written Request**

At such time that the developer believes that the construction of all required public and private improvements have been completed, all improvements are accessible and visible for inspection, a written request for acceptance shall be submitted to the Public Works Director.

##### **10.1.1.2. Record Drawings**

A complete set of "as-constructed" drawings of the public improvements shall accompany the request for acceptance. Upon approval by the City, the developer will be required to submit a certified set of 3 mil mylar copies of the "as-constructed" drawings and a compact disc with PDFs and AutoDac Electronic files of the drawings. 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"). At a minimum, record drawings shall indicate the horizontal or vertical layout of all underground water, sanitary sewer, and storm sewer facilities (including distances between valves, fittings, manholes, etc.), profiles of streets, sanitary sewer mains and storm sewer mains, details of special or unusual installations, and detention pond volumes. If significant corrections to the improvements are noted during the acceptance inspection, the record drawings may be returned to the developer or contractor for revisions. The final submittal of record drawings shall include the mylar copy mentioned above along with a 24" x 36" copy with 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.

##### **10.1.1.3. Certification of Storm Drainage Detention**

**Registered Land Surveyor:** 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 sewer sizes and invert elevations at inlets, manholes, and discharge location, and representative open channel cross-sections, and dimensions of all the drainage structures.

**Registered Professional Engineer:** The responsible design engineer 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."



#### **10.1.1.4. Preparation of Corrections List**

Water and sewer utilities shall be inspected throughout installation. Upon completion of installation and prior to paving operations, a punch list shall be generated stating all discrepancies that relate to water and sewer utilities. Once a written request for acceptance, certification of storm drainage detention, and record drawings have been received, the Public Works Director will instruct the appropriate Engineering Construction Inspector to schedule an inspection of the improvements. The developer or his representative 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 plans, the Official Development Plan, the Public Improvements Agreement, 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 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 mailed to the developer.

#### **10.1.1.5. Correction of Deficiencies**

Correction list items shall be corrected within sixty (60) days of the date of the corrections list. If all of the noted deficiencies are not corrected within this time, the public improvements may be reinspected and any new defects may be added to the corrections 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.

#### **10.1.1.6. Written Acceptance**

Upon the completion of all items on the correction list and payment of all outstanding fees, reimbursements, and other items owed to the City, the Public Works Director will issue a written acceptance of the public improvements.

### **10.1.2 WARRANTY PERIOD**

#### **10.1.2.1. Duration**

All public improvements shall be subject to a warranty period of at least two (2) years after the date of the letter of acceptance from the Public Works Director.

#### **10.1.2.2. Maintenance Responsibility**

The developer shall be responsible for the maintenance of all public improvements during the warranty period. The Public Works Director will notify the developer of any maintenance that may be necessary during this time. Routine maintenance normally performed by the developer 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%).



### **10.1.2.3. 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 in the event of such emergency. However, if the developer or his representative cannot be contacted quickly or if the developer is unable to take immediate action to relieve the urgent situation, the City may proceed with such action as deemed necessary by the Public Works Director, and the developer will be billed for all costs of these actions at cost plus fifteen percent (15%).

## **10.1.3 END OF WARRANTY PROCEDURE**

### **10.1.3.1. Preparation of Corrections List**

At approximately 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. The developer or his representative will be invited to accompany the City's representative on all such inspections. The condition of the public improvements will be inspected for conformance with the approved plans, the Official Development Plan, the Public Improvements Agreement, 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 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.

### **10.1.3.2. Correction of Deficiencies**

Warranty correction list items should be corrected within 2 months of the date of the warranty correction list, unless authorized by the Public Works Director 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 reinspected, a revised correction list may be issued, and the end of the warranty period may be adjusted at the discretion of the Public Works Director 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.

### **10.1.3.3. Written Acknowledgment of End of Warranty**

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

## **10.1.4 ACCEPTANCE/WARRANTY INSPECTION CRITERIA**



**10.1.4.1. General**

All public and private improvements shall be installed in conformance with the approved plans, the Official Development Plan, the Public Improvements Agreement, and these STANDARDS AND SPECIFICATIONS. The Public Works Director shall be the final authority in the determination of defects and required corrections to public and private improvements.

**10.1.4.2. Grading and 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 2 of these STANDARDS AND SPECIFICATIONS.

**10.1.4.3. 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 3 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:

- a. All valves, blow-off installations, and fire hydrants shall be operable.
- b. 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.
- c. 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.
- d. 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.
- e. A minimum of five feet (5') of clearance for operation shall be provided around all fire hydrants and water valve risers.
- f. Manhole rims and covers for water valve vaults shall be adjusted to within one-eighth inch (1/4") below grade in paved areas or one inch (1") above grade in landscaped areas.
- g. The construction and operation of any required pumping systems shall be in conformance with the specifications issued and approved for that specific installation.
- h. All mains and manholes shall be free of construction debris, dirt, trash, and other foreign material.



- i. Manhole steps shall be properly spaced and aligned.

**10.1.4.4. 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 4 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:

- a. All mains and manholes shall be free of construction debris, dirt, trash, and other foreign material.
- b. The City's TV inspection of all sanitary sewer mains shall be completed prior to the acceptance of public and private improvements.
- c. 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.
- d. Manhole steps shall be properly spaced and aligned.
- e. The construction and operation of any required sewage lift systems shall be in conformance with the specifications issued and approved for that specific installation.

**10.1.4.5. Storm Sewer System**

The required inspection and testing of storm sewer mains and appurtenances that shall be performed are outlined in Chapter 5 of these STANDARDS AND SPECIFICATIONS. At the times of acceptance and warranty inspections of all public improvements, additional aspects of storm sewer system construction that shall be inspected include, but shall not be limited to, the following;

- a. All pipes and manholes shall be free of construction debris, dirt, trash, and other foreign material.
- b. The City's TV inspection of all sanitary sewer mains shall be completed prior to the acceptance of public and private improvements.
- c. 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.
- d. Manhole steps shall be properly spaced and aligned.
- e. Inlets shall be properly aligned to within one-eight inch (1/8") below grade next to sidewalk or curb and gutter.

**10.1.4.6. Concrete**

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:



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

**10.1.4.7. Roadway**

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:

- a. Breakage or cracking greater than 1/8".
- b. Ponding of any size.
- c. Settlement affecting drainage, pedestrian or traffic safety.
- d. Surface segregation of fines or aggregate
- e. Hazardous conditions
- f. Alligating
- g. Improper grade or inverted crown.



EROSION CONTROL

- EC1 CONCRETE WASHOUT
- EC2 VEHICLE TRACKING CONTROL
- EC3 SEDIMENT CONTROL LOG
- EC4 SILT FENCE EROSION BARRIER
- EC5 A&B SEDIMENT BASIN
- EC6 INLET PROTECTION
- EC7 INLET PROTECTION CURB SOCK

STREETS

- R1 LOCAL TYPICAL SECTION
- R2 ARTERIAL/COLLECTOR TYPICAL SECTION
- R3 VERTICAL CURB AND GUTTER
- R4 COMBINATION CURB, GUTTER AND WALK
- R5 CURB RAMP COMBINATION - CURB, GUTTER AND WALK
- R6 CURB RAMP BARRIER - CURB AND WALK
- R7 SIDEWALK RAMP WITH CROSS PAN BARRIER CURB
- R8 RAMP DRIVE FOR VERTICAL CURB, ATTACHED WALK
- R9 RAMP DRIVE FOR MOUNTABLE CURB AND DETACHED WALK
- R10 STANDARD SIDEWALK CHASE DRAIN DETAIL
- R11 CHASE DRAIN DETAILS
- R12 MEDIAN COVER MATERIAL ( PATTERNED CONCRETE)
- R13 MEDIAN EDGING ( PATTERNED CONCRETE )
- R14 SLEEVE DETAIL

SANITARY SEWER

- SS1 STANDARD MANHOLE BASE
- SS2 MANHOLE BARRELS AND ALTERNATE TOPS
- SS3 MONOLITHIC BASES FOR DROP MANHOLE
- SS4 DROP MANHOLE DETAIL
- SS5 INTERMEDIATE PLATFORM FOR MANHOLES OVER 17' IN DEPTH
- SS6 TYPICAL TRENCH SECTION PIPE PROTECTION
- SS7 TYPICAL HOUSE SERVICE LOCATION
- SS8 STANDARD CLEAN-OUT DETAIL
- SS9 JACKING DETAIL
- SS10 TYPICAL UNDERDRAIN CLEANOUT DETAIL
- SS11 ENCASEMENT FOR CONDUIT CROSSINGS
- SS12 MANHOLE COVER DETAIL
- SS13 STANDARD SANITARY SEWER UNDERDRAIN CLEANOUT
- SS14 TYPICAL GREASE AND SAND/OIL INTERCEPTOR DETAIL

STORM SEWER


- ST1 STANDARD MANHOLE BASE
- ST2 MANHOLE BARRELS AND ALTERNATIVE TOPS
- ST3 INTERMEDIATE PLATFORM FOR MANHOLES OVER 17' IN DEPTH
- ST4 TYPICAL PIPE BEDDING
- ST5A-C CURB INLET - TYPE R
- ST6 STORM SEWER MANHOLE COVER DETAIL
- ST7 ENCASEMENT FOR CONDUIT CROSSINGS

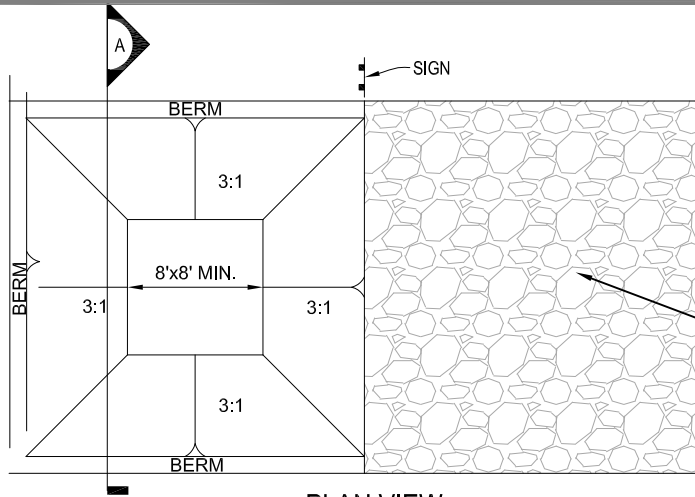
TRAFFIC

- T1 TRAFFIC SIGNAL POLE
- T2 POLE AND SIGNAL ARM DATA
- T3 SIGNAL POLE TABLES 2, 3 AND 4
- T4 SIGNAL POLE LOADING INFORMATION
- T5 TRAFFIC SIGNAL SERIES DETAILS
- T6 TRAFFIC SIGNAL POLE SERIES DETAILS 5-9
- T7 MAST ARM POLE FOUNDATION DETAILS
- T8 TYPICAL SIGN POST ANCHOR DETAIL
- T9 PEDESTRIAN PUSH BUTTON POST AND SIGN
- T10 SIGNAL POLE AND MAST ARM MOUNTING DETAILS
- T11 LOOP DETECTOR/PULL BOX DETAILS WATER VALVE STEM TYPE ( wvPB)
- T12 LOOP DETECTOR DETAILS
- T13 TRAFFIC SIGNAL PULL BOX
- T14 GENERAL INSTALLATION NOTES
- T15 SCHOOL FLASHING BEACON ASSEMBLY SIDE OF ROAD
- T16 SCHOOL FLASHING BEACON ASSEMBLY - OVERHEAD
- T17 SCHOOL FLASHING BEACON ASSEMBLY - OVERHEAD BACK VIEW

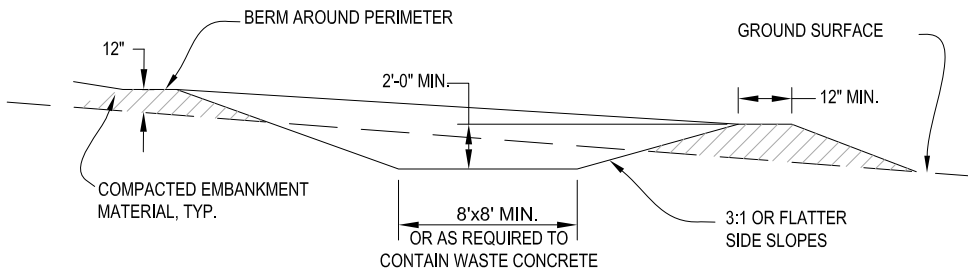
WATER STANDARDS

- W1 TYPICAL TRENCH SECTION PIPE PROTECTION
- W2 FIRE HYDRANT INSTALLATION DETAIL
- W3 CONCRETE THRUST BLOCKS BEARING SURFACES AND INSTALLATION
- W4 CONCRETE THRUST BLOCKING FOR UNBALANCED FITTINGS
- W5 POLYETHYLENE WRAP FOR DUCTILE IRON PIPE
- W6 TRACER WIRE ON PLASTIC PIPE
- W7 SETTINGS FOR 5/8" X 3/4" AND 1" METERS
- W8 METER SETTING FOR 1 1/2" AND 2" METER WITH VALVE AND BYPASS
- W9 STANDARD 3" AND 4" METER SETTING DETAIL
- W10 TYPICAL METER VAULT
- W11 STANDARD CONCRETE METER SUPPORTS
- W12 WALL AND BODY CLAMPS 3" METER
- W13 WALL CLAMPS FOR 4" TO 12" METERS
- W14 WALL CLAMPS FOR 4" TO 12" METERS
- W15 A.C. TO D.I. PIPE ADAPTER
- W16 CONDUIT CROSSING
- W17 STANDARD AIR VALVE INSTALLATION
- W18 BUTTERFLY VALVE INSTALLATION IN WATER MAINS 16" OR LARGER
- W19 WATER DISTRIBUTION SYSTEM TYPICAL PLAN FOR CUL-DE SACS
- W20 BORING DETAIL
- W21 TRANSMISSION MAIN BLOW-OFF INSTALLATION
- W22 WATER MANHOLE COVER DETAIL
- W23 RESIDENTIAL SERVICE TAP

REVISIONS				PUBLIC WORKS DEPARTMENT ENGINEERING DIVISION	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			TABLE OF CONTENTS	APPROVED BY:	DHW	
				DRAWING NO:	X-X	
				SCALE:	N.T.S.	



**PLAN VIEW**




**SECTION A**

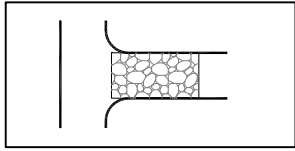
**CONCRETE WASHOUT AREA INSTALLATION NOTES:**

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.

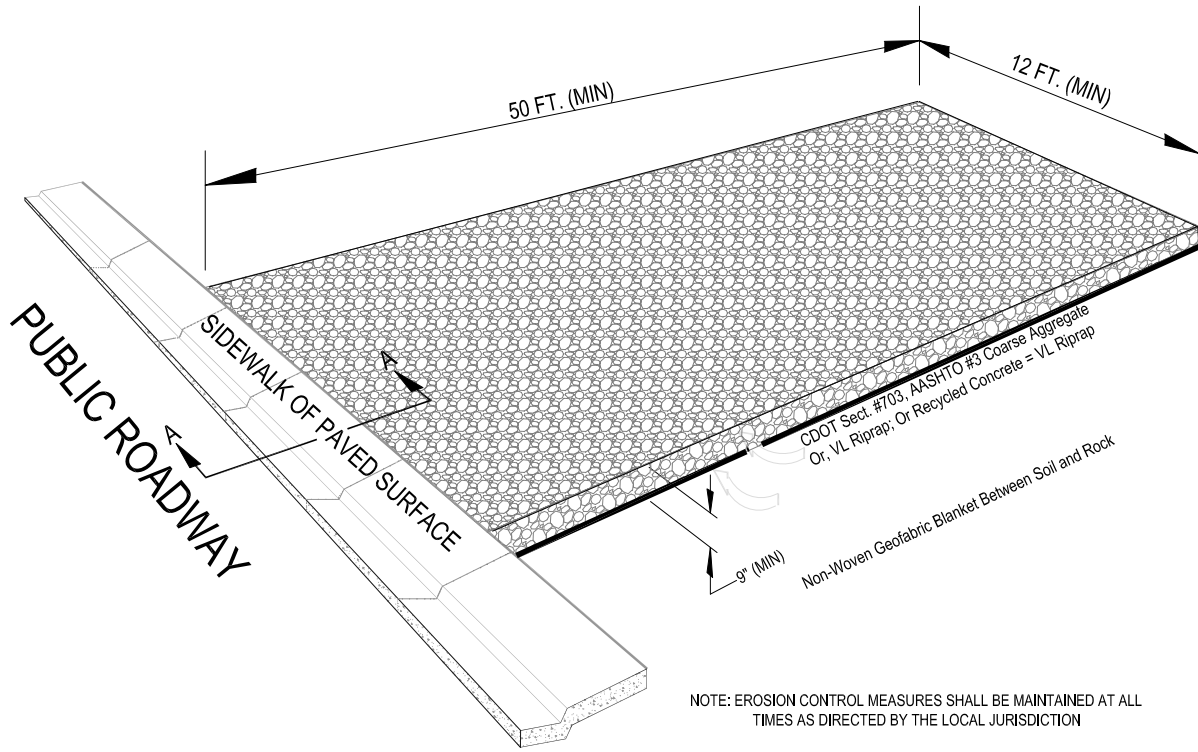
**CONCRETE WASHOUT AREA MAINTENANCE NOTES:**

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.

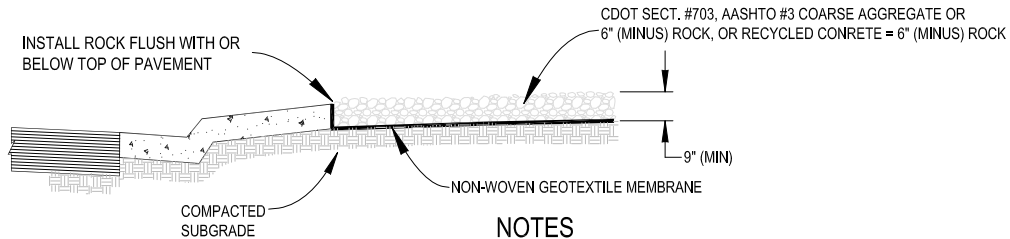
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:	
DATE	ITEM	BY		CONCRETE WASHOUT		DRAWN BY:	JLT
						APPROVED BY:	
					DRAWING NO:	EC1	
					SCALE:	N.T.S.	



VTC



NOTE: EROSION CONTROL MEASURES SHALL BE MAINTAINED AT ALL TIMES AS DIRECTED BY THE LOCAL JURISDICTION




SECTION A-A

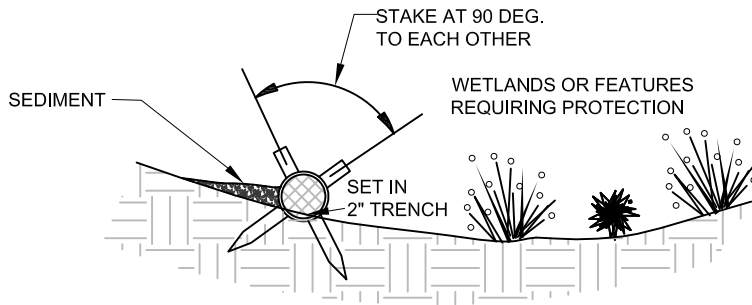
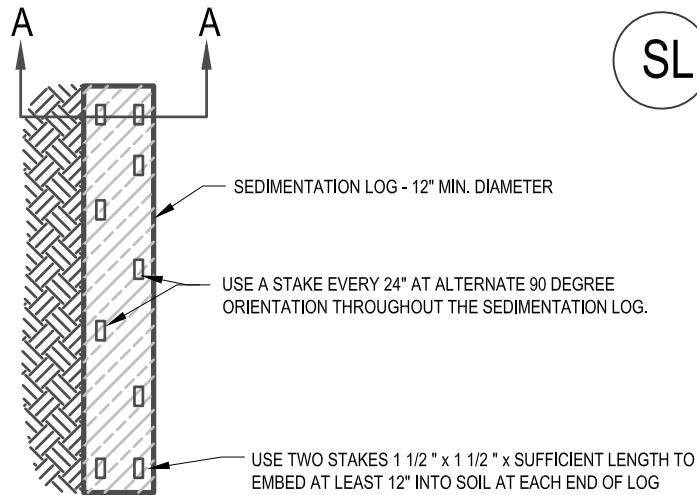
**NOTES**

1. 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.

## DETAIL VEHICLE TRACKING CONTROL

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			VEHICLE TRACKING CONTROL	APPROVED BY:		
				DRAWING NO:	EC2	
				SCALE:	N.T.S.	

SL




### SECTION A-A

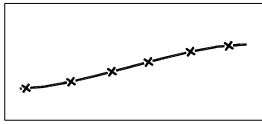
#### SEDIMENT CONTROL LOG INSTALLATION NOTES

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".

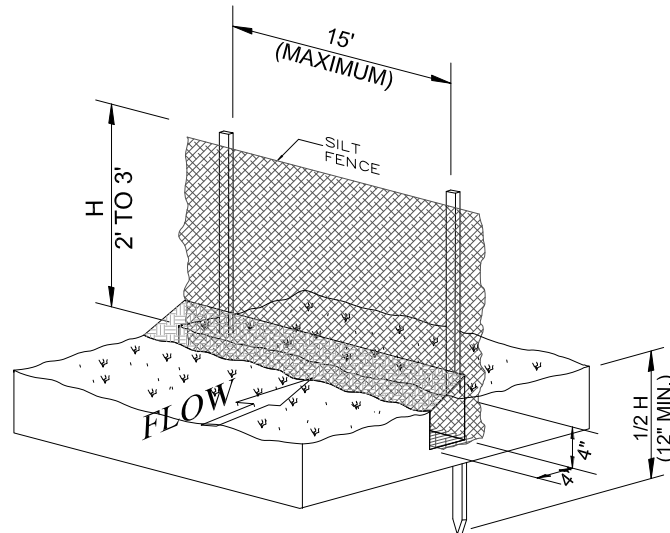
#### SEDIMENT CONTROL LOG MAINTENANCE NOTES

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.

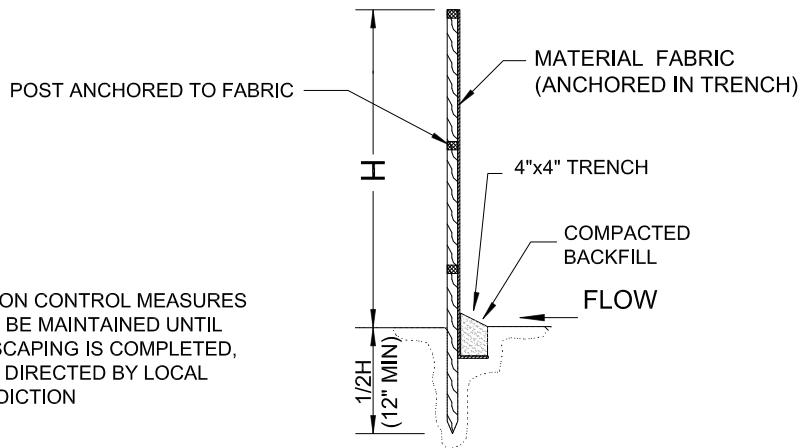
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			SEDIMENT CONTROL LOG	APPROVED BY:		
					DRAWING NO:	EC3
				SCALE:	N.T.S.	



SF




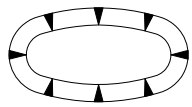
SILT FENCE INSTALLATION



NOTE: EROSION CONTROL MEASURES SHALL BE MAINTAINED UNTIL LANDSCAPING IS COMPLETED, OR AS DIRECTED BY LOCAL JURISDICTION

SECTION

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			SILT FENCE EROSION BARRIER	APPROVED BY:		
				DRAWING NO:	EC4	
				SCALE:	N.T.S.	



5.0 x 5.0 x 2.0 D RIPRAP PAD  
 D<sub>50</sub> = 9", TYPE L. (SEE TABLE  
 MD-7, MAJOR DRAINAGE,  
 VOL. 1 OR AS CALLED OUT  
 ON THE PLANS)

INLETS TO SEDIMENT BASIN  
 SHALL ENTER AT FURTHEST  
 DISTANCE TO OUTLET AND SHALL  
 CONSIST OF TEMPORARY SLOPE  
 DRAIN (SEE TSD DETAILS)

RELATIVE ELEVATION, TYP.

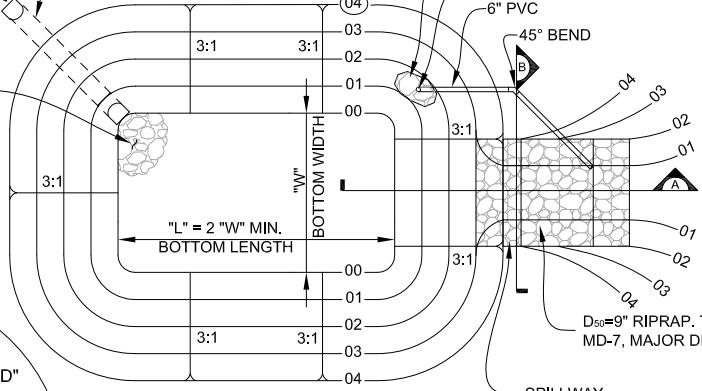
1" TO 2" CRUSHED ROCK

RISER PIPE

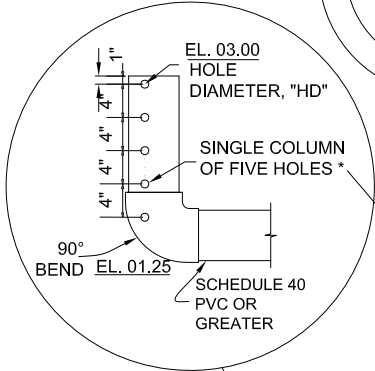
6" PVC

45° BEND

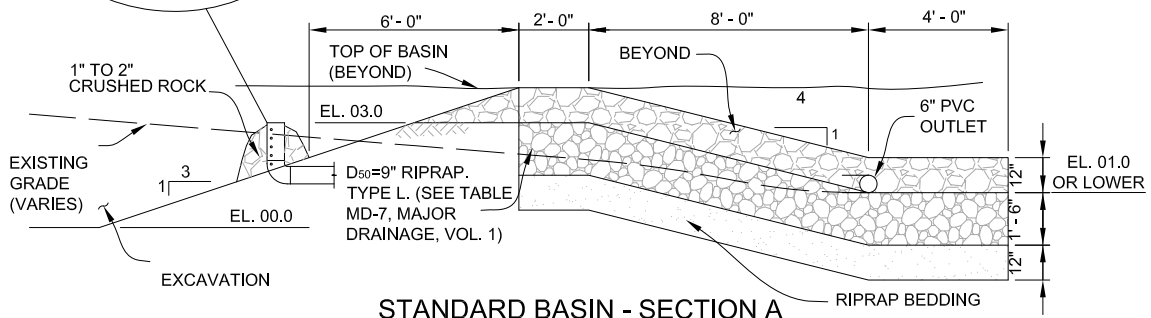
D<sub>50</sub>=9" RIPRAP. TYPE L. (SEE TABLE  
 MD-7, MAJOR DRAINAGE, VOL. 1)



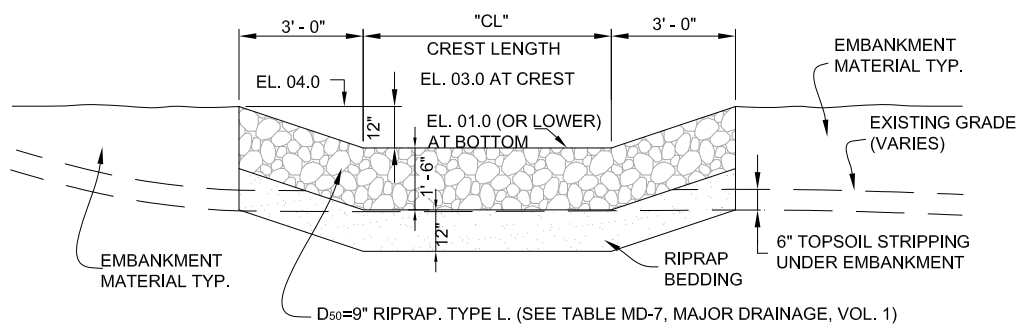
**STANDARD BASIN - PLAN**




\* EXCEPT WHERE THE HOLES EXCEED  
 1" DIAMETER, THEN UP TO TWO  
 COLUMNS OF SAME SIZED HOLES  
 MAY BE USED (ONE COL. PREFERRED)

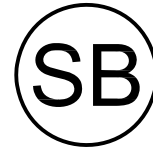
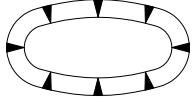


**STANDARD BASIN - SECTION A**



**STANDARD BASIN - SECTION B**

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			<b>SEDIMENT BASIN</b>	APPROVED BY:		
				DRAWING NO:	EC5A	
				SCALE:	N.T.S.	



SIZING INFORMATION FOR STANDARD SEDIMENT BASIN			
Upstream Drainage Area (rounded to nearest acre), (ac)	Basin Bottom Width (W), (ft)	Spillway 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

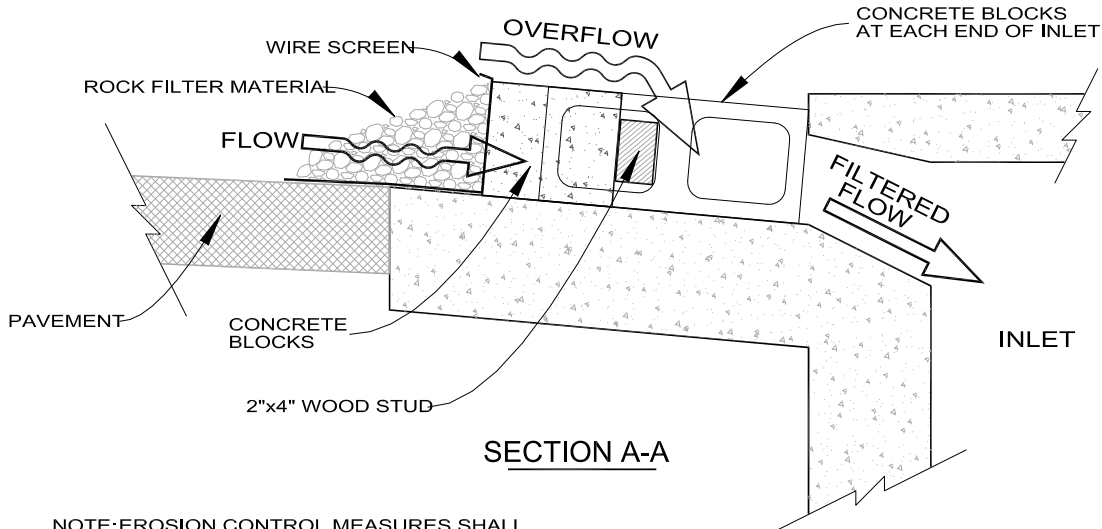
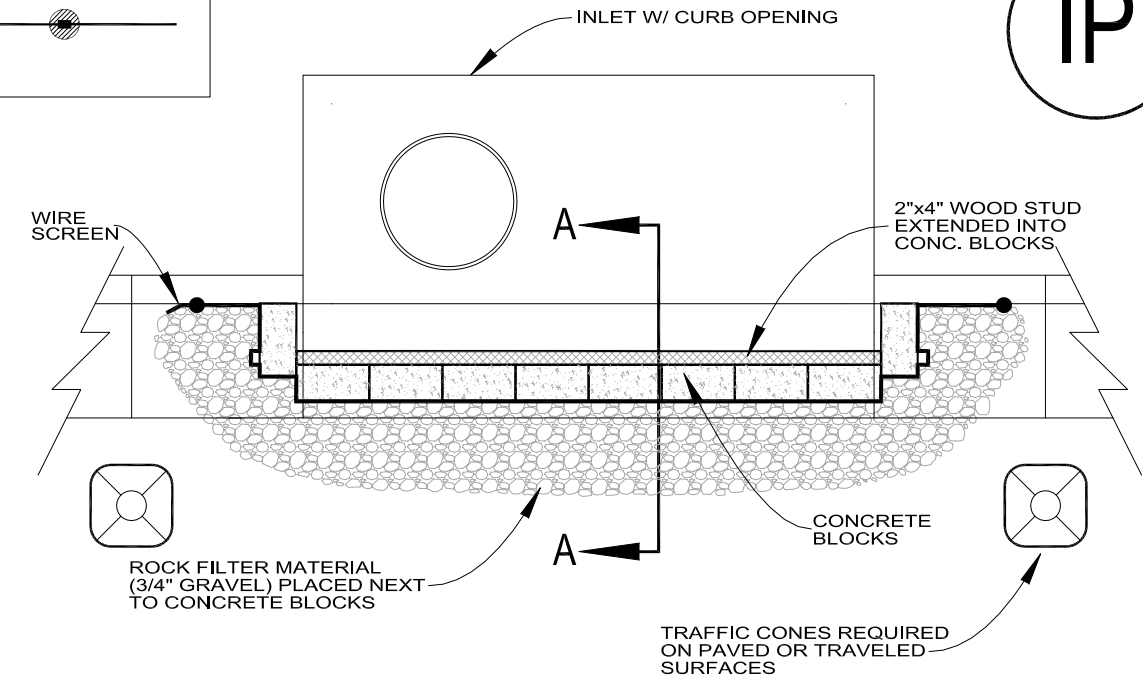
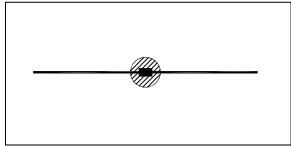
- SEE PLAN VIEW AND SECTIONS FOR:
  - LOCATION OF SEDIMENT BASIN.
  - TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
  - FOR STANDARD BASIN, BOTTOM WIDTH, "W", CREST LENGTH, "CL", AND HOLE DIAMETER, "HD".
  - FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT, "H", NUMBER OF COLUMNS, "N", HOLE DIAMETER, "HD", AND PIPE DIAMETER "D".
- FOR STANDARD BASIN, BOTTOM DIMENSION 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-DISTURBING 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 SHOWN 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				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			SEDIMENT BASIN	APPROVED BY:		
				DRAWING NO:	EC5B	
				SCALE:	N.T.S.	

IP



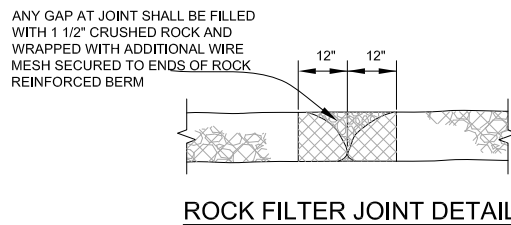
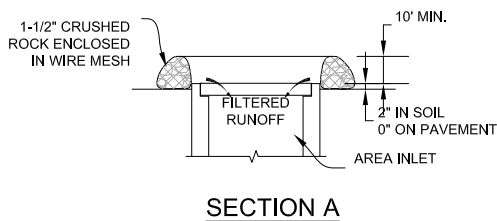
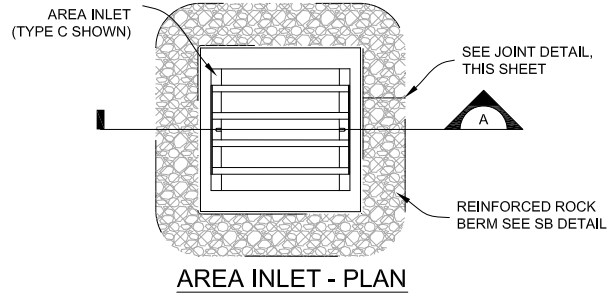
NOTE: EROSION CONTROL MEASURES SHALL BE MAINTAINED AT ALL TIMES AS DIRECTED BY THE LOCAL JURISDICTION

## DETAIL CURB INLET GRAVEL FILTER

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JL T
			CURB INLET GRAVEL FILTER	APPROVED BY:		
					DRAWING NO:	EC6
					SCALE:	N.T.S.



INLET PROTECTION CONTINUED




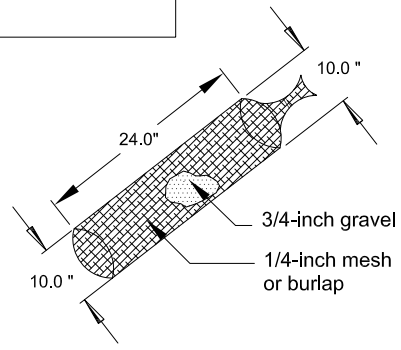
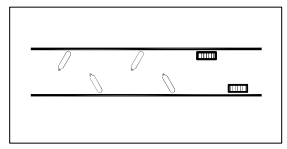
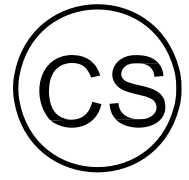
INLET PROTECTION INSTALLATION NOTES

1. INLET PROTECTION AFTER INLET CONSTRUCTION OR AFTER PAVEMENT SHALL BE INSTALLED WITHIN 48 HOUR AFTER INLET CONSTRUCTION OR PAVING IS COMPLETED.
2. CRUSHED ROCK SHALL BE FRACTURED FACE (ALL SIDES) AND SHALL COMPLY WITH GRADATION SHOWN IN CDOT SECT. 703-2, #4 aggregate (1-1/2" MINUS). RECYCLED CONCRETE MEETING THIS GRADATION MAY BE USED.
3. WIRE MESH SHALL BE FABRICATED OF 10 GAUGE WIRE TWISTED INTO A MESH WITH A MAXIMUM OPENING OF 1.0 INCH (COMMONLY 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 AT 2-INCH CENTERS ON ENDS OF BERM.
5. REINFORCED ROCK BERM SHALL BE CONSTRUCTED IN ONE PIECE OR SHALL BE CONSTRUCTED USING JOINT DETAIL.

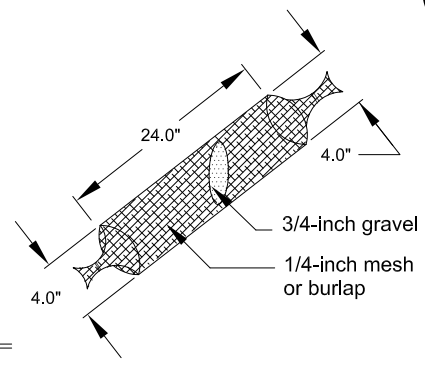
INLET PROTECTION MAINTENANCE NOTES

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. REPAIRS AS NEEDED.
2. SEDIMENT ACCUMULATED UPSTREAM OF INLET PROTECTION SHALL BE REMOVED WHEN THE SEDIMENT DEPTH UPSTREAM OF ROCK BERM IS WITHIN 2-1/2 INCHES OF THE 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.

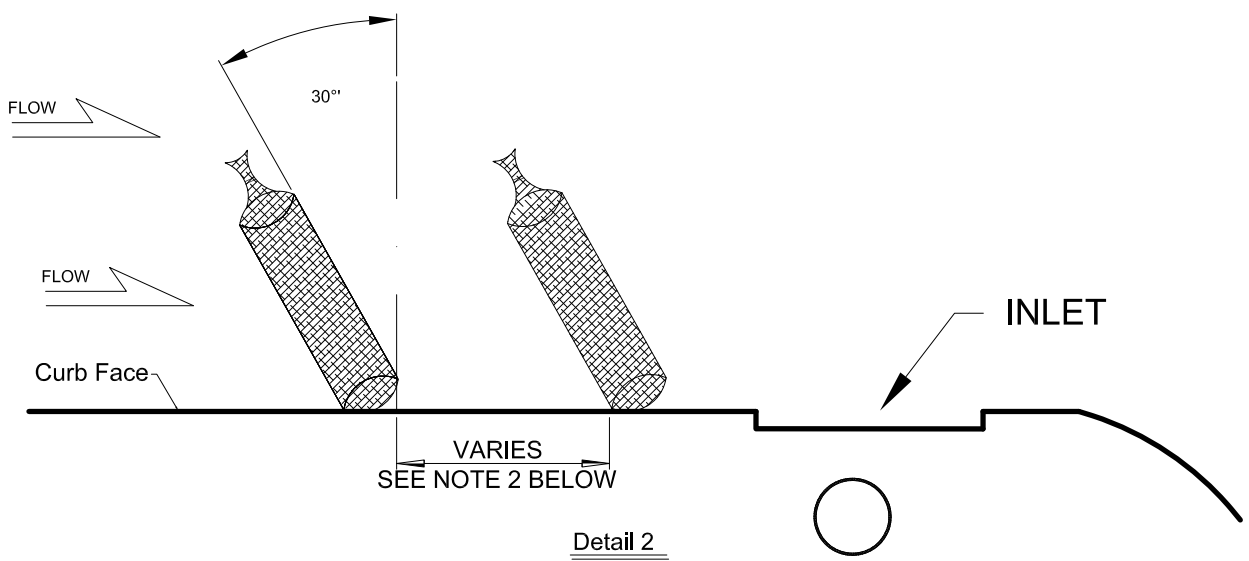
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JL T
			<b>INLET PROTECTION</b>	APPROVED BY:		
				DRAWING NO:	EC7	
				SCALE:	N.T.S.	



OR




Detail 1

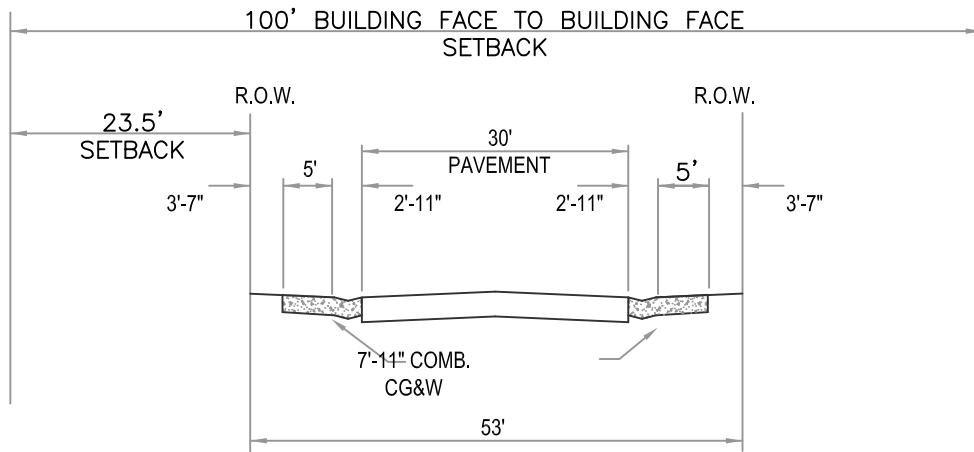


Detail 2

NOTES:

- 1) Socks will be used upgradient of inlet perpendicular to and flush with curb.
- 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, also 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.

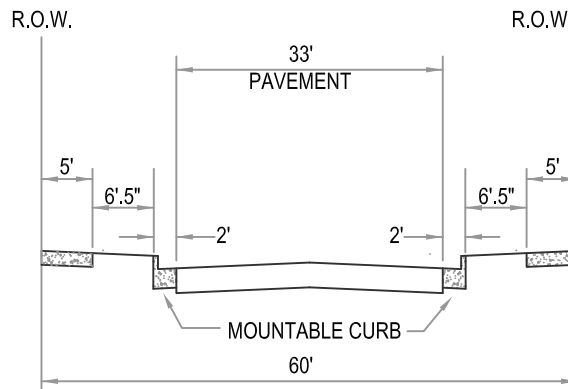
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			INLET PROTECTION CURB SOCK	APPROVED BY:		
				DRAWING NO:	EC8	
				SCALE:	N.T.S.	




- PARKING ALLOWED ON BOTH SIDES OF STREET
- UTILIZED IN SINGLE FAMILY RESIDENTIAL AREAS

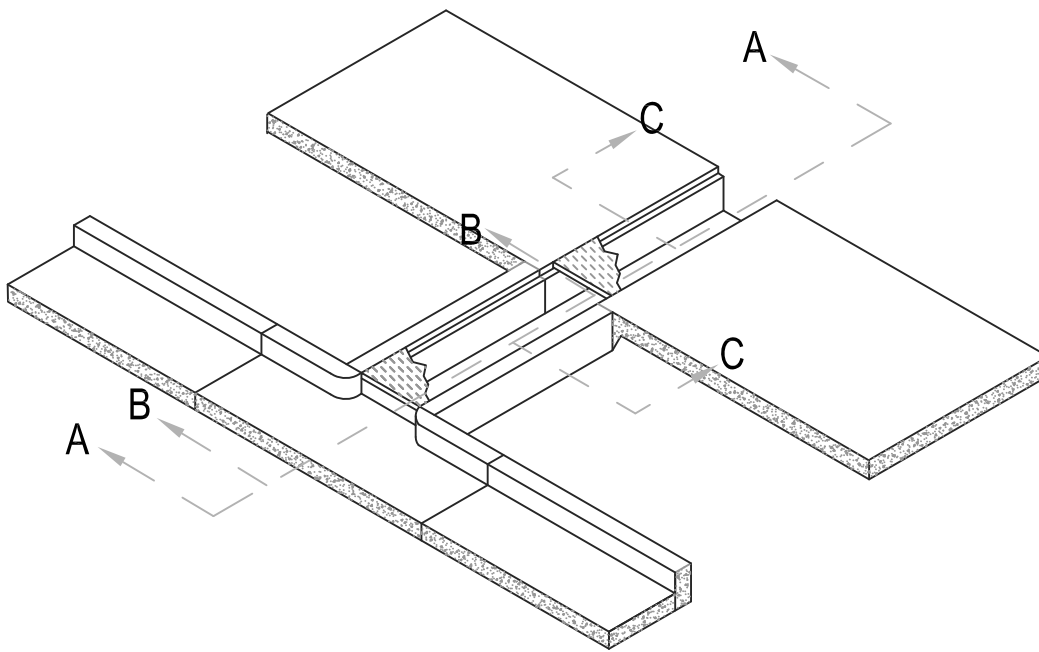
### LOCAL W/ ATTACHED WALK

TO BE USED ONLY WITH WRITTEN PERMISSION FROM THE PUBLIC WORKS DIRECTOR

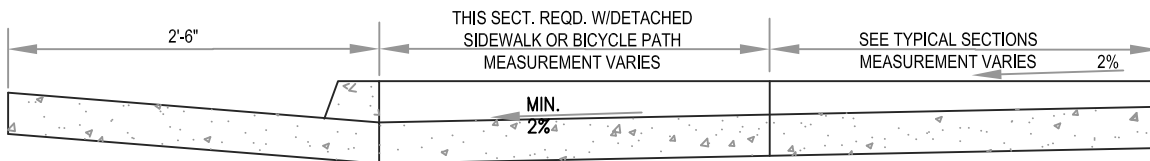


- PARKING ALLOWED ON BOTH SIDES OF STREET
- UTILIZED IN SINGLE FAMILY RESIDENTIAL AREAS


REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	
DATE	ITEM	BY		ISSUED:	
				DRAWN BY: JLT	
				APPROVED BY:	
				DRAWING NO: R1	
				SCALE: N.T.S.	
			LOCAL TYPICAL SECTION		



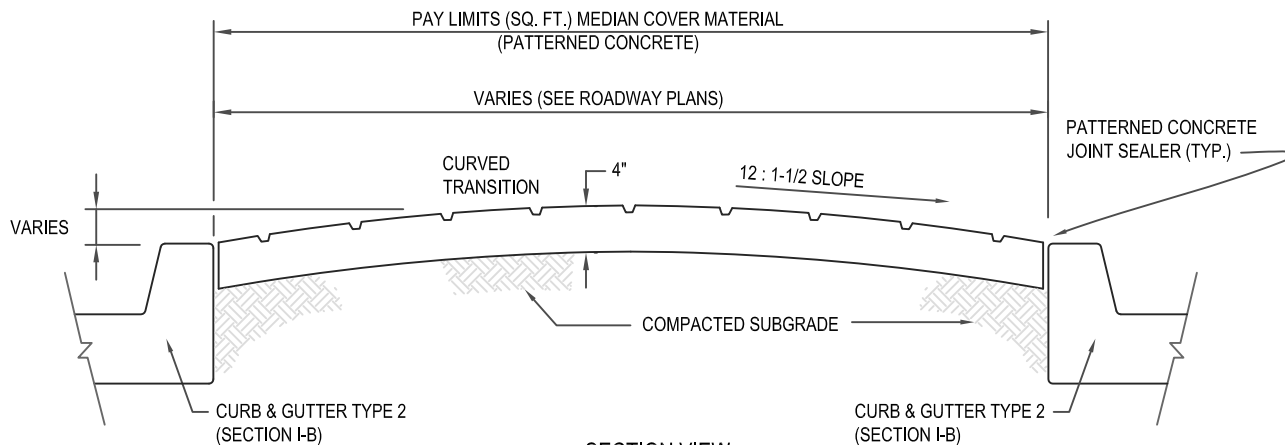
**CHASE DRAIN**



**SECTION A-A**

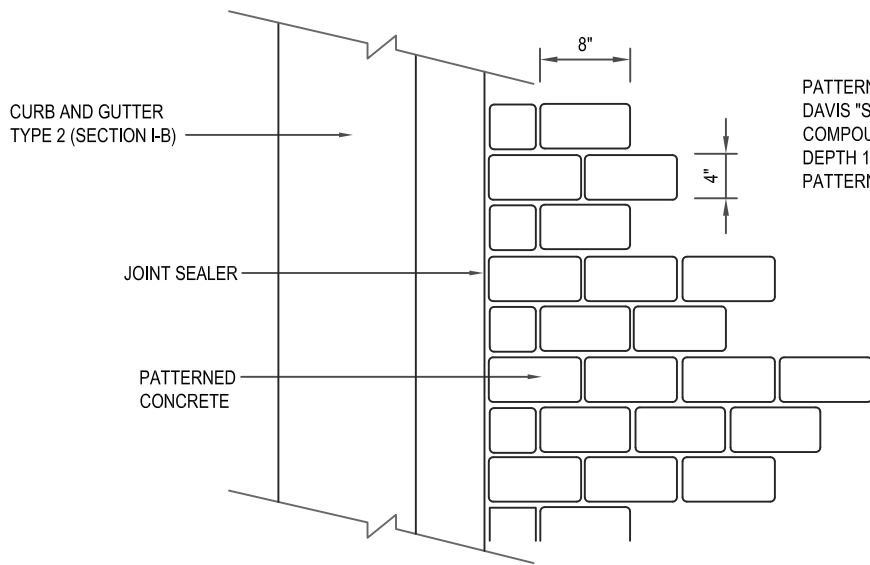
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:	
DATE	ITEM	BY				DRAWN BY:	JLT
			<b>STANDARD SIDEWALK CHASE DRAIN DETAIL</b>		APPROVED BY:		
					DRAWING NO:	R10	
					SCALE:	N.T.S.	






**SECTION VIEW**

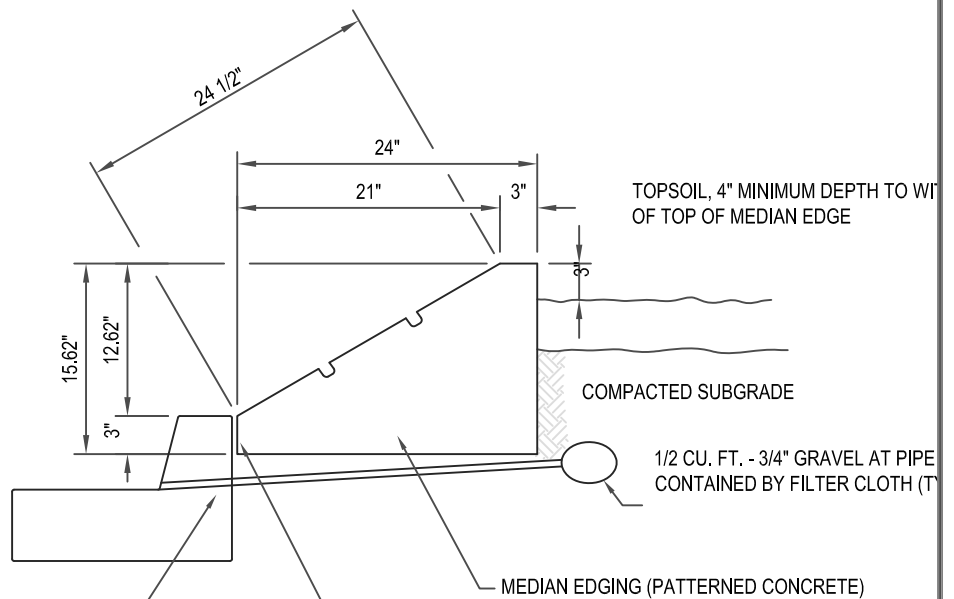
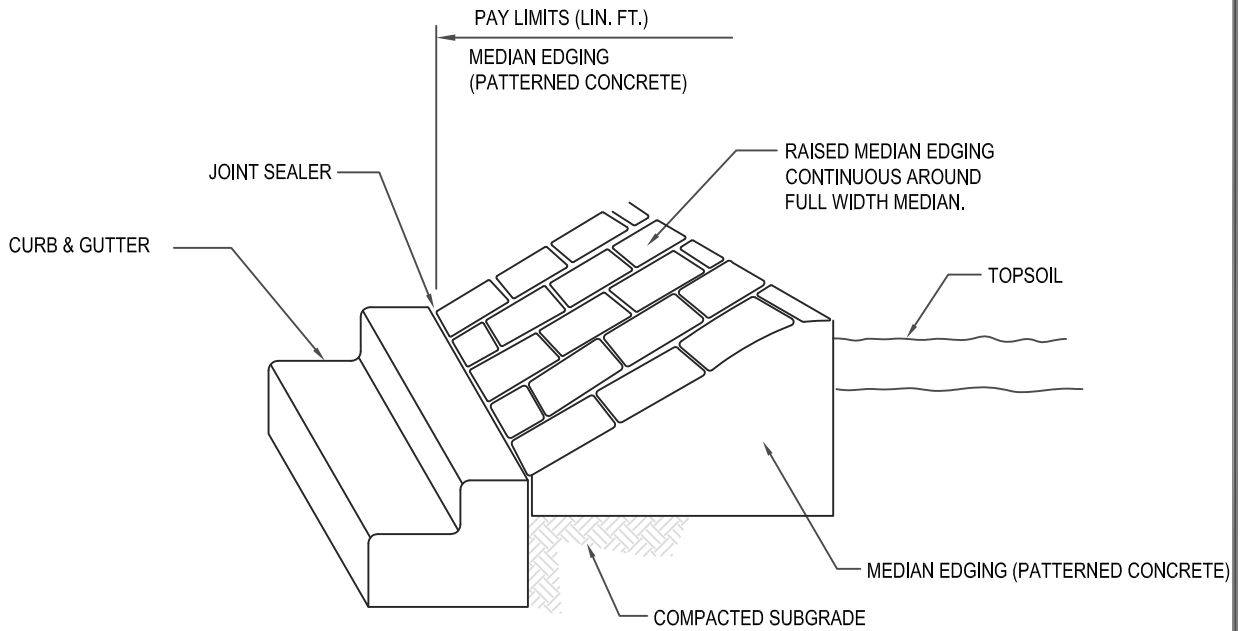
PLACE JOINT SEALER IN JOINT BETWEEN PATTERNED CONCRETE ABUTTING CONCRETE (TYP). JOINT SEALER TO BE PEARL WHITE SIKAFLEX-2C OR APPROVED EQUAL. COST OF JOINT SEALER TO BE INCLUDED IN ITEM 610 - PATTERNED CONCRETE.




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.

**PLAN VIEW**

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			MEDIAN COVER MATERIAL ( PATTERNED CONCRETE )	APPROVED BY:		
				DRAWING NO:	R12	
				SCALE:	N.T.S.	

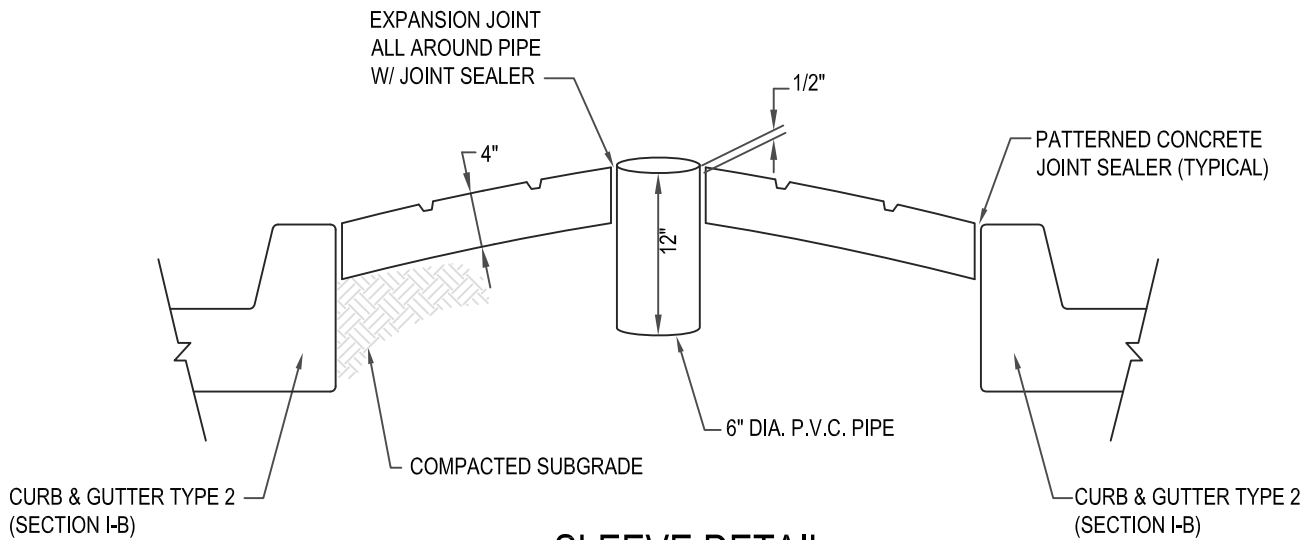


WEEP HOLE WITH 3/4" PVC PIPE  
 CONSTRUCTED AT 20' SPACING CENTERS  
 WITH 1/2 CU. FT. GRAVEL PACK. COST OF  
 ALL MATERIALS TO BE INCLUDED IN MEDIAN  
 EDGING (PATTERNED CONCRETE) PLACE  
 WEEP HOLES UNDER ALL RAISED MEDIAN  
 EDGING THAT ABUTS CURBING.


REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
					APPROVED BY:	
					DRAWING NO:	R13
					SCALE:	N.T.S.

MEDIAN EDGING  
 ( PATTERNED CONCRETE )

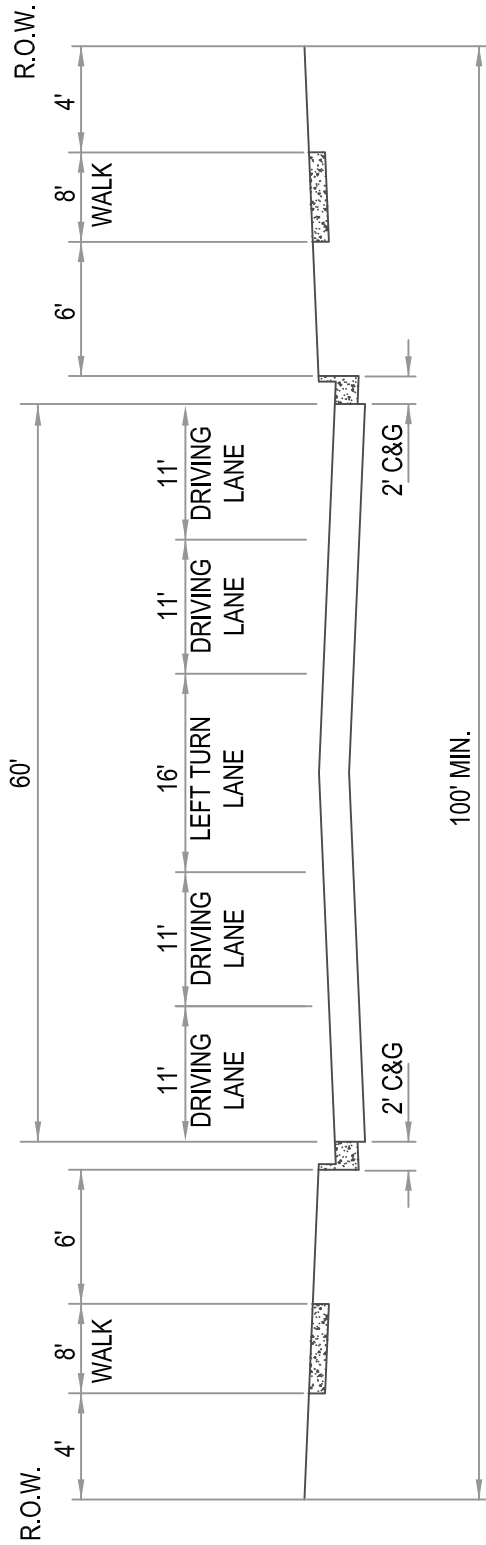
USE SLEEVE WHERE TRAFFIC SIGN POST IS TO BE PLACED IN MEDIAN ISLAND WITH PATTERNED CONCRETE. INCLUDE COST IN ITEM 614-STEEL SIGN POST. (LOCATION AS DIRECTED BY ENGINEER.)



**SLEEVE DETAIL**

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			SLEEVE DETAIL	APPROVED BY:		
				DRAWING NO:	R14	
				SCALE:	N.T.S.	





**ARTERIAL**

- NO PARKING ALLOWED.
- MEDIAN MAY BE PAINTED OR CURBED. .

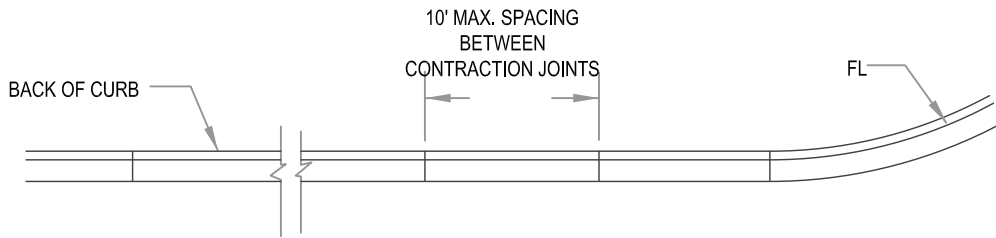
REVISIONS		
DATE	ITEM	BY



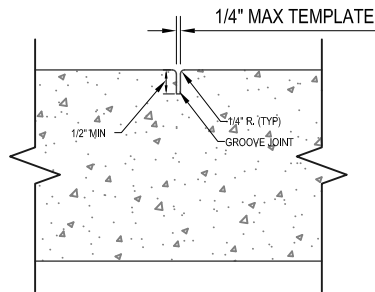
DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

ARTERIAL TYPICAL SECTION

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	R2
SCALE:	N.T.S.

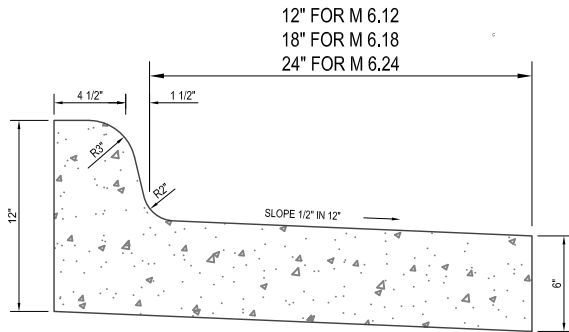


LAYOUT

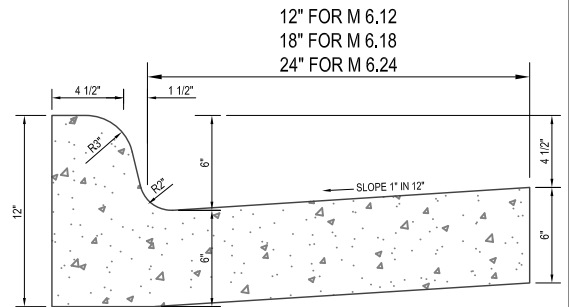


CONTRACTION JOINT

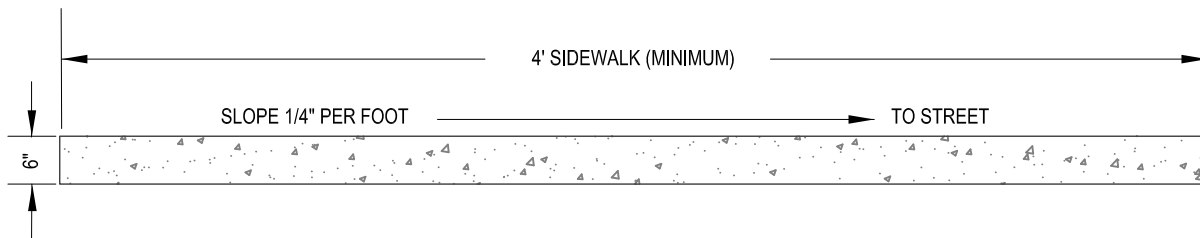
10' MAXIMUM SPACING  
FOR EXPANSION JOINT INFORMATION, SEE DETAIL B-6-A




6" VERTICAL MEDIAN CURB AND GUTTER

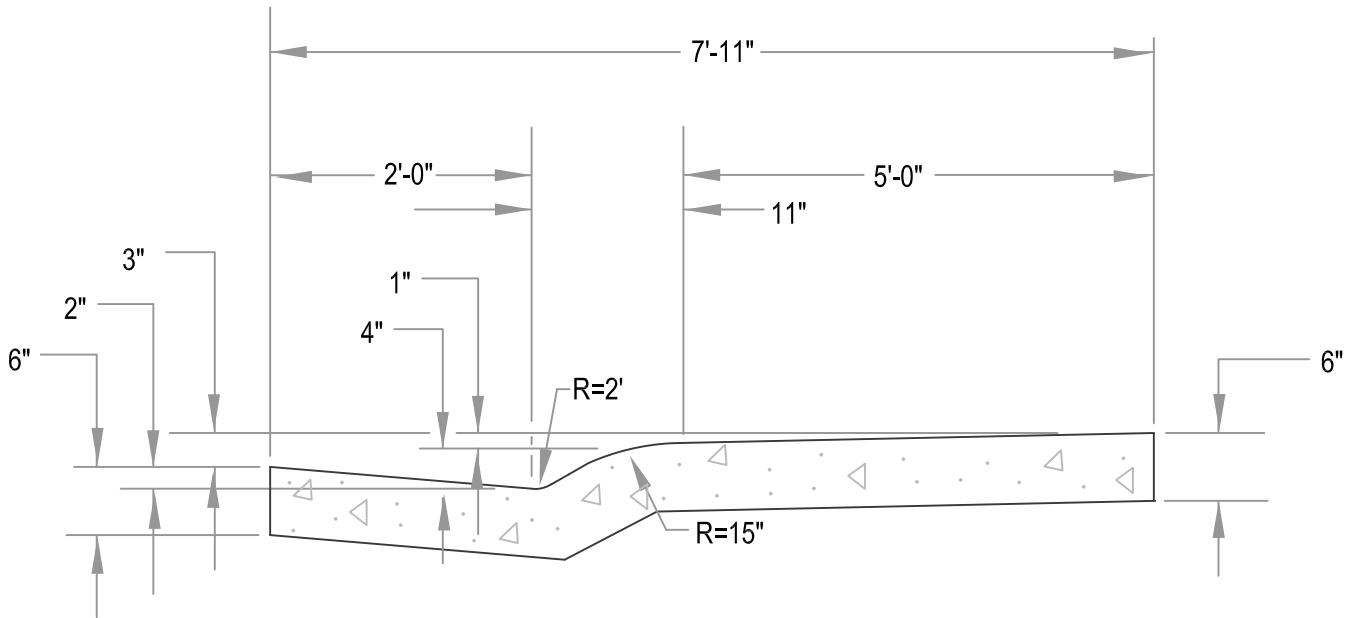


6" VERTICAL CURB AND GUTTER

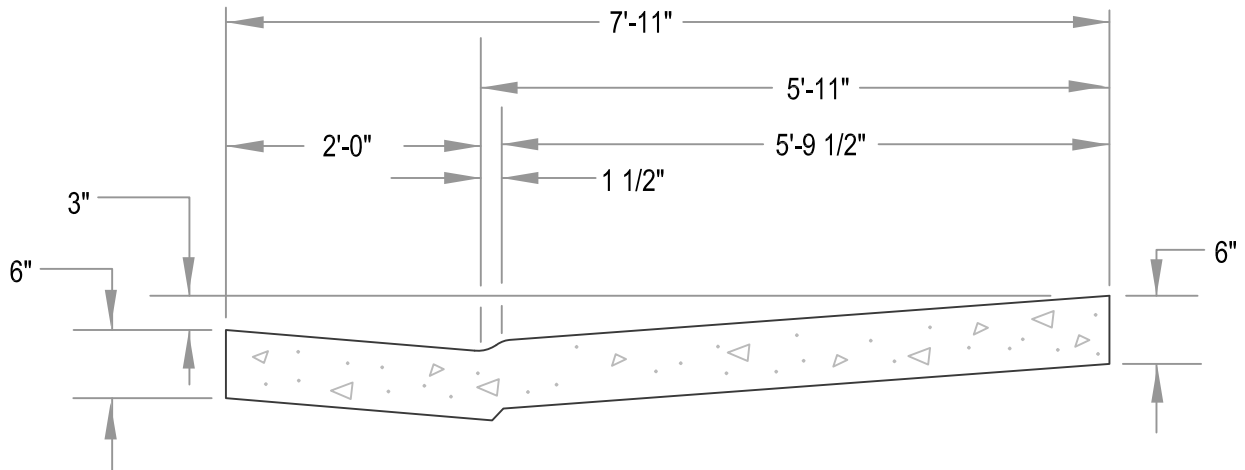


ATTACHED OR DETACHED WALK


REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			VERTICAL CURB AND GUTTER	APPROVED BY:		
				DRAWING NO:	R3	
				SCALE:	N.T.S.	



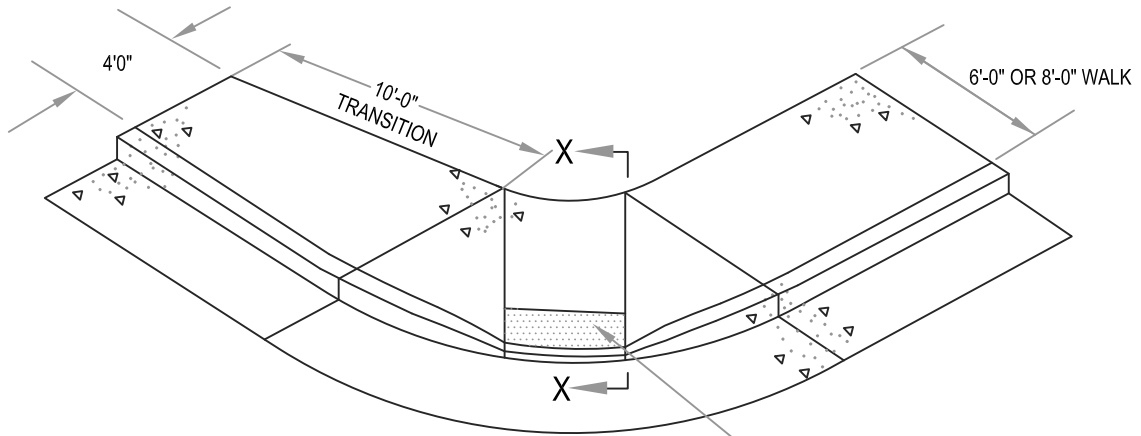
**COMBINATION CURB, GUTTER & WALK**  
**STANDARD SECTION**



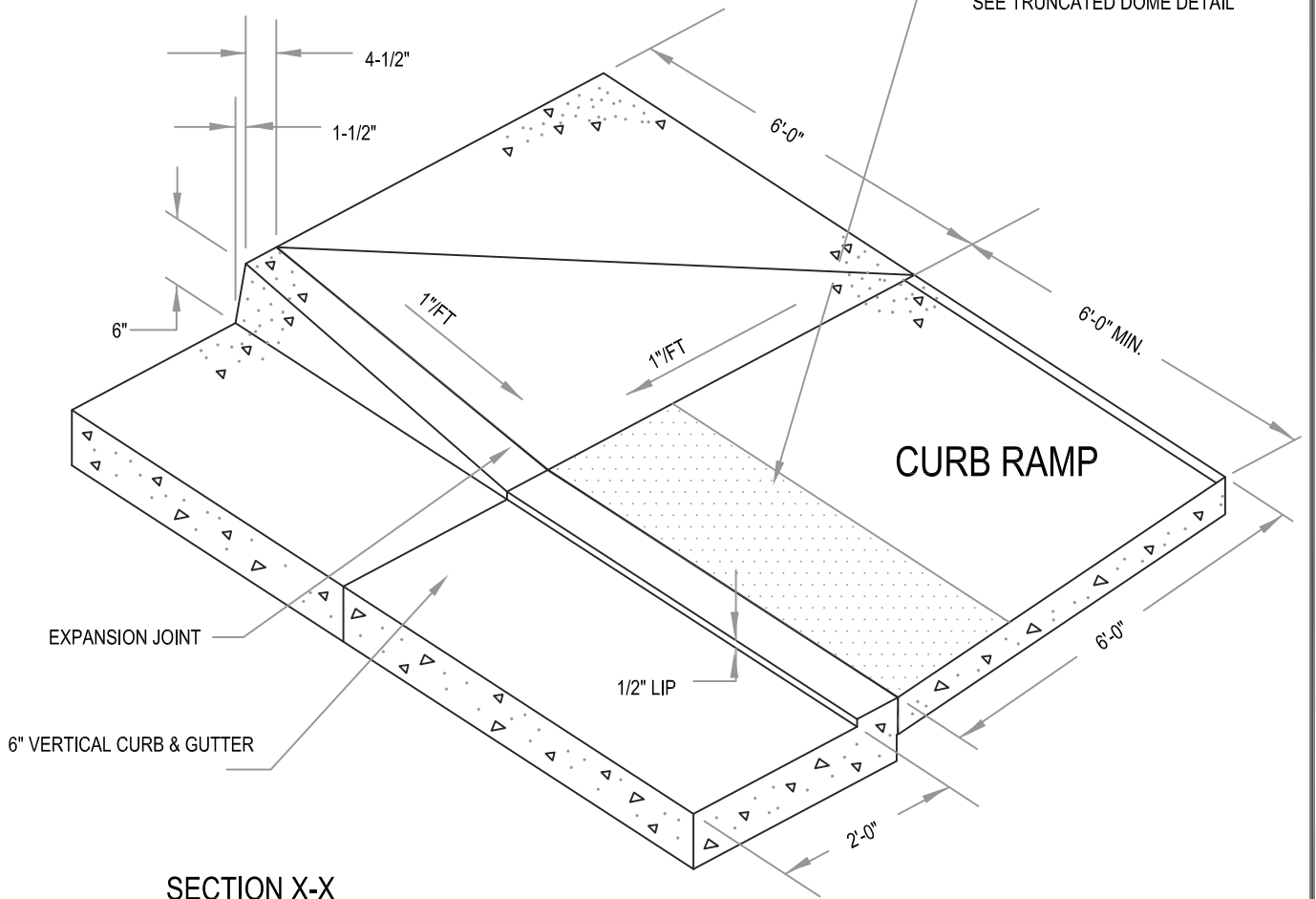
**COMBINATION CURB, GUTTER & WALK**  
**DEPRESSED SECTION**

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:	
DATE	ITEM	BY				DRAWN BY:	JLT
					APPROVED BY:		
			COMBINATION CURB , GUTTER AND WALK		DRAWING NO:	R4	
					SCALE:	N.T.S.	






TRUNCATED DOMES DETECTABLE WARNING SURFACE  
SEE TRUNCATED DOME DETAIL

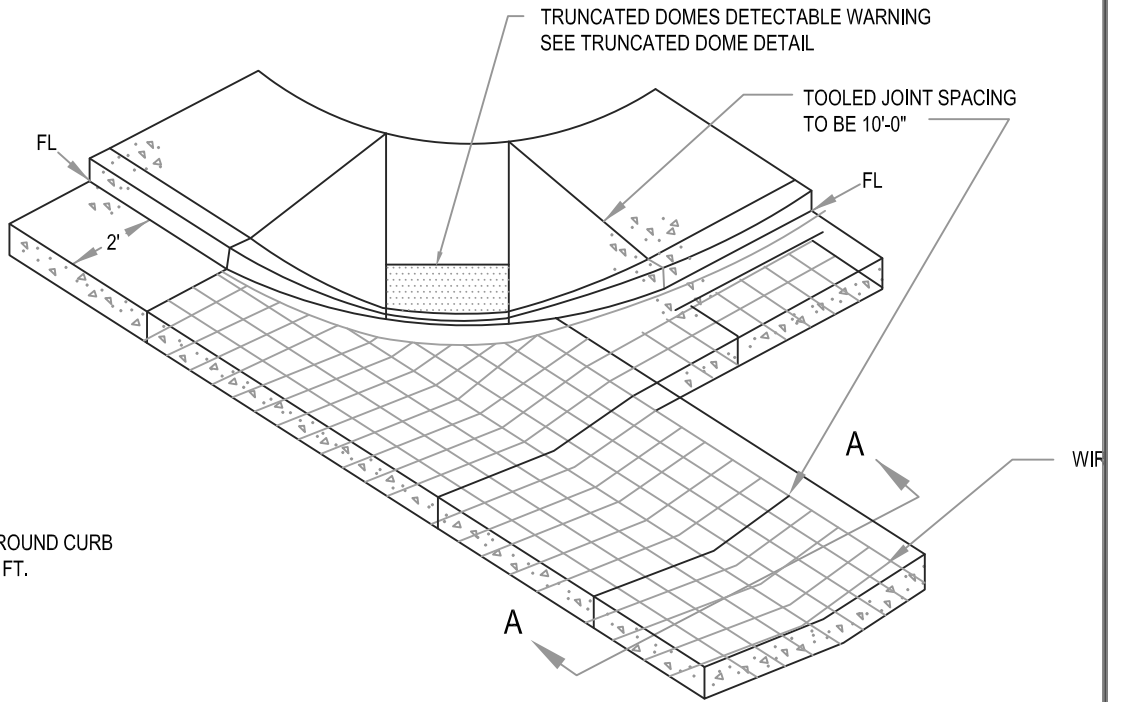


**SECTION X-X**

NOTE:

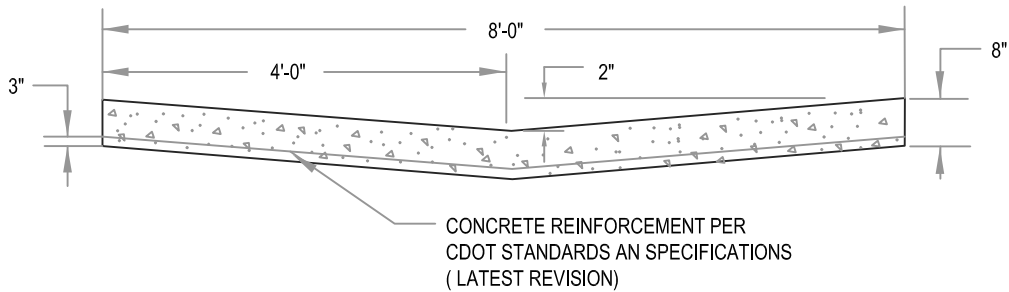
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
					APPROVED BY:	
					DRAWING NO:	R6
					SCALE:	N.T.S.

CURB RAMP BARRIER  
CURB AND WALK




NOTE:  
MINIMUM FACE FACE AROUND CURB  
RETURNS SHALL BE 0.3 FT.

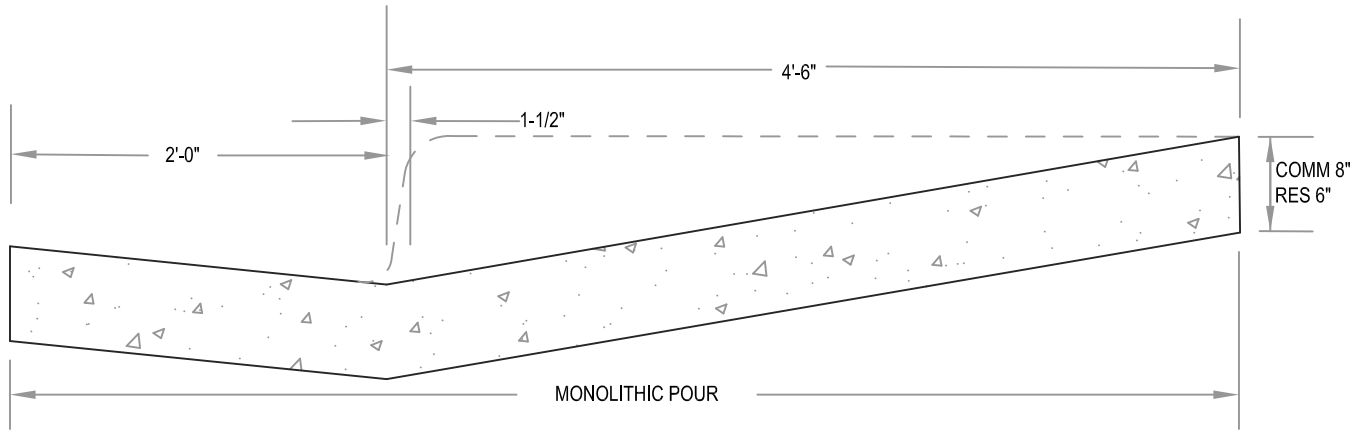
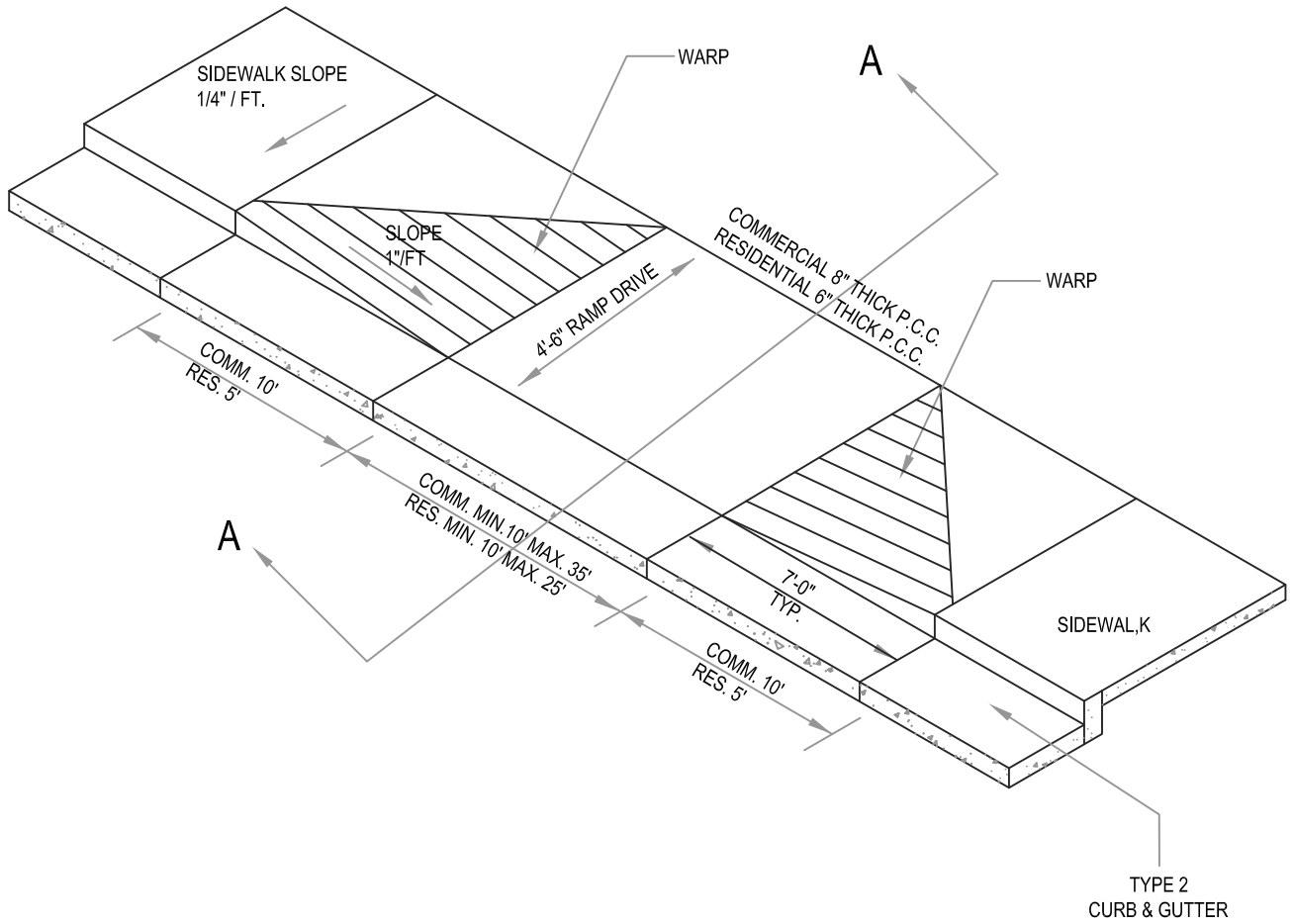
CURB, GUTTER & WALK




SECTION A-A

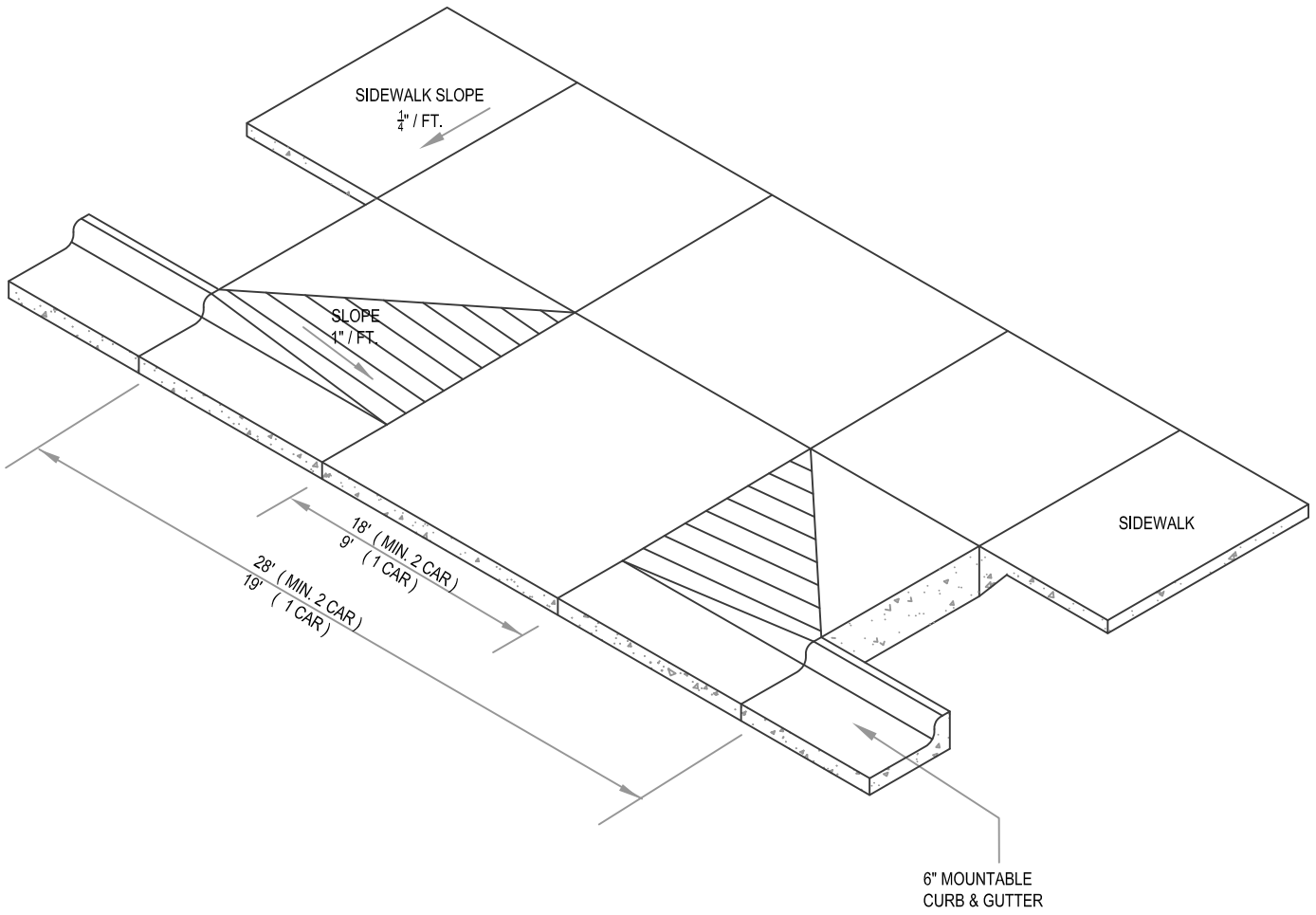
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			SIDEWALK RAMP WITH CROSS PAN BARRIER CURB	APPROVED BY:		
				DRAWING NO:	R7	
				SCALE:	N.T.S.	

NOTE:  
CONTRACTION JOINTS ARE REQUIRED AT EACH  
SIDE OF WARPED SECTION AND EVERY 10' (MAX)  
ALONG THE DRIVEWAY.



**SECTION A-A**

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:
DATE	ITEM	BY				DRAWN BY: JLT
			<b>RAMP DRIVE FOR VERTICAL CURB ATTACHED WALK</b>		APPROVED BY:	
					DRAWING NO: R8	
					SCALE: N.T.S.	



REVISIONS		
DATE	ITEM	BY

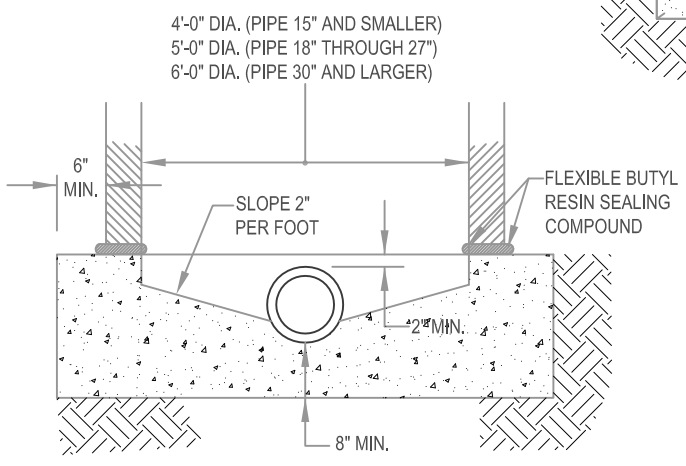
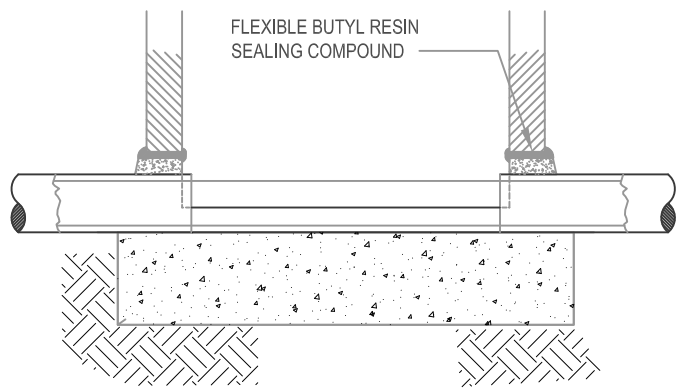
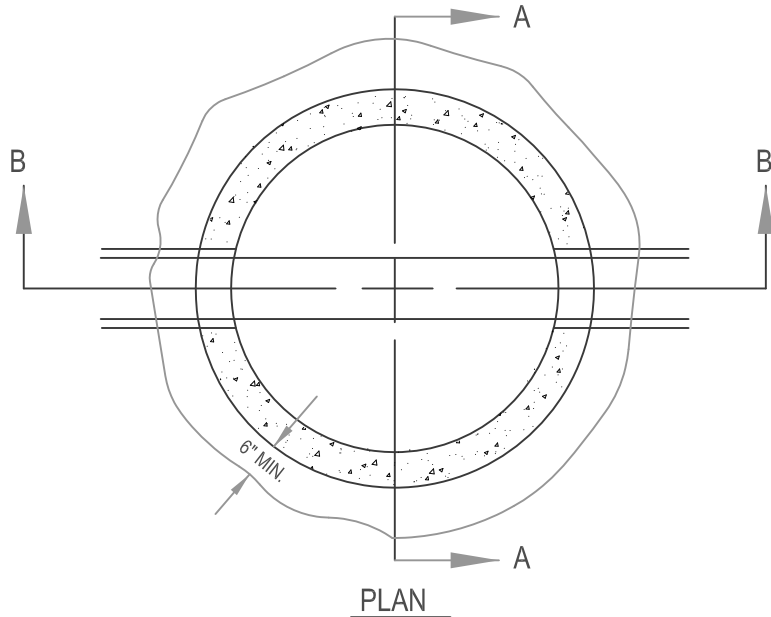


DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

RAMP DRIVE FOR MOUNTABLE CURB  
AND DETACHED WALK

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	R9
SCALE:	N.T.S.





**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).

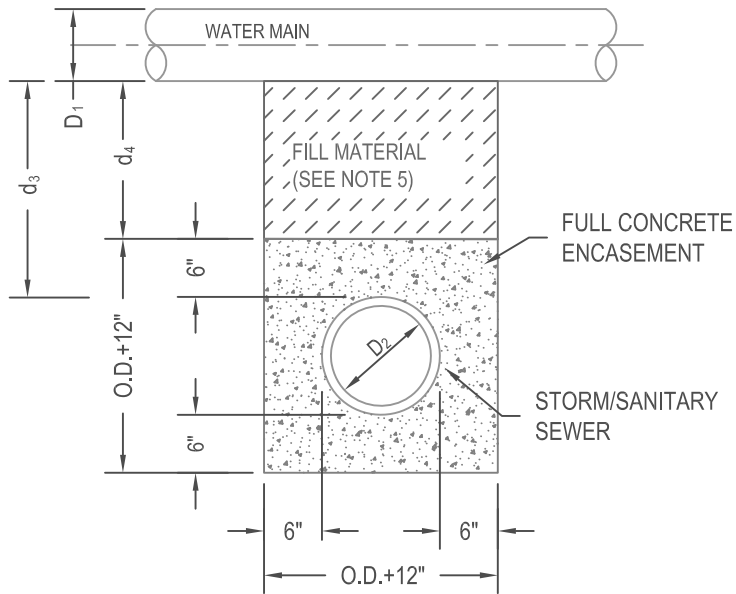
REVISIONS		
DATE	ITEM	BY



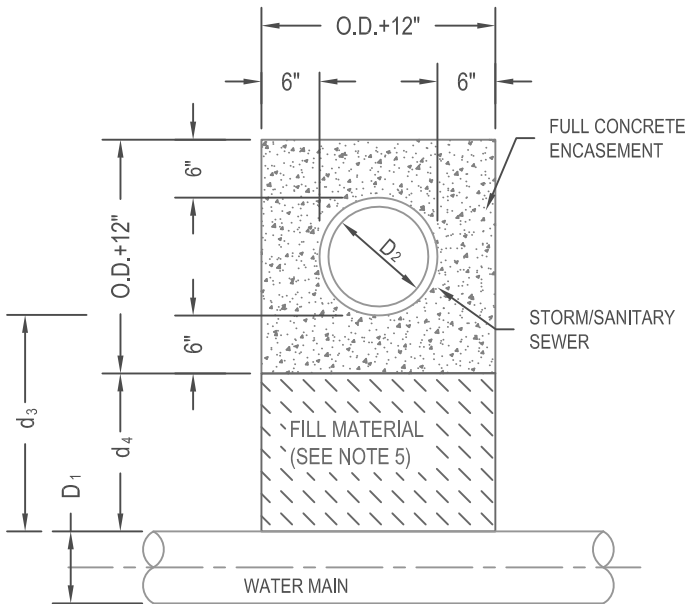
DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

STANDARD MANHOLE BASE

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	SS1
SCALE:	N.T.S.




**STORM OR SANITARY SEWER CROSSING UNDER WATER MAIN**  
 IF  $d_3 > 18"$ , ENCASEMENT NOT REQUIRED

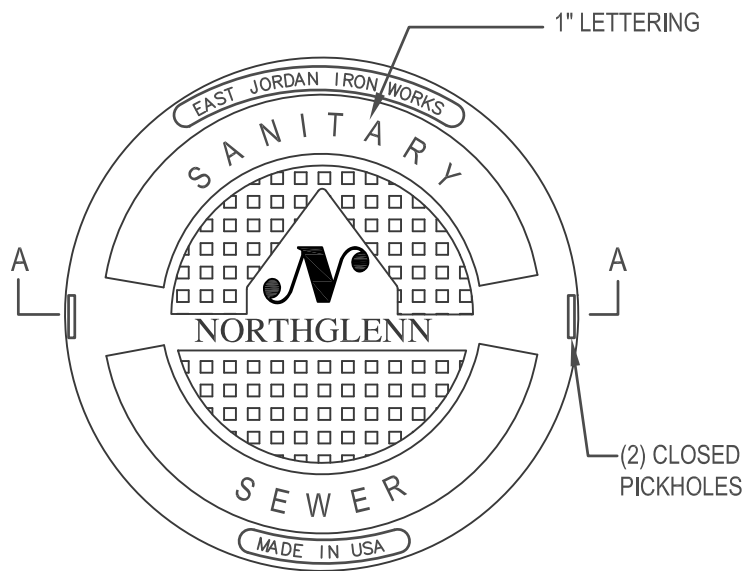


**STORM OR SANITARY SEWER CROSSING OVER TOP OF WATER MAIN**  
 ENCASEMENT REQUIRED REGARDLESS OF DIMENSION  $d_3$   
 (SEE NOTE 1 FOR SPECIAL CASES)

**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

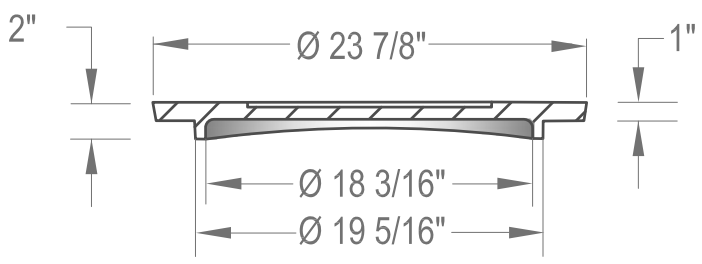
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			<b>ENCASEMENT FOR CONDUIT            CROSSINGS</b>	APPROVED BY:		
				DRAWING NO:	SS10	
				SCALE:	N.T.S.	



TOP OF COVER



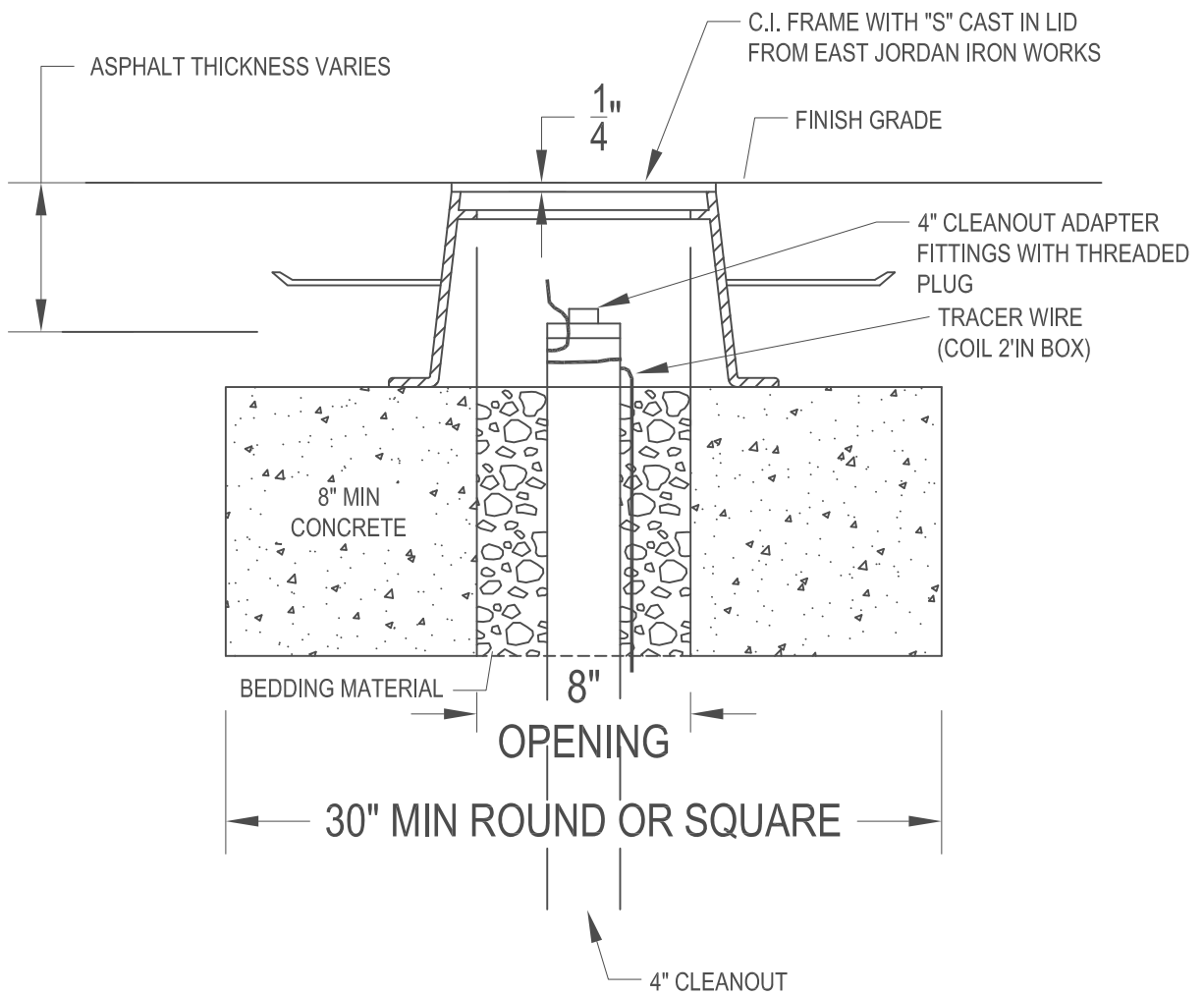
BOTTOM OF COVER




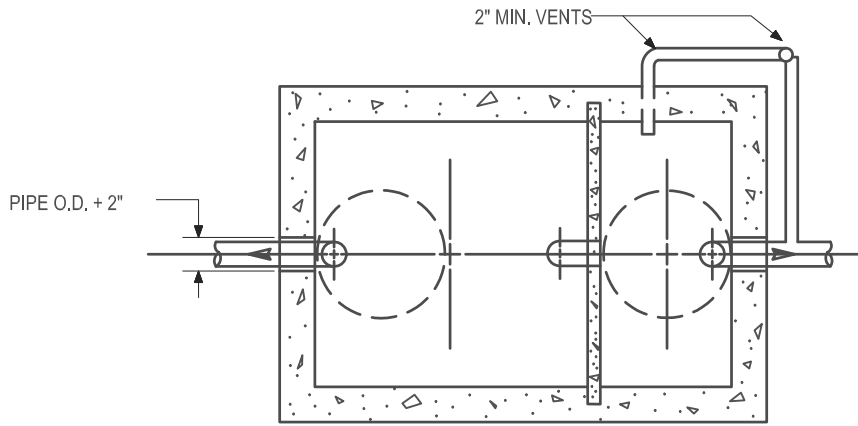
SECTION A-A

COVER: GRAY IRON ASTM A 48 CL35 B  
 LOAD RATING: HEAVY DUTY  
 WEIGHT: 135LBS. (61kg)  
 MACHINED SURFACE  
 EAST JORDAN IRON WORKS PRODUCT

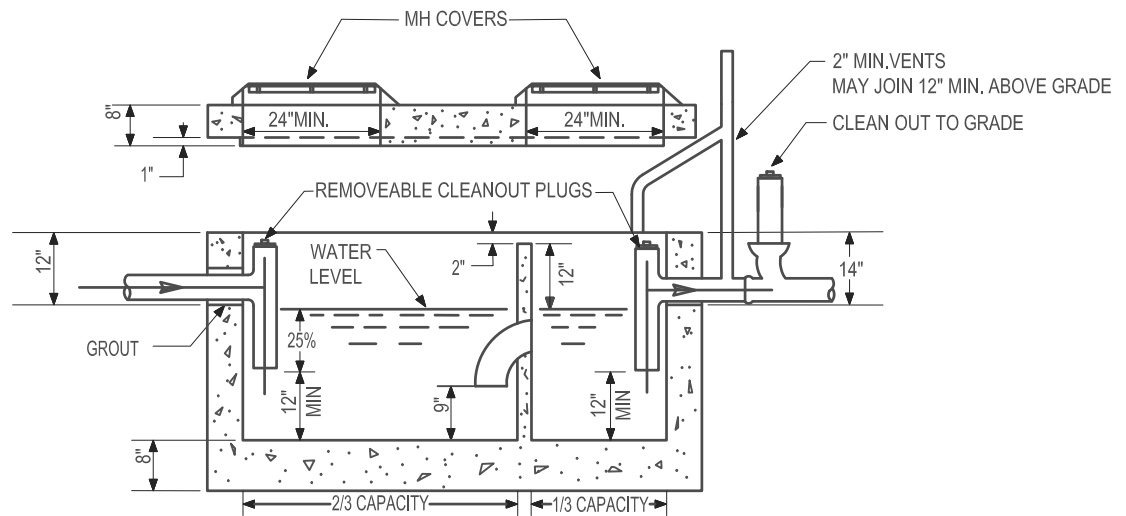
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
SANITARY SEWER MANHOLE COVER DETAIL				APPROVED BY:		
				DRAWING NO:	SS11	
				SCALE:	N.T.S.	



REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			STANDARD SANITARY SEWER UNDERDRAIN CLEANOUT		APPROVED BY:	
					DRAWING NO:	SS12
					SCALE:	N.T.S.




**PLAN VIEW**



**SECTION**

**GENERAL NOTES:**

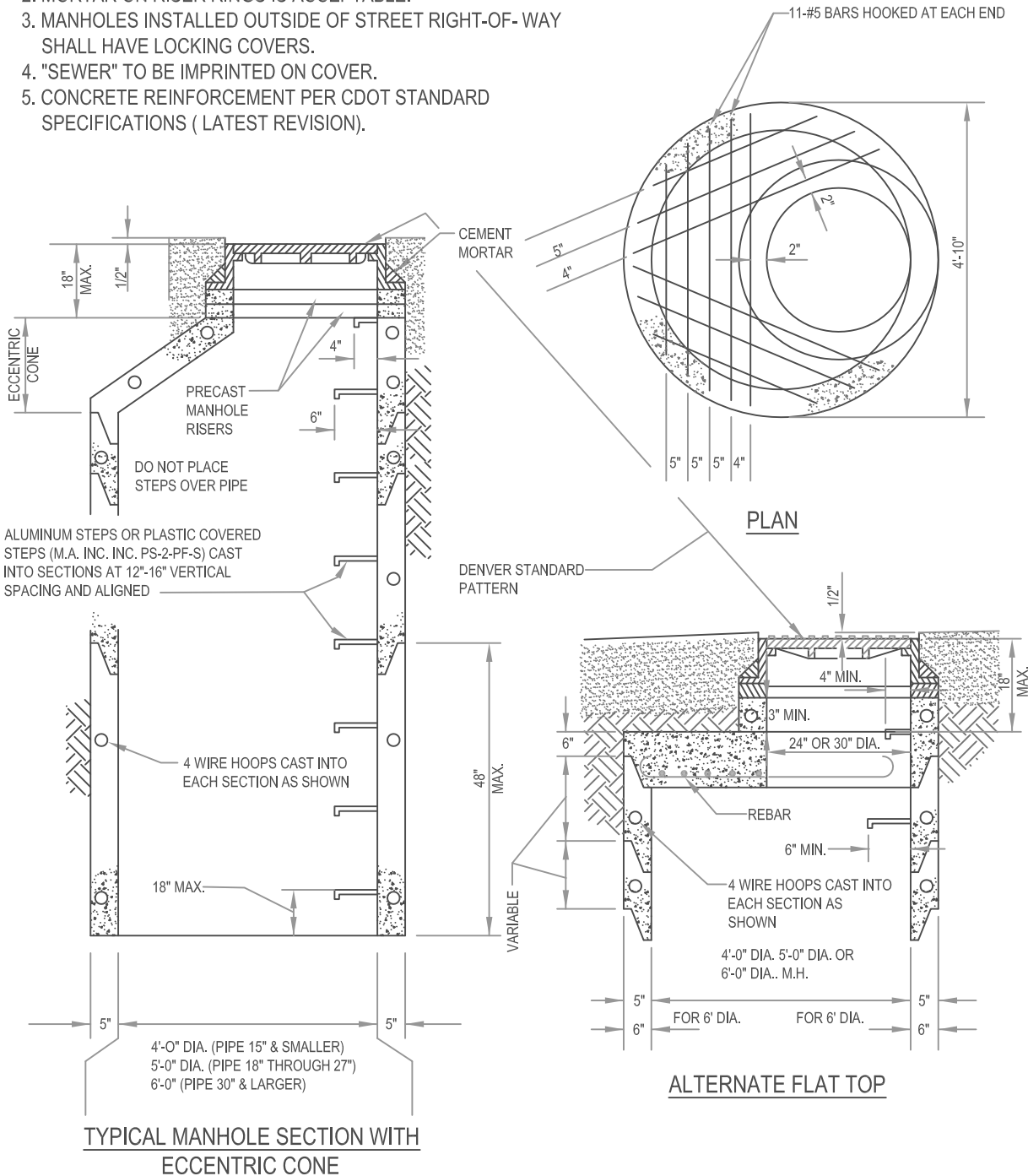
1. THESE DETAILS ARE ONLY INTENDED TO SHOW CONCEPTUAL/STANDARD REQUIREMENTS FOR GREASE AND SAND/OIL INTERCEPTORS AND ARE NOT INTENDED TO BE USED FOR CONSTRUCTION. DESIGN CRITERIA AND DETAILED CONSTRUCTION DRAWINGS, STAMPED AND SIGNED BY A COLORADO REGISTERED ARCHITECT OR ENGINEER, MUST BE SUBMITTED TO THE BUILDING DIVISION FOR APPROVAL.
2. ALL PIPE AND FITTINGS MUST BE APPROVED SOIL PIPE, 3" MINIMUM IN DIAMETER, UNLESS NOTED OTHERWISE.
3. WALLS , BOTTOM AND TOP OF INTERCEPTOR MUST BE REINFORCED THROUGHOUT WITH ADDITIONAL REINFORCEMENT AROUND ACCESS OPENINGS AS SPECIFIED ARCHITECT OR ENGINEER. ALL REINFORCEMENT SHALL HAVE 1 1/2" MIN. COVER TO FACE OF CONCRETE.
4. THE ARCHITECT OR ENGINEER MUST SPECIFY THE THICKNESS OF WALLS, BOTTOM AND TOP SLAB.
5. OUTLET PIPE INVERT MUST BE 2" LOWER THAN INLET.
6. THE PUBLIC WORKS AND UTILITY DEPARTMENT MUST APPROVE BOLT DOWN COVERS..
7. VENT PIPES MAY BE JOINED 12" ABOVE GRADE MINIMUM.
8. SMALL COMPARTMENT HAS 1/3 TOTAL CAPACITY.
9. INLET PIPE DOWNSPOUT PENETRATES WATER LEVEL A MINIMUM OF 25% OF TOTAL LIQUID LEVEL AND INLET PIPE DOWNSPOUT IS NOT LESS THAN 12" OFF THE BOTTOM.

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
					APPROVED BY:	
					DRAWING NO:	SS13
					SCALE:	N.T.S.

TYPICAL GREASE AND SAND/OIL  
INTERCEPTOR DETAIL

**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. "SEWER" TO BE IMPRINTED ON COVER.
5. CONCRETE REINFORCEMENT PER CDOT STANDARD SPECIFICATIONS ( LATEST REVISION).



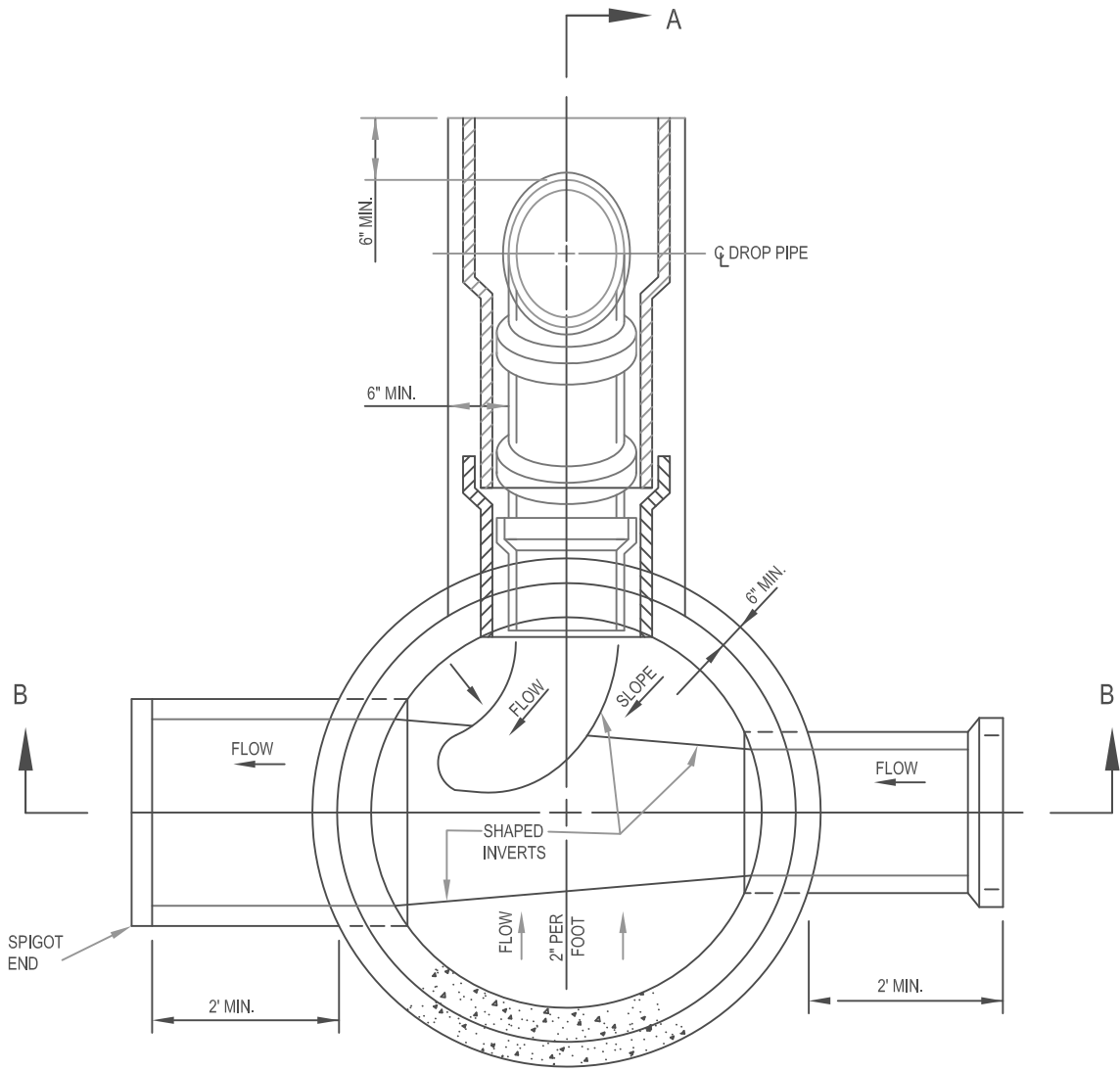
REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

MANHOLE BARRELS AND  
ALTERNATE TOPS


ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	SS2
SCALE:	N.T.S.

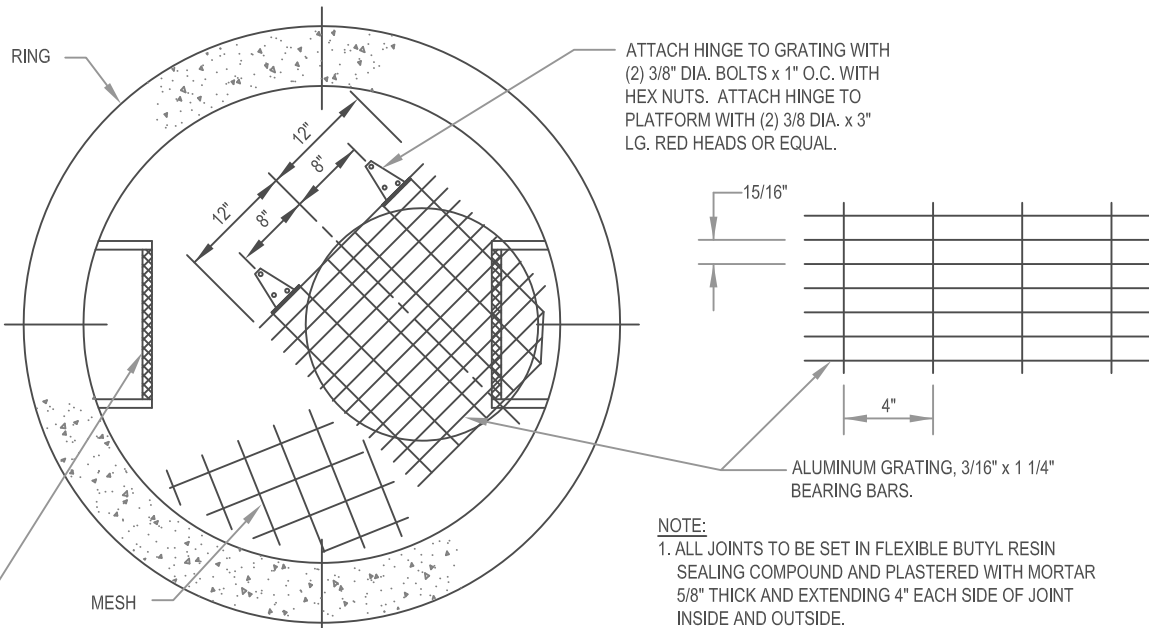


**NOTES:**

1. BASES SHALL BE REINFORCED WHEN THE DISTANCE FROM INVERT TO TOP OF COVER WILL EXCEED 15 FT., AND IN ANY CASE WHEN INTERIOR DIA. OF MANHOLE IS 5' AND LARGER
2. SQUARE BASES ARE ACCEPTABLE.

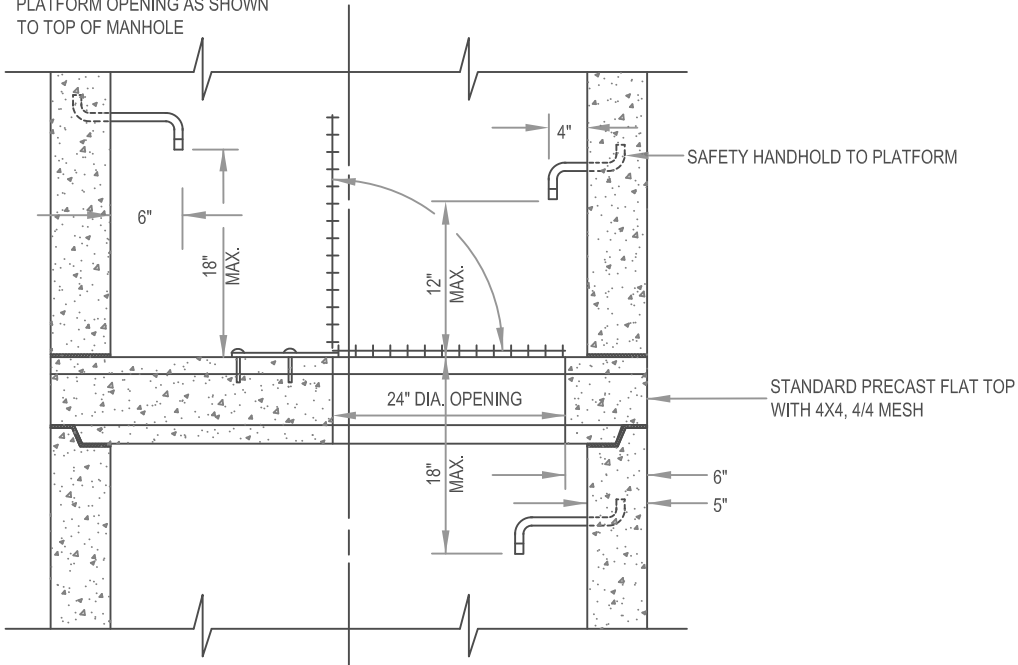
PLAN

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			MONOLITHIC BASES FOR DROP MANHOLE	APPROVED BY:		
				DRAWING NO:	SS3	
			SCALE:	N.T.S.		




- NOTE:**
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. CONCRETE REINFORCEMENT PER CDOT STANDARD SPECIFICATIONS ( LATEST REVISION).

ALIGN STEPS ABOVE & OPPOSITE PLATFORM OPENING AS SHOWN TO TOP OF MANHOLE

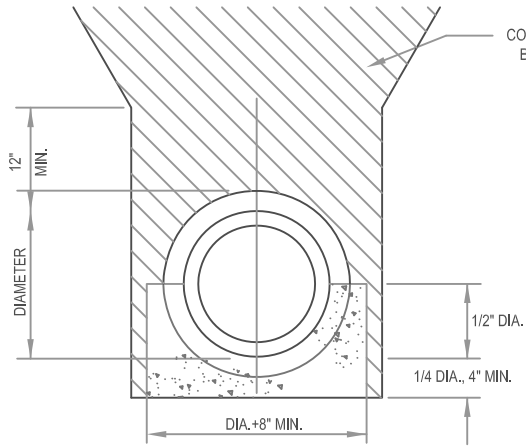


TO BE USED WHEN THE DISTANCE FROM INVERT TO TOP OF COVER EXCEEDS 17 FT.

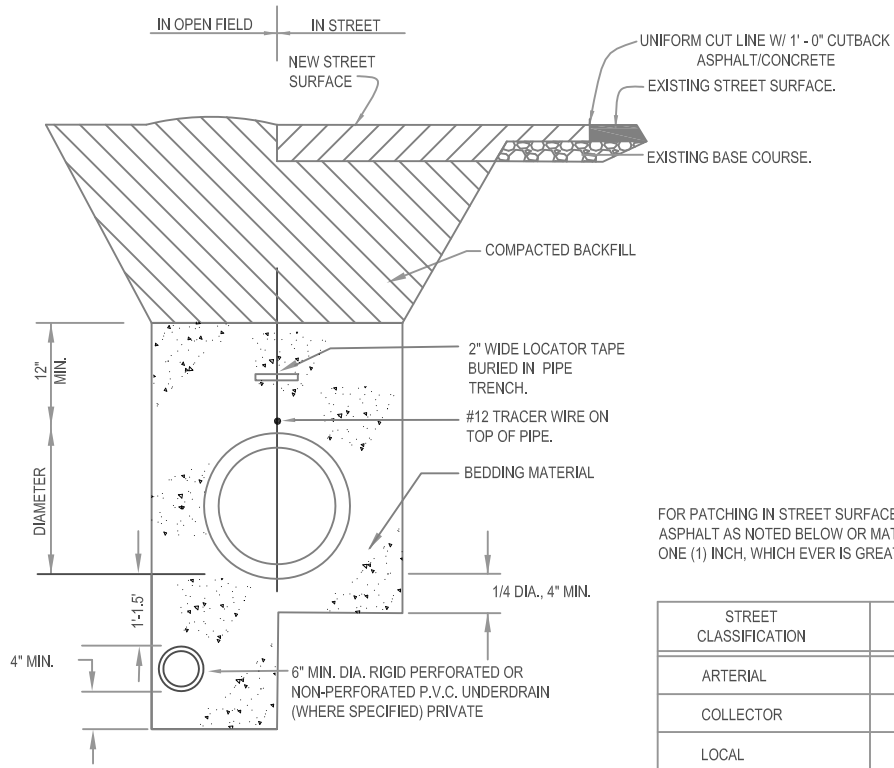
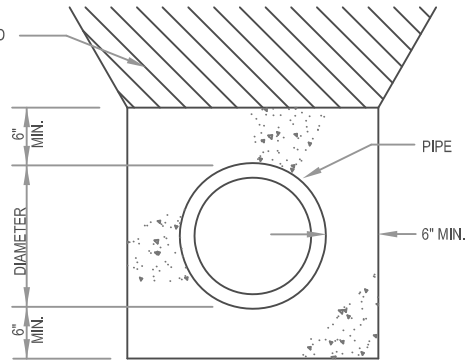
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			INTERMEDIATE PLATFORM FOR MANHOLES OVER 17' IN DEPTH	APPROVED BY:		
					DRAWING NO:	SS4
					SCALE:	N.T.S.



**CLASS A  
CONCRETE CRADLE**



**TYPICAL CONCRETE ENCASEMENT**



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	9"
COLLECTOR	7"
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"

**CLASS B  
GRANULAR BEDDING**

**NOTES:**

1. THIS DETAIL IS TO BE USED UNDER NORMAL CONDITIONS. WHERE EXCESSIVE GROUND WATER IS PRESENT AN ALTERNATE DESIGN WILL BE REQUIRED.

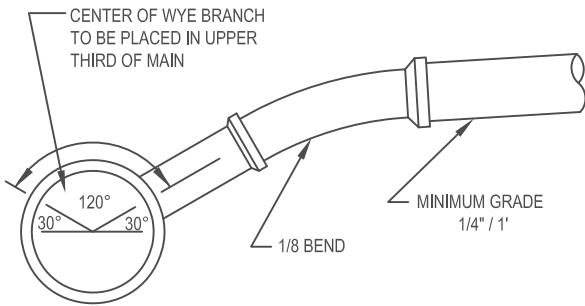
REVISIONS		
DATE	ITEM	BY



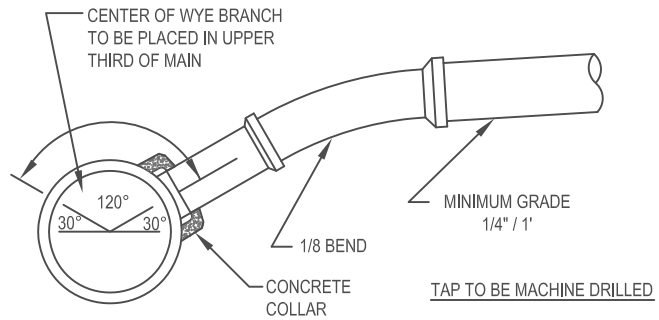
DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

TYPICAL TRENCH SECTION  
PIPE PROTECTION

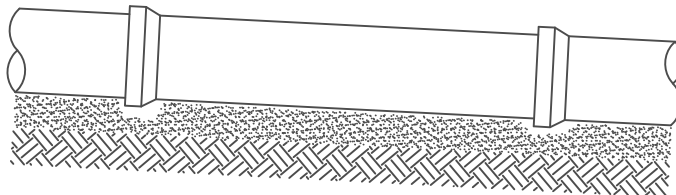
ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	SS5
SCALE:	N.T.S.



1/8 BEND CONNECTION TO TEE



1/8 BEND & SADDLE CONNECTION

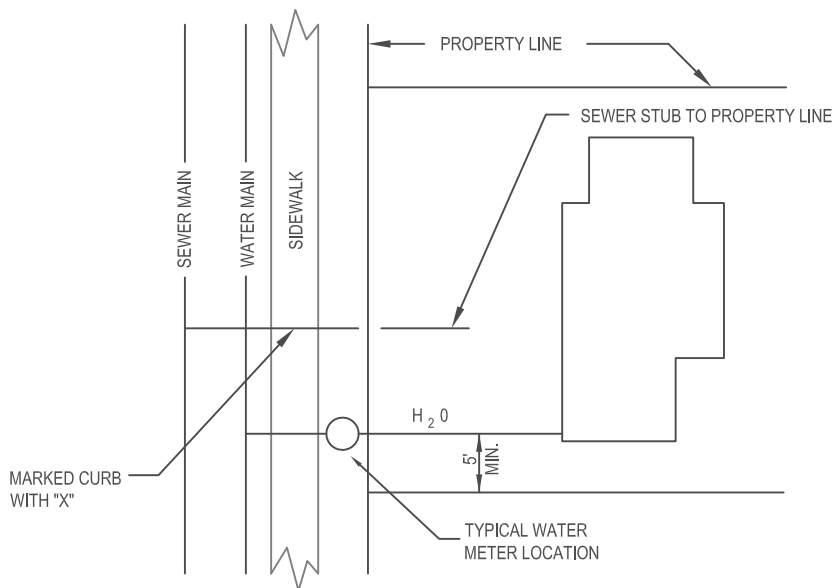


FACTORY PREPARED A.S.T.M. C-425 COMPRESSION TYPE JOINTS ONLY OR APPROVED EQUIVALENT.

BELL SHOULD NOT TOUCH SIDES OR BOTTOM OF BELL HOLE.

4" MINIMUM BEDDING ABOVE AND BELOW PIPE.

ACCEPTABLE BEDDING



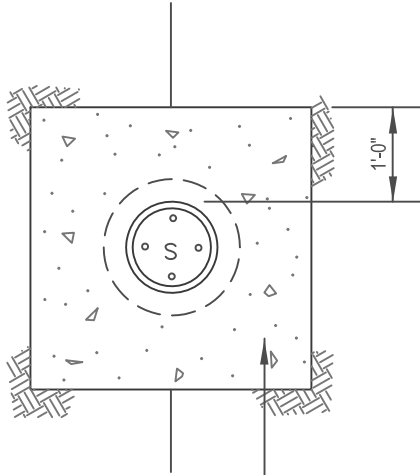
REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

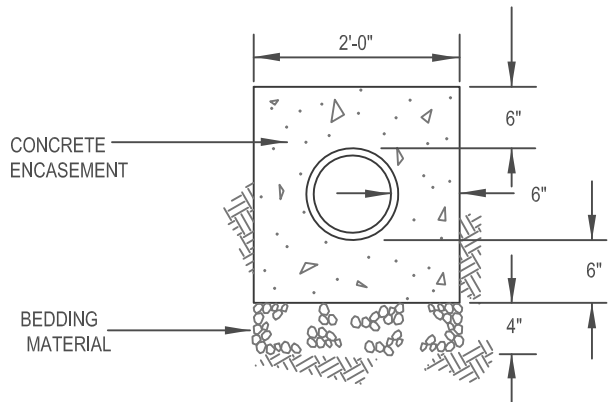
TYPICAL HOUSE SERVICE  
LOCATION

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	SS6
SCALE:	N.T.S.

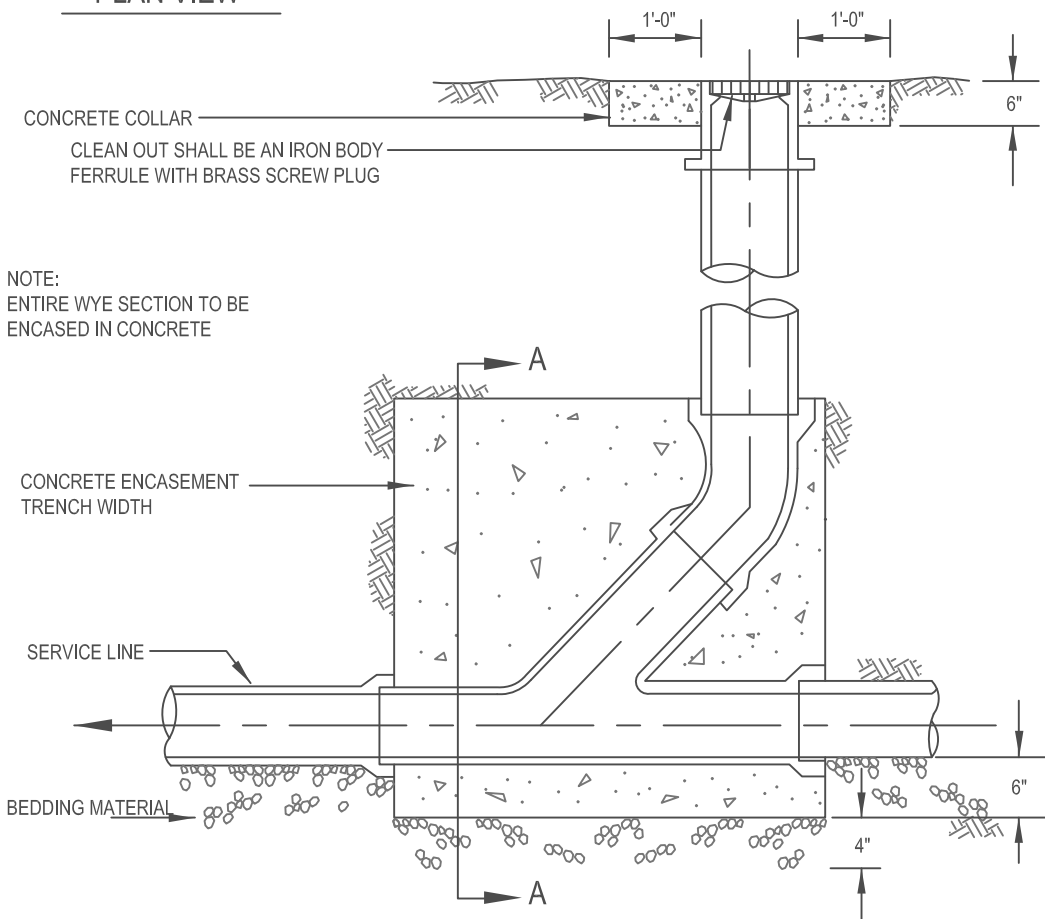


CONCRETE COLLAR TO BE USED IN UNPAVED AREAS ONLY

**PLAN VIEW**



**SECTION A-A**



**ELEVATION**

NOTE:  
ENTIRE WYE SECTION TO BE ENCASED IN CONCRETE

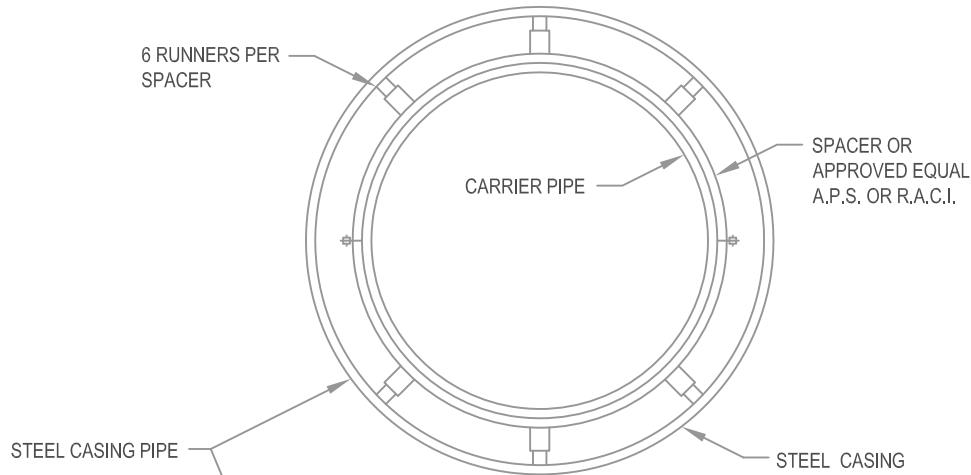
REVISIONS		
DATE	ITEM	BY



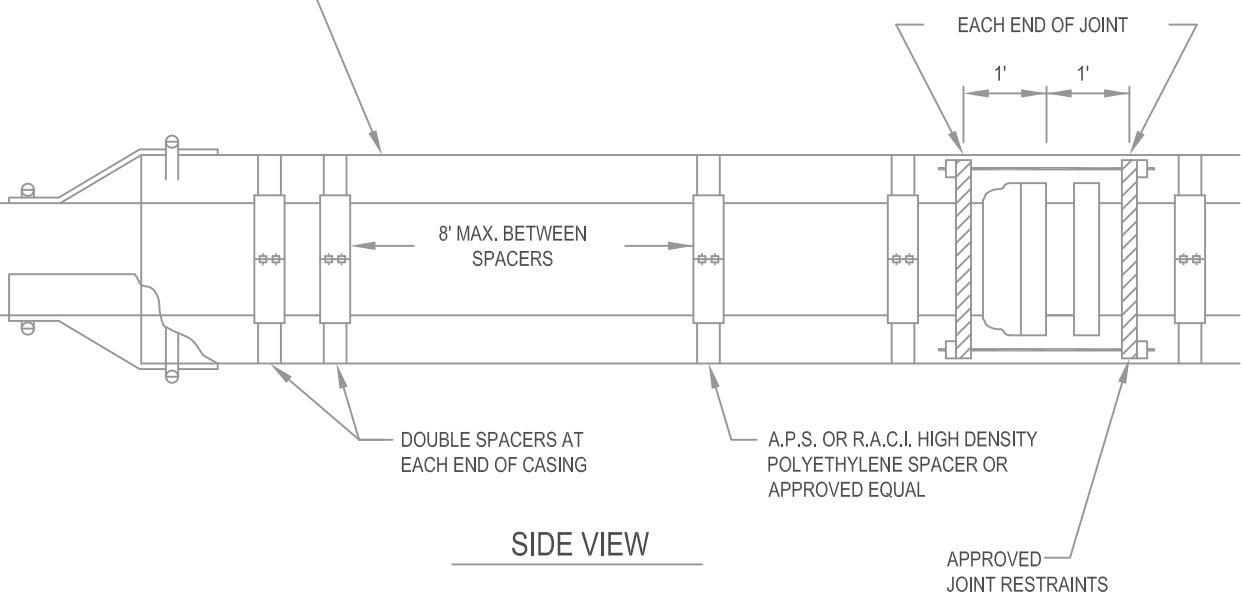
DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

STANDARD CLEAN-OUT  
DETAIL

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	SS7
SCALE:	N.T.S.



SECTION VIEW



SIDE VIEW

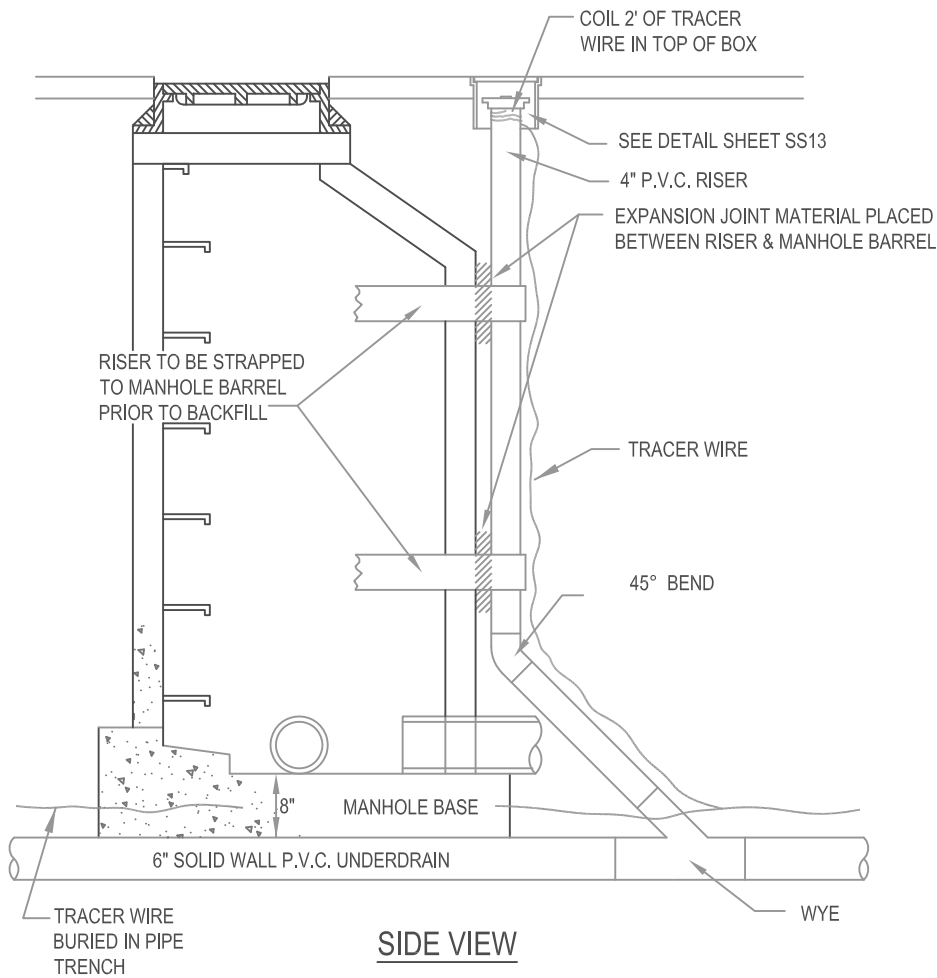
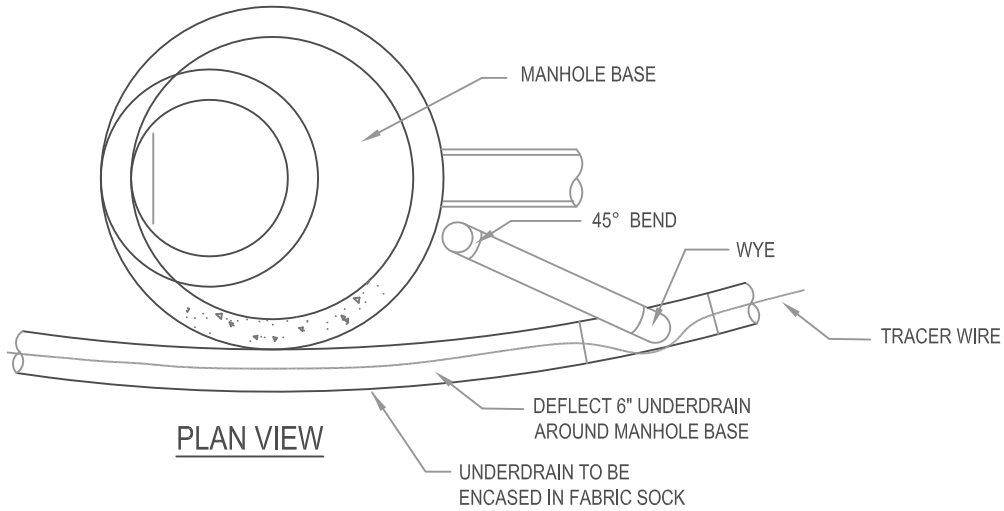
REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

JACKING  
DETAIL

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	SS8
SCALE:	N.T.S.



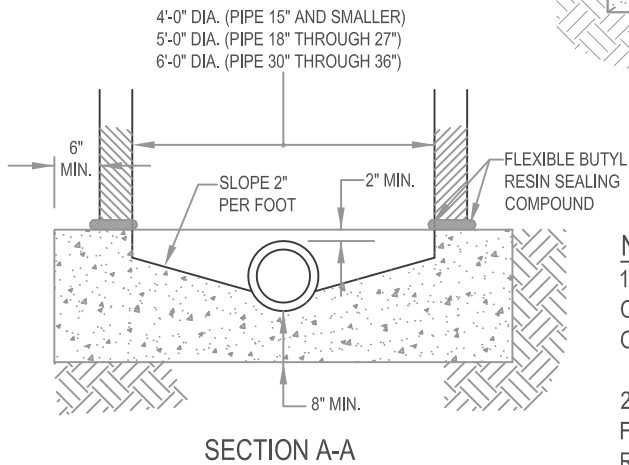
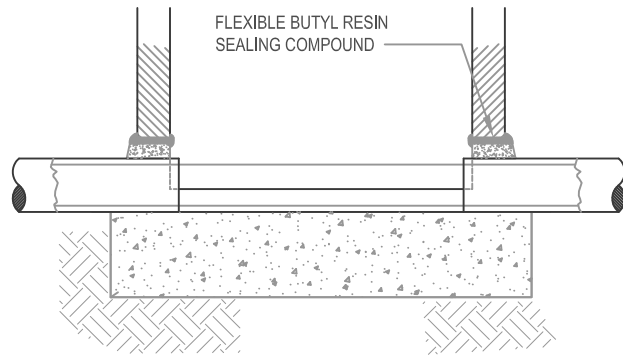
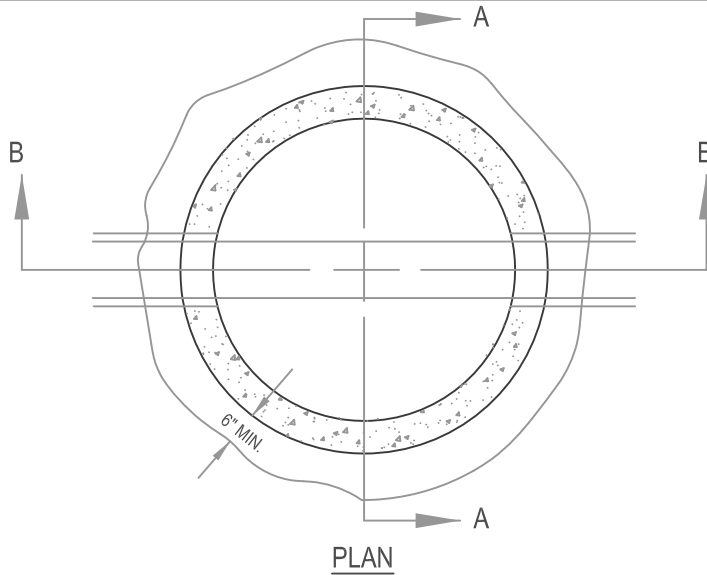
REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

TYPICAL UNDERDRAIN CLEANOUT  
DETAIL

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	SS9
SCALE:	N.T.S.



- NOTES:**
1. JOINTS TO BE SET IN FLEXIBLE BUTYL RESIN SEALING COMPOUND AND GROUTED WITH MORTAR INSIDE AND OUTSIDE.
  2. BASES SHALL BE REINFORCED WHEN THE DISTANCE FROM INVERT TO TOP OF COVER WILL EXCEED 15 FT. REINFORCING TO BE APPROVED BY CITY ENGINEER.
  3. SQUARE BASES ARE ACCEPTABLE.
  4. FOR PIPE 36" AND LARGER, OR WHERE CONDITIONS SUCH AS MULTIPLE PIPES WARRANT, A CONCRETE BOX BASE WILL BE REQUIRED. (SEE CDOT STANDARD DRAWING M-604-20)

REVISIONS		
DATE	ITEM	BY



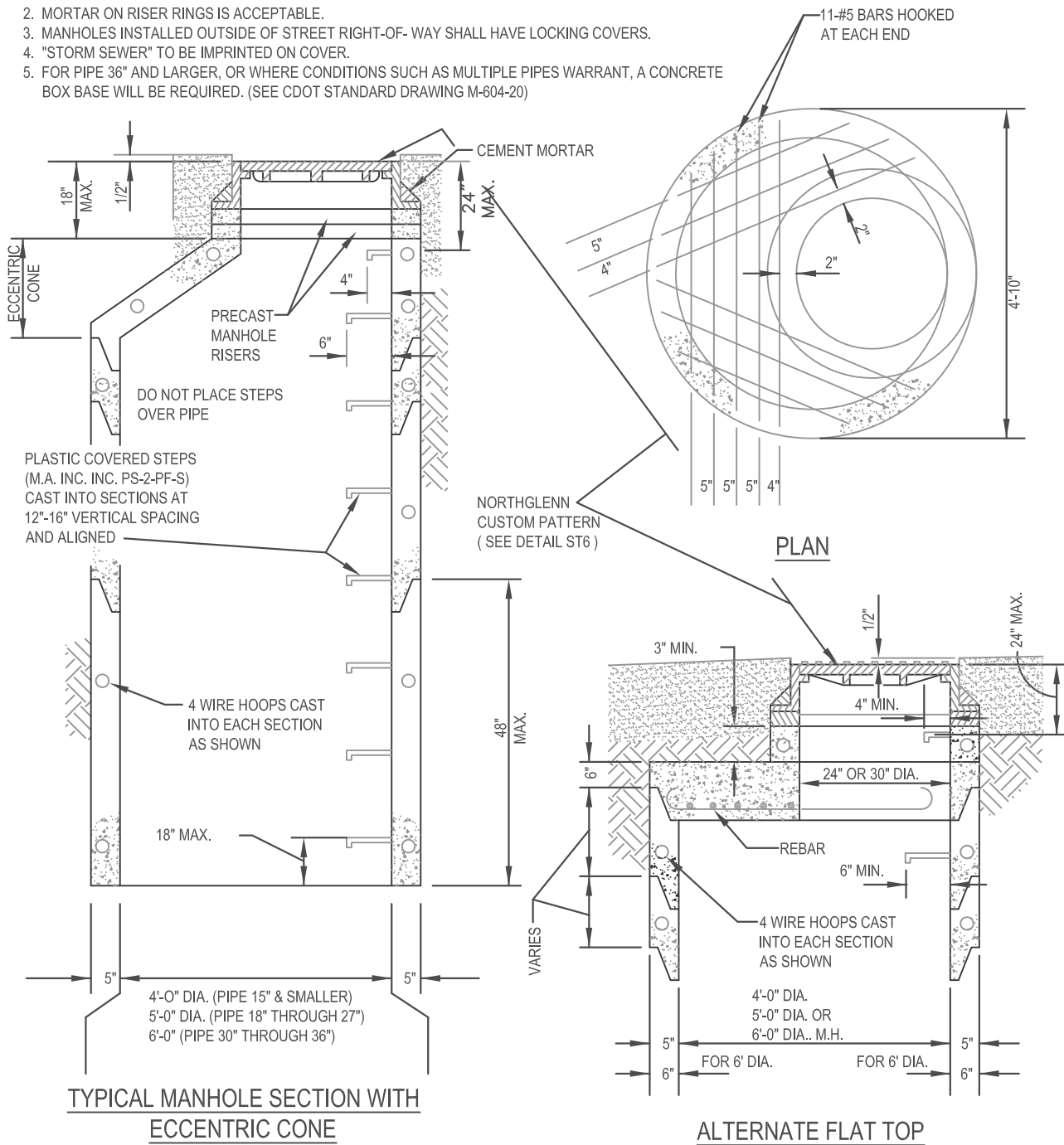
DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

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. FOR PIPE 36" AND LARGER, OR WHERE CONDITIONS SUCH AS MULTIPLE PIPES WARRANT, A CONCRETE BOX BASE WILL BE REQUIRED. (SEE CDOT STANDARD DRAWING M-604-20)



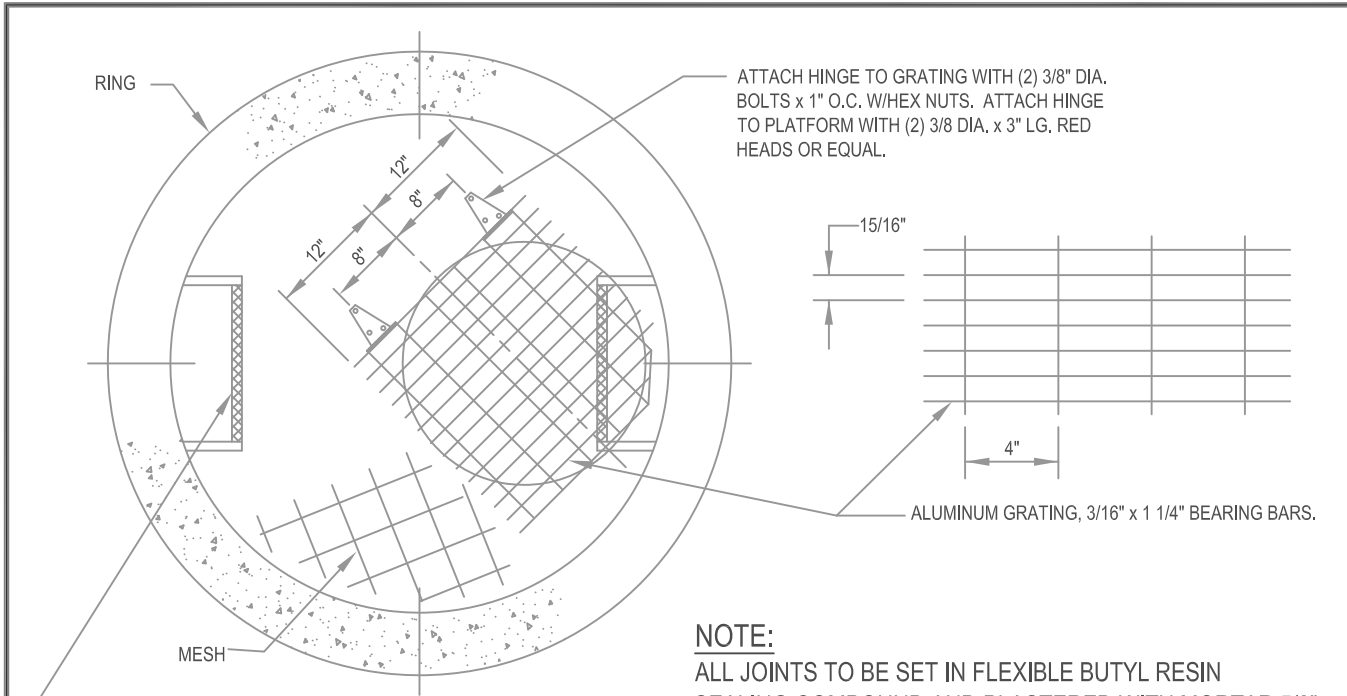
REVISIONS		
DATE	ITEM	BY



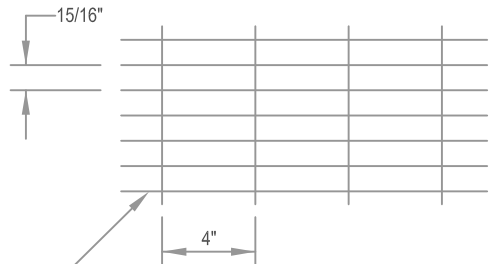
DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

MANHOLE BARRELS AND  
ALTERNATIVE TOPS

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	ST2
SCALE:	N.T.S.



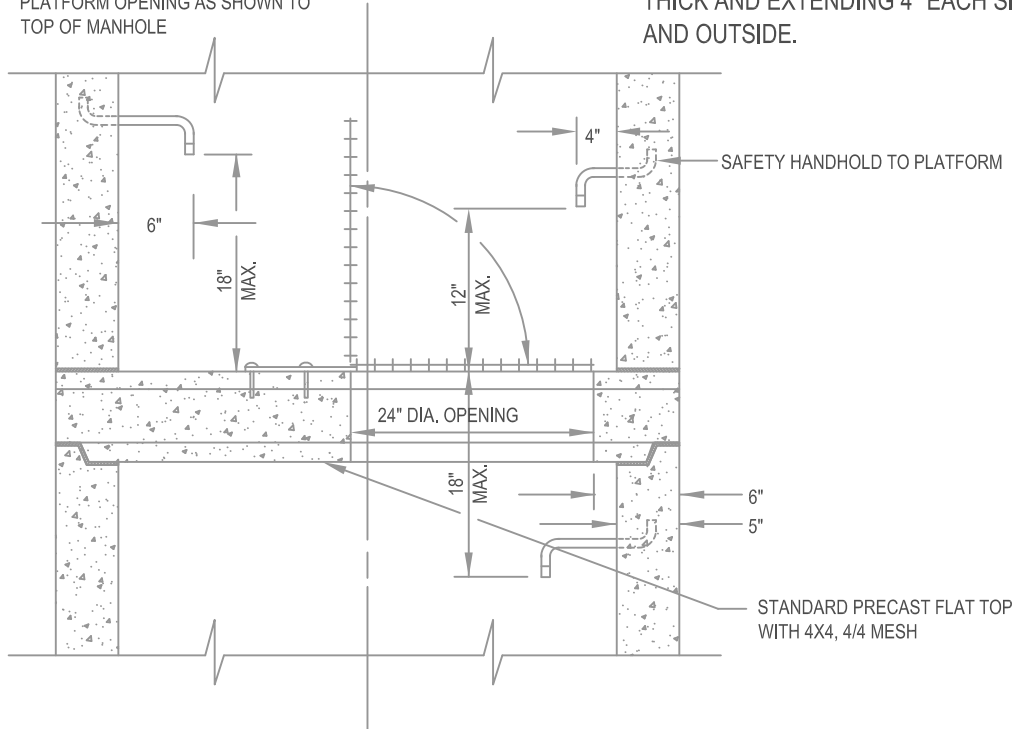
ATTACH HINGE TO GRATING WITH (2) 3/8" DIA. BOLTS x 1" O.C. W/HEX NUTS. ATTACH HINGE TO PLATFORM WITH (2) 3/8 DIA. x 3" LG. RED HEADS OR EQUAL.



ALUMINUM GRATING, 3/16" x 1 1/4" BEARING BARS.

**NOTE:**  
 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.

ALIGN STEPS ABOVE & OPPOSITE PLATFORM OPENING AS SHOWN TO TOP OF MANHOLE



TO BE USED WHEN THE DISTANCE FROM INVERT TO TOP OF COVER EXCEEDS 17 FT.

REVISIONS		
DATE	ITEM	BY

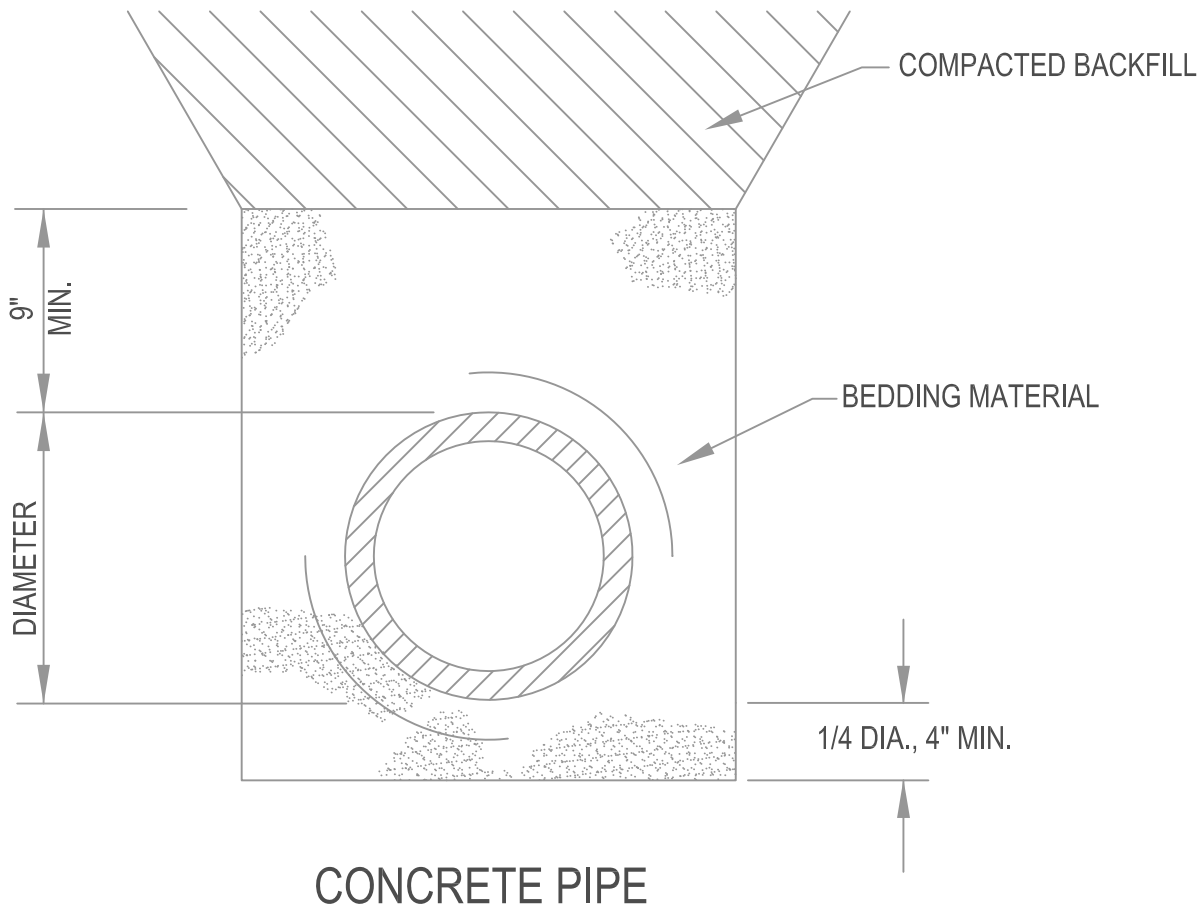


DEPARTMENT OF  
 CIP DESIGN &  
 ENGINEERING

INTERMEDIATE PLATFORM FOR  
 MANHOLES OVER 17' IN DEPTH

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	ST3
SCALE:	N.T.S.




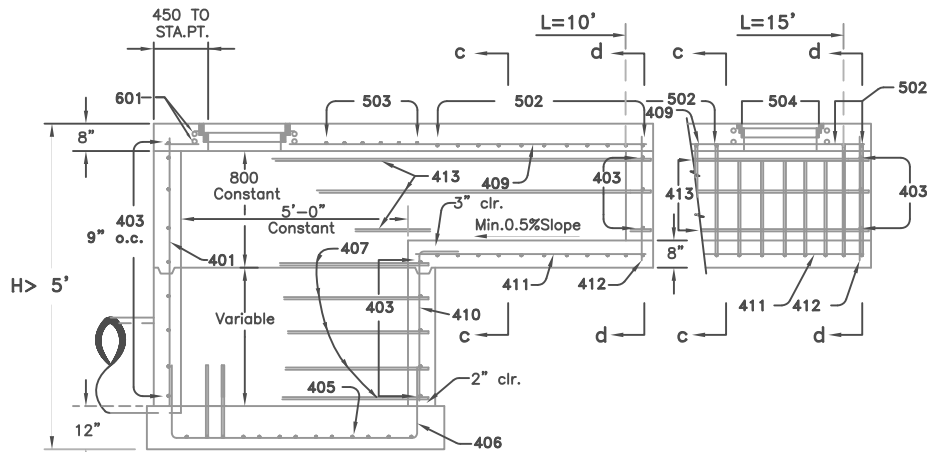
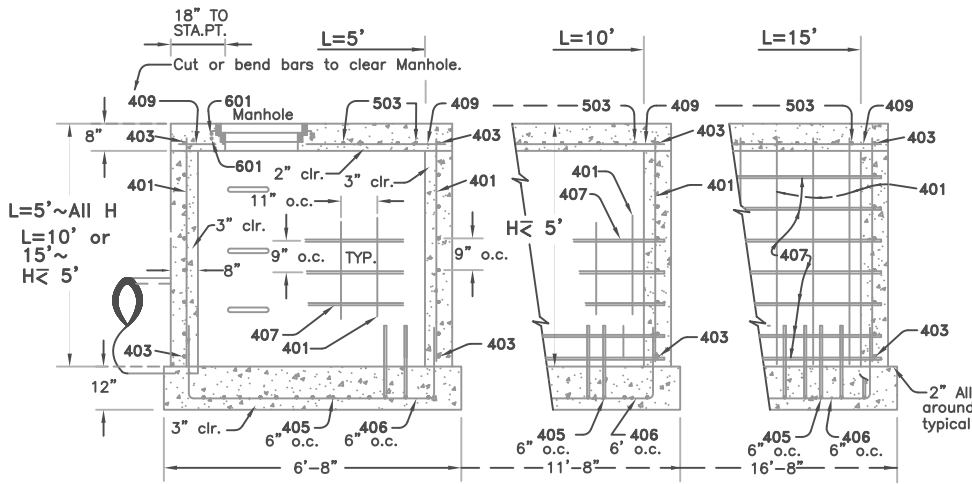
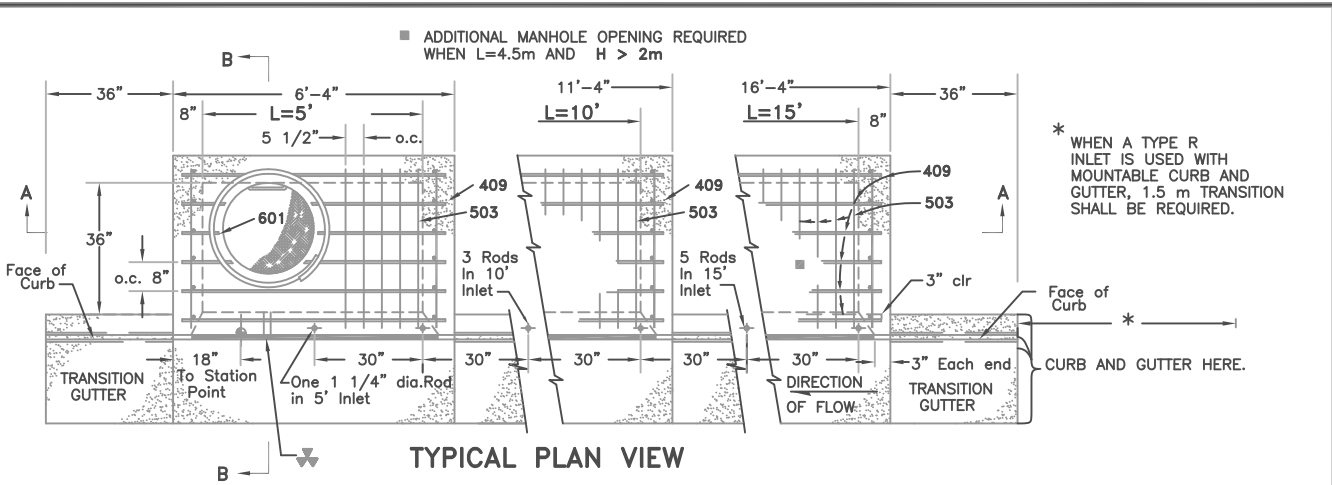


CONCRETE PIPE

NOTES:

THIS DETAIL IS TO BE USED UNDER NORMAL CONDITIONS.  
 WHERE EXCESSIVE GROUND WATER IS PRESENT AN ALTERNATE  
 DESIGN WILL BE REQUIRED.

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			TYPICAL PIPE BEDDING	DEPARTMENT OF CIP DESIGN & ENGINEERING	APPROVED BY:	
					DRAWING NO:	ST4
					SCALE:	N.T.S.



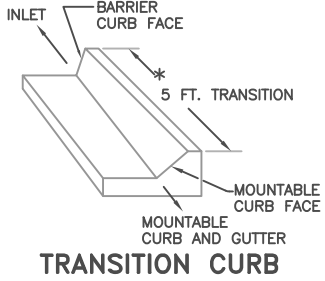
REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

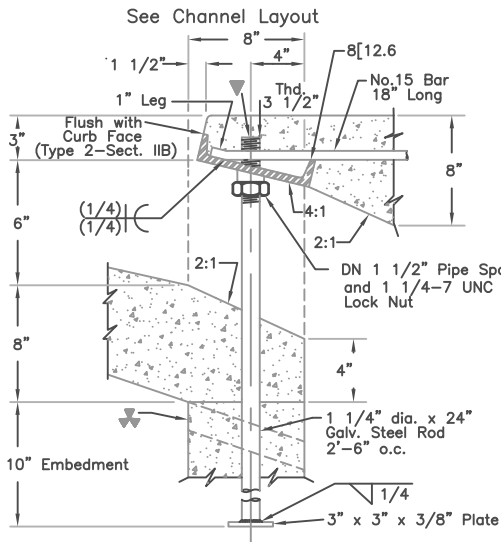
CURB INLET TYPE R

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	ST5A
SCALE:	N.T.S.

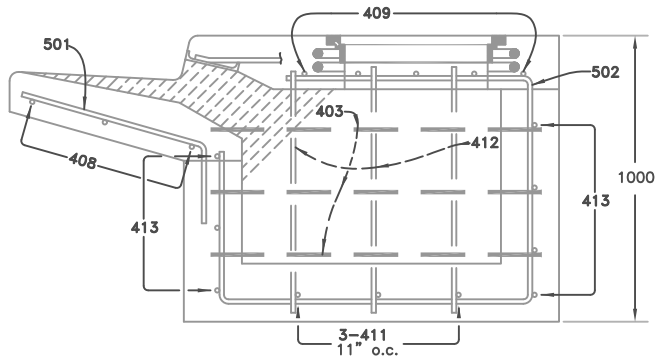


**TRANSITION CURB**

MEET SHAPE OF NORMAL BARRIER

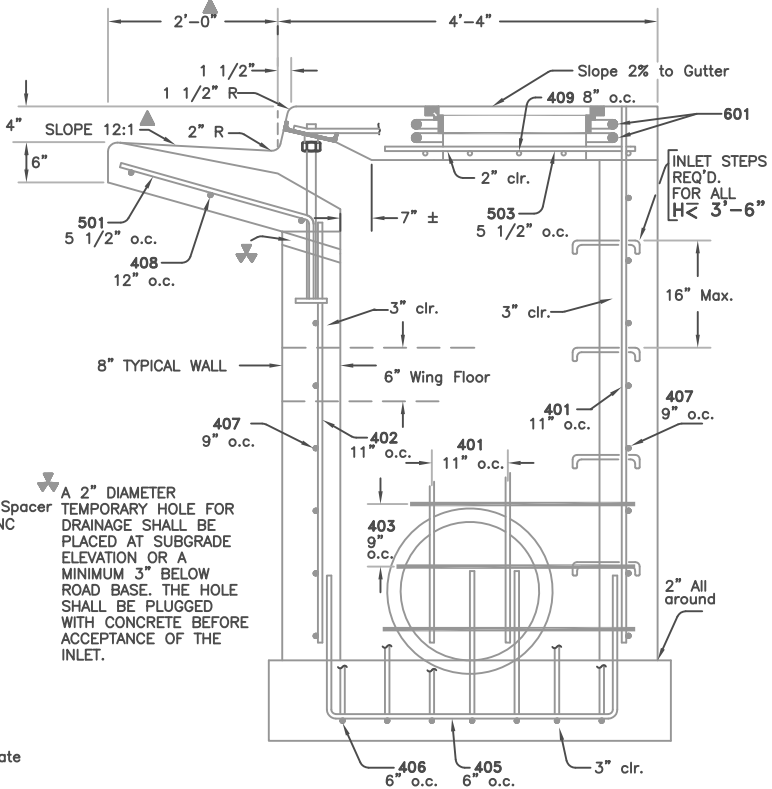


**▼ CURB FACE ASSEMBLY, PLACE ENTIRE ASSEMBLY BEFORE POURING CONCRETE**



(DOTTED BARS ARE IN SECTION d-d)  
**SECTIONS c-c & d-d**

▲ - 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.

REVISIONS		
DATE	ITEM	BY

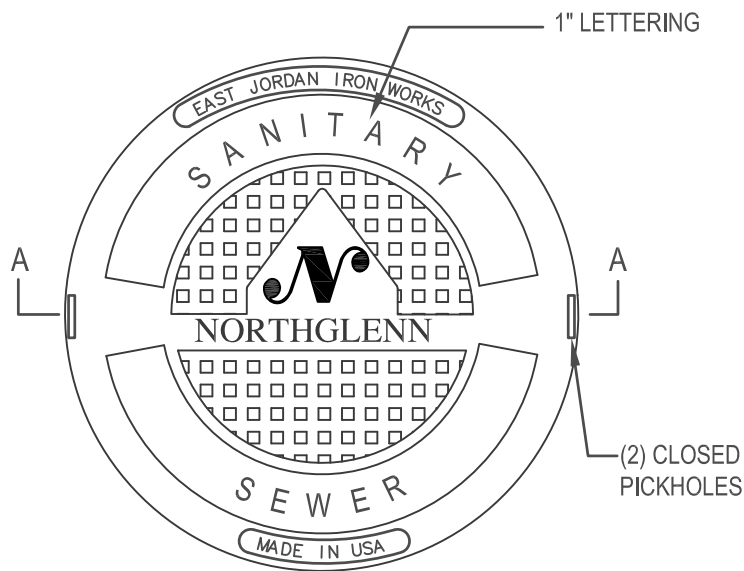


DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

CURB INLET TYPE R

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	ST5B
SCALE:	N.T.S.

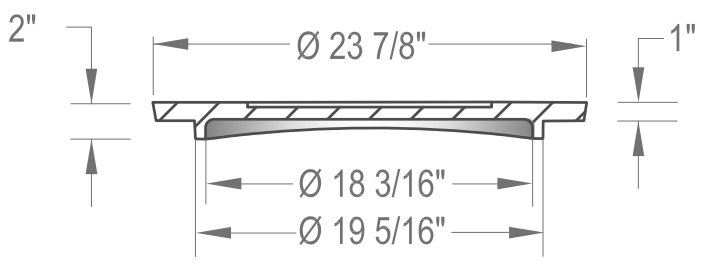




TOP OF COVER



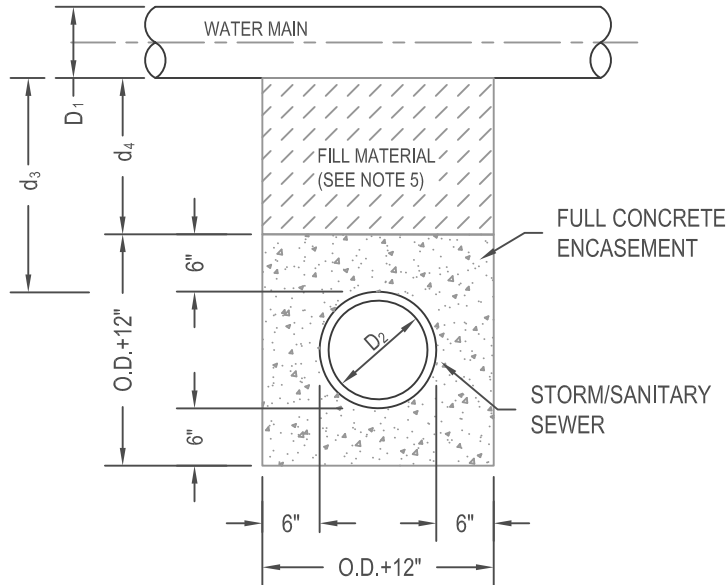
BOTTOM OF COVER



SECTION A-A

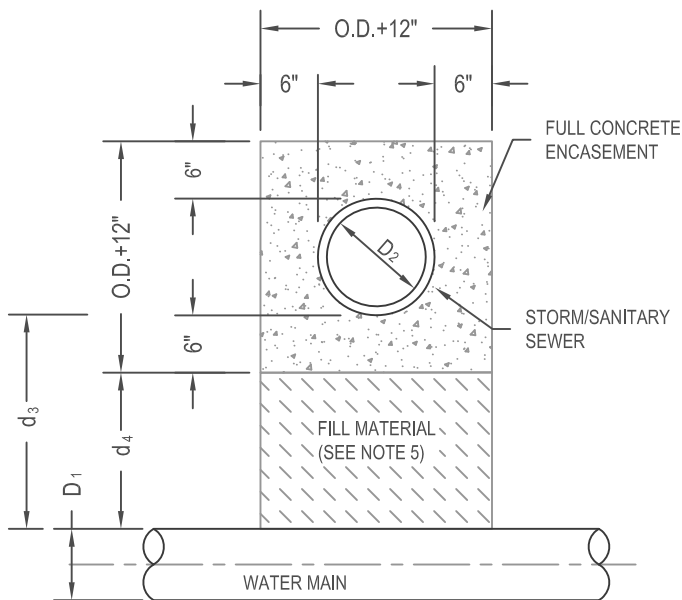
COVER: GRAY IRON ASTM A 48 CL35 B  
 LOAD RATING: HEAVY DUTY  
 WEIGHT: 135LBS. (61kg)  
 MACHINED SURFACE  
 EAST JORDAN IRON WORKS PRODUCT

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:			
DATE	ITEM	BY			DRAWN BY:	JLT		
					SANITARY SEWER MANHOLE COVER DETAIL		APPROVED BY:	
							DRAWING NO:	ST6
							SCALE:	N.T.S.



**STORM OR SANITARY SEWER CROSSING UNDER WATER MAIN**

IF  $d_3 > 18"$ , ENCASEMENT NOT REQUIRED




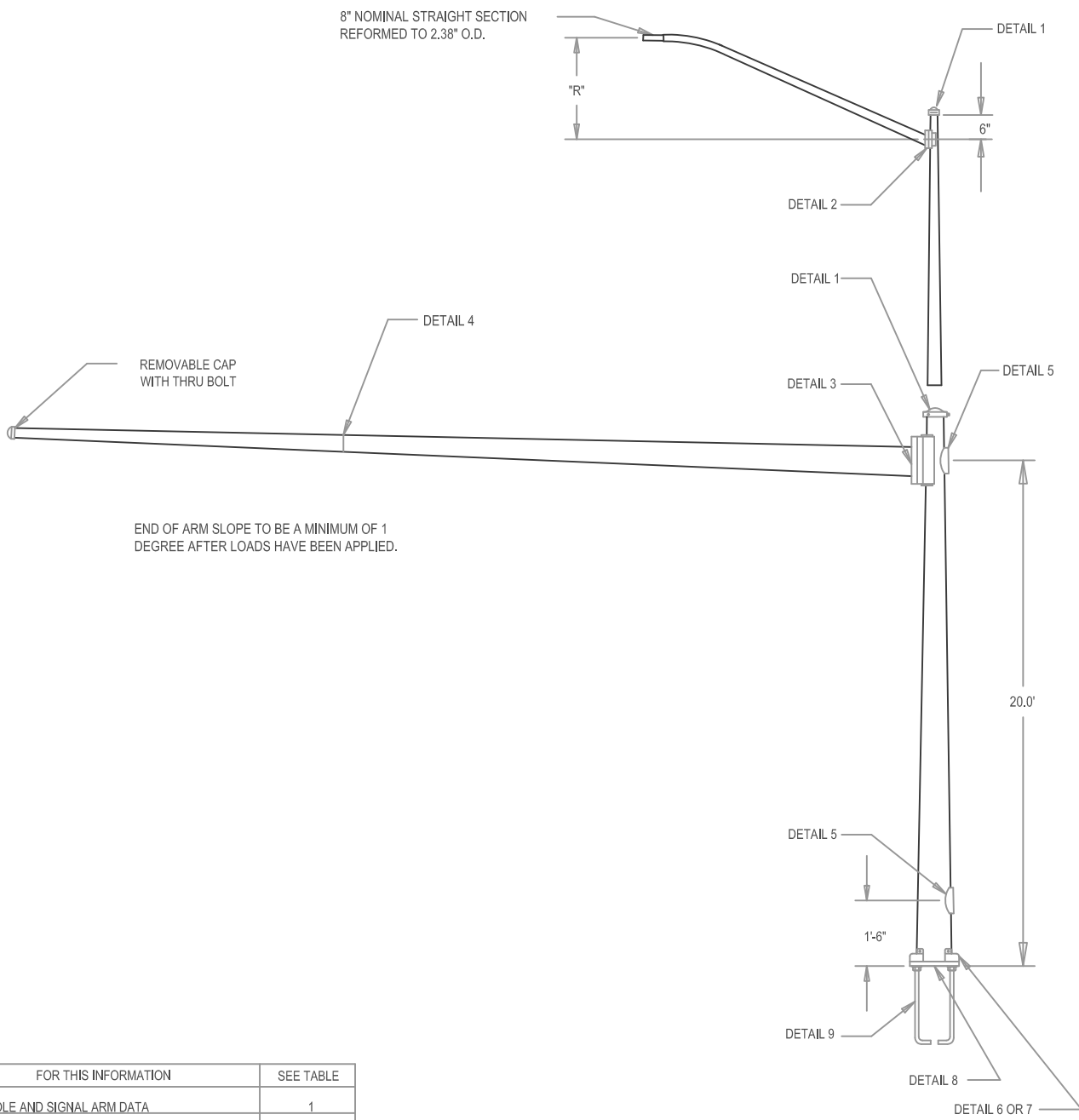
**STORM OR SANITARY SEWER CROSSING OVER TOP OF WATER MAIN**

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

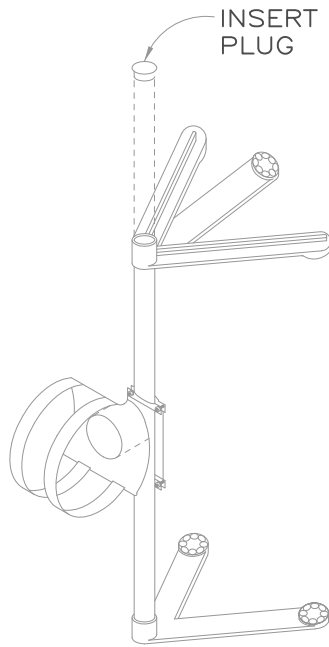
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			ENCASEMENT FOR CONDUIT CROSSINGS	APPROVED BY:		
				DRAWING NO:	ST7	
				SCALE:	N.T.S.	



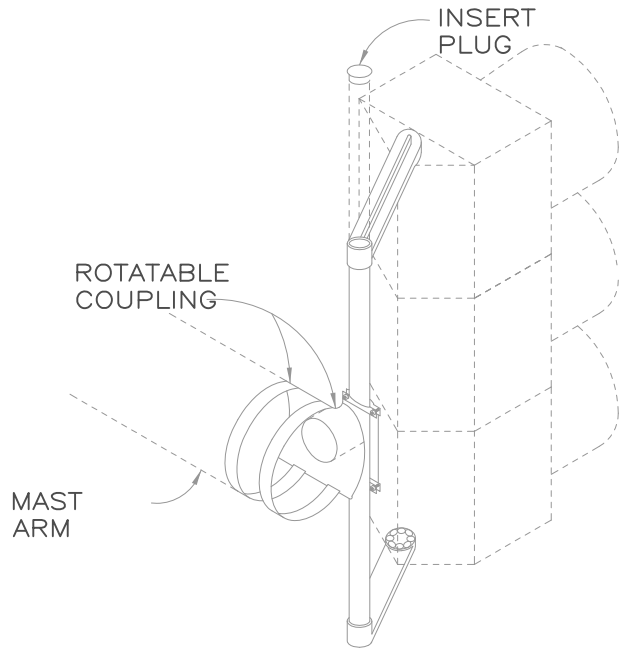
FOR THIS INFORMATION	SEE TABLE
POLE AND SIGNAL ARM DATA	1
MATERIAL DATA	2
LUMINAIRE ARM DATA	3
POLE LENGTHS	4

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	
DATE	ITEM	BY		ISSUED:	
			TRAFFIC SIGNAL POLE	DRAWN BY:	JLT
				APPROVED BY:	
				DRAWING NO:	T1
				SCALE:	N.T.S.


GENERAL NOTES: 1. PIPE COUPLINGS FOR SIGNAL BRACKETS SHALL BE EITHER 1-1/2 OR 2 INCH DEPENDING UPON THE SIGNAL HEAD TO BE INSTALLED. SIGNAL BRACKETS SHALL BE FURNISHED BY THE MANUFACTURER OF THE SIGNAL HEADS. 2. UNLESS OTHERWISE SPECIFIED, ALL TRAFFIC SIGNALS MOUNTED ABOVE THE ROADWAY SHALL HAVE A HEIGHT OF 17'-6", ALL SIDE MOUNTED TRAFFIC SIGNALS SHALL HAVE A HEIGHT OF 10', AND PEDESTRIAN SIGNALS AT A HEIGHT OF 8' AS MEASURED TO THE BOTTOM OF THE SIGNAL HEAD HOUSING OR BRACKET. 3. ALL SIGNAL HEADS SHALL BE MOUNTED IN SUCH A MANNER AS TO BE EASILY REMOVED FROM THEIR SUPPORTING STRUCTURE. 4. GASKET SEALING COMPOUND SHALL BE USED IN ADDITION TO ANY LEAD WASHERS REQUIRED FOR CREATING A WATER-TIGHT CONNECTION BETWEEN THE SIGNAL HEAD AND MOUNTING BRACKET. 5. SIGNAL HEADS SHALL BE SECURELY AFFIXED BY THE USE OF A SERRATED COUPLING OR OTHER ACCESSORIES RECOMMENDED BY THE SIGNAL MANUFACTURER. 6. WIRING FROM INSIDE MAST ARM THROUGH 1" FIELD DRILLED HOLE IN ARM, SHALL BE BROUGHT THROUGH THE MOUNTING SUPPORT TUBE AND LOWER ARM (AS SHOWN). FIELD DRILLED HOLES SHALL HAVE RUBBER GROMMETS INSTALLED.



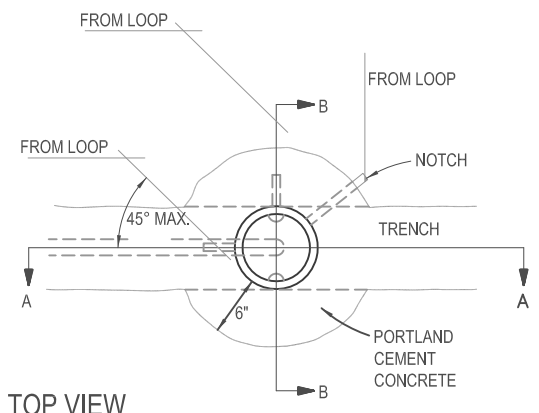
MA 5-1  
MOUNTING  
HARDWARE



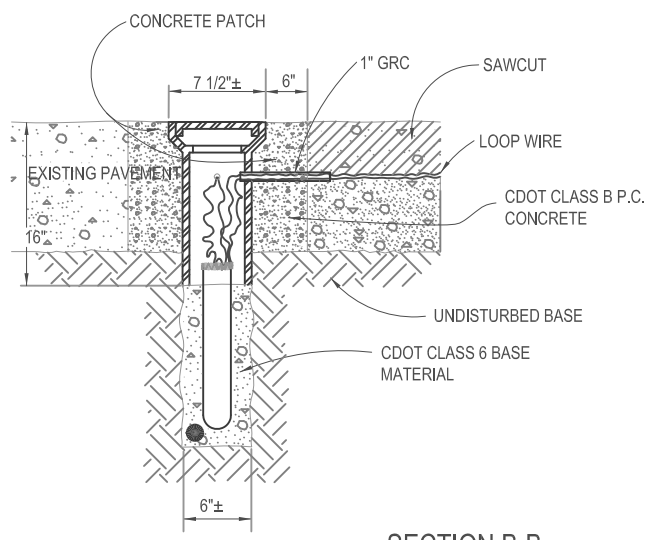
MA 5 ADJUSTABLE  
MAST ARM MOUNTING  
HORIZONTAL OR  
VERTICAL  
INSTALLATION

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			SIGNAL POLE AND MAST ARM MOUNTING DETAILS	APPROVED BY:		
				DRAWING NO:	T10	
				SCALE:	N.T.S.	

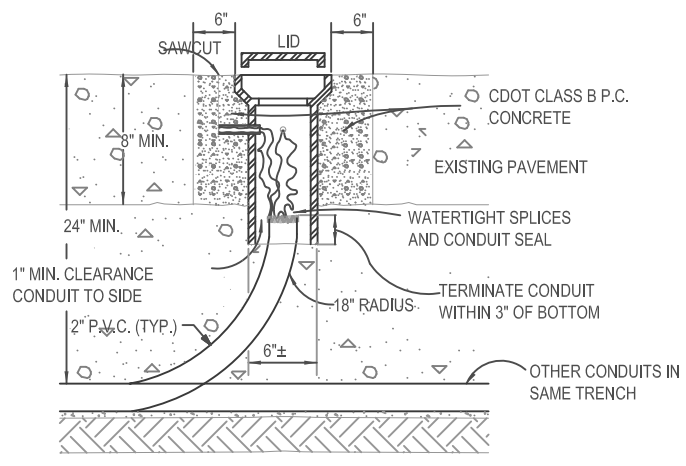




**TOP VIEW**




**SECTION B-B**

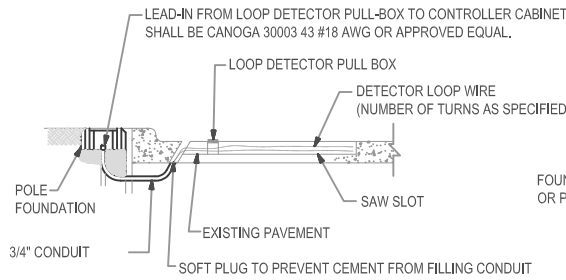


**SECTION A-A**

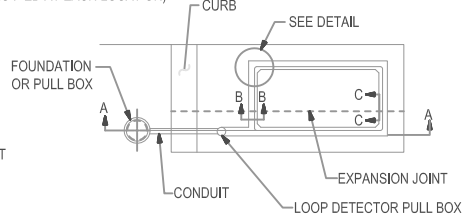
**NOTES ON PULL BOX INSTALLATION:**

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				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:	
DATE	ITEM	BY				DRAWN BY: JLT	
						APPROVED BY:	
						DRAWING NO: T11	
						SCALE: N.T.S.	
LOOP DETECTOR/PULL BOX DETAILS WATER VALVE STEM TYPE(wvPB)							

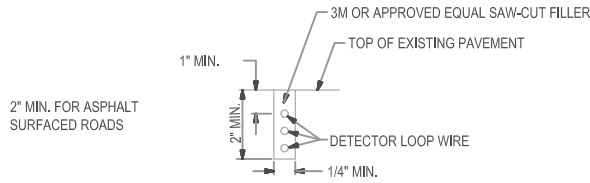


**SECTION A-A**



**STANDARD LOOP**

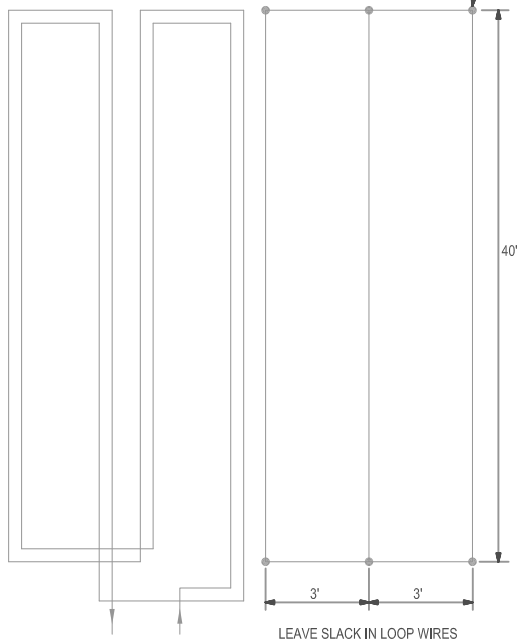
**NOTE:**  
FINISHED LOOP MUST SHOW NO SHORTED TURNS NO BROKEN WIRE AND 15 MEGOHMS (MINIMUM) TO GROUND, MEASURED WITH A QUALITY MEGOHM METER (SEE GENERAL NOTES).



3" MAX. WILL BE PERMITTED IN ASPHALT AND IN VICINITY OF EXPANSION JOINTS TO ALLOW FOR REQUIRED CLEAR DISTANCE TO TUBING.

**SECTION B-B**

LOOPS SHALL BE SIZE SHOWN UNLESS OTHERWISE STATED ON PLANS




**WIRE CONFIGURATION**

**LAYOUT**

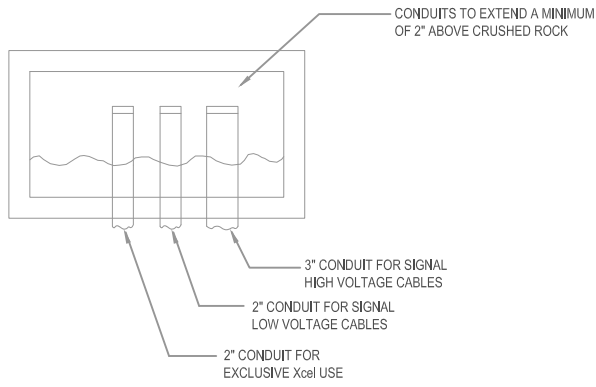
**LOOP DETECTOR INSTALLATION DETAIL**

**GENERAL NOTES FOR TD-5 DETECTORS:**

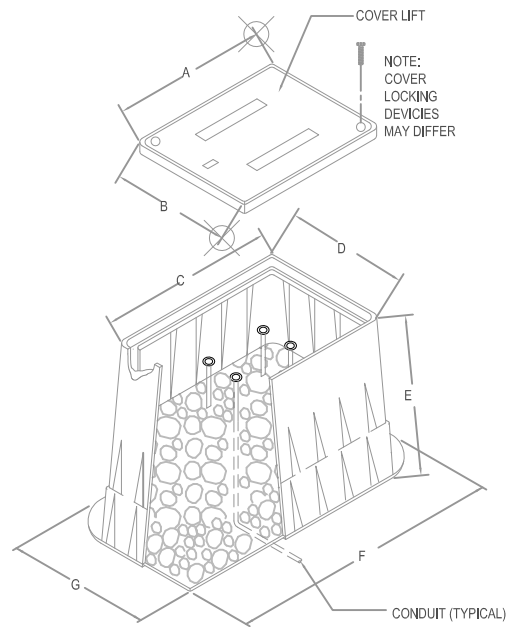
1. LOOP SIZE AND LOCATION SHALL BE AS SHOWN IN THE PLANS
  2. THE NUMBER OF TURNS OF WIRE SHALL BE AS INDICATED IN THE PLANS OF THE SPECIFIC INSTALLATION OR AS OTHERWISE SPECIFIED BY THE EQUIPMENT MANUFACTURER SUPPLYING THE LOOP DETECTOR AMPLIFIERS AND APPROVED BY THE TRAFFIC ENGINEERING DIVISION. ALL 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.

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
					APPROVED BY:	
					DRAWING NO:	T12
					SCALE:	N.T.S.

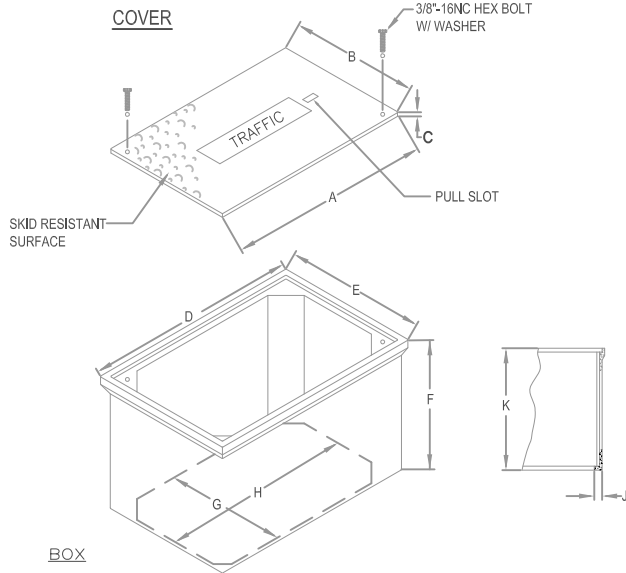
**LOOP DETECTOR DETAILS**



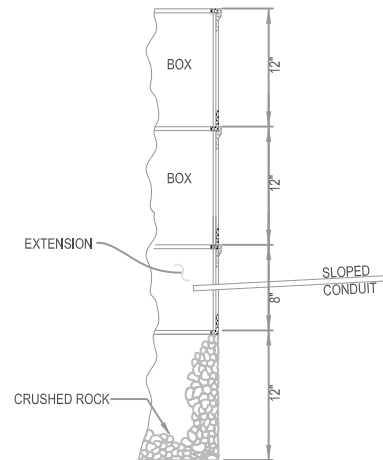
TYPICAL PULL BOX



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	<b>14</b>	<b>14</b>	12 3/4	10 1/2	10 1/2	1	12	UPSTREAM DETECTOR SPLICES, INTERCONNECT

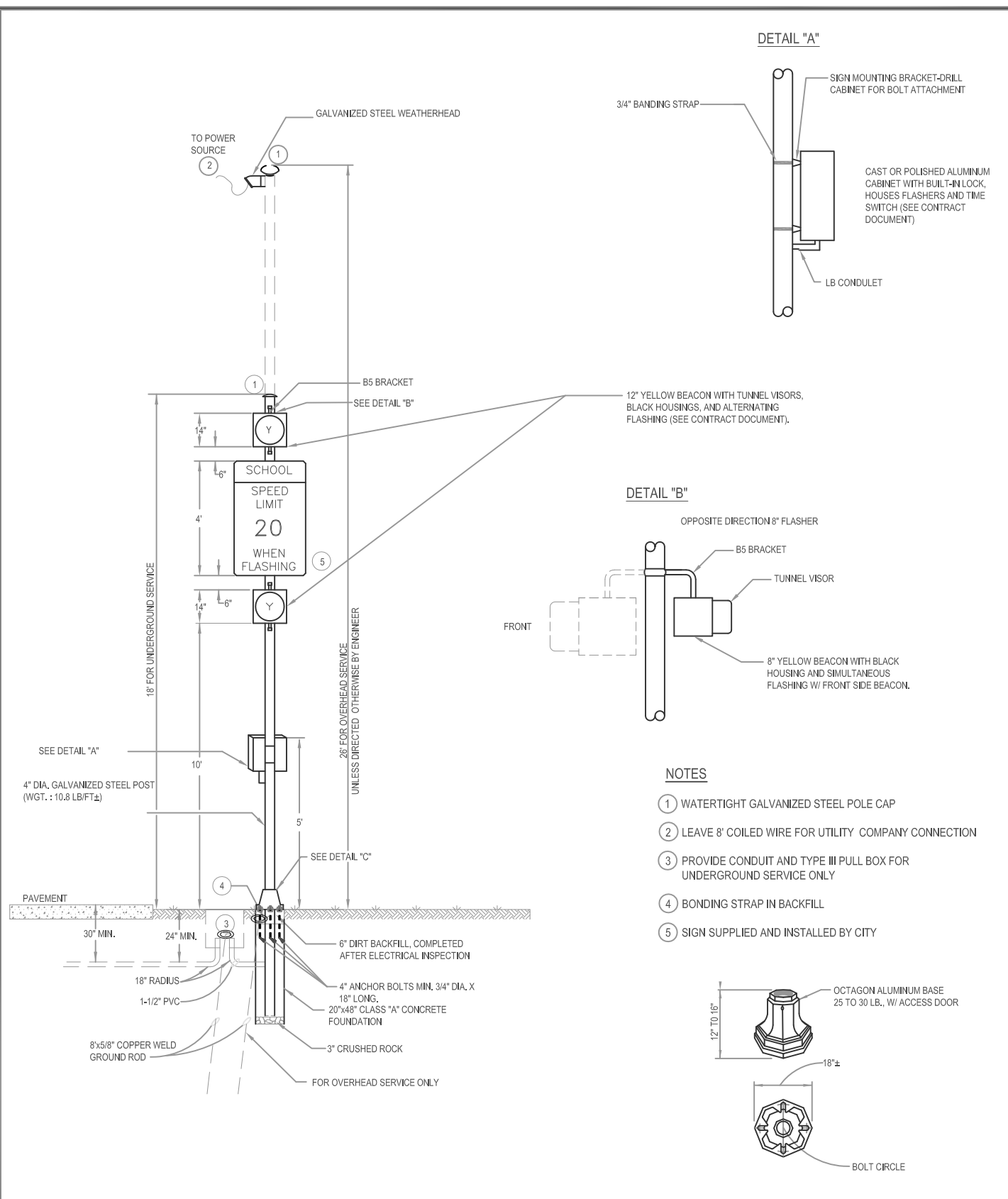
PRECAST PULL BOX FOR USE IN CONCRETE/ASPHALT/  
SIDEWALK AREAS BEHIND CURB  
SEE CONTRACT DOCUMENTS FOR MATERIAL SPECIFICATIONS.

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			TRAFFIC SIGNAL PULL BOX	APPROVED BY:	APPROVED BY:	
					DRAWING NO: T13	
					SCALE: N.T.S.	

TRAFFIC SIGNAL PLAN: GENERAL INSTALLATION NOTES

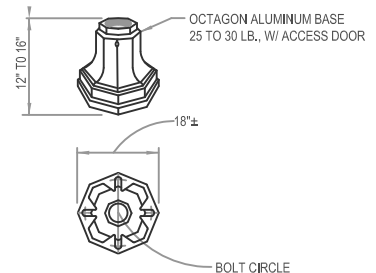
1. ALL CABINET DIMENSIONS ARE NOMINAL.
2. CABINET SHALL BE BONDED TO THE GROUND ROD.
3. CABINETS SHALL BE FIBERGLASS.
4. IF TELEPHONE INTERCONNECT IS SPECIFIED, A MINIMUM OF 5 INCHES CLEAR VERTICAL SPACE SHALL BE LEFT BENEATH ALL OTHER EQUIPMENT INSIDE THE CABINET.
5. ALL STRANDED WIRES TERMINATED IN THE CABINET UNDER A BINDER HEAD SCREW SHALL BE EQUIPPED WITH A SOLDERLESS, PRESSURE TYPE SPADE CONNECTOR WITH A PRE-INSULATED SHANK. ONLY ONE WIRE SHALL BE USED WITH EACH SPADE CONNECTOR. NO MORE THAN THREE CONDUCTORS SHALL BE CONNECTED TO ANY ONE TERMINAL ON THE TERMINAL BOARD PROVIDED IN THE CABINET.
6. CONTROLLERS AND RELAYS SHALL BE LOCATED TO PERMIT SAFE AND EASY REMOVAL.
7. IF THE CABINET IS LOCATED IN AN UNPAVED AREA, A RAISED CONCRETE PAD SHALL BE PROVIDED.
8. ALL CONCRETE SHALL BE PER CITY OF WESTMINSTER STANDARD SPECIFICATIONS FOR DESIGN AND CONSTRUCTION.
9. THE ENDS OF THE SPARE CONDUCTORS SHALL NOT BE CUT BACK. SPARE CONDUCTORS SHALL BE NEATLY COILED AND TAPED FOR POSSIBLE FUTURE USE. ALL CABLES SHALL BE CLEARLY IDENTIFIED IN THE CABINET BY MEANS OF METAL OR DURABLE PLASTIC TAGS.
10. WORK SHALL BE NEAT, UNCLUTTERED "FIRST-CLASS" WORKMANSHIP AND SHALL CONFORM TO APPLICABLE SECTIONS OF THE NATIONAL ELECTRIC CODE, CURRENT EDITION, AND ANY LOCAL REGULATIONS.
11. ALUMINISTIC OR CAULKING COMPOUND SHALL BE USED WHEREVER THE CABINET COMES IN CONTACT WITH THE BASE TO INSURE WEATHER TIGHTNESS. ALUMINISTIC COMPOUND WILL BE REQUIRED IF THE CABINET IS CONSTRUCTED FROM ALUMINUM.
12. THE ITEMS TRAFFIC SIGNAL-LIGHT POLE AND TRAFFIC SIGNAL-LIGHT SPAN WIRE POLE SHALL INCLUDE THE EXTENSION OF THE POLE AND THE MAST ARM FOR THE MOUNTING OF THE LUMINAIRE.
13. ALL REINFORCING STEEL SHALL BE CITY OF WESTMINSTER STANDARD SPECIFICATIONS FOR DESIGN AND CONSTRUCTION.

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			GENERAL INSTALLATION NOTES	APPROVED BY:		
				DRAWING NO:	T14	
				SCALE:	N.T.S.	



**NOTES**

- ① WATERTIGHT GALVANIZED STEEL POLE CAP
- ② LEAVE 8' COILED WIRE FOR UTILITY COMPANY CONNECTION
- ③ PROVIDE CONDUIT AND TYPE III PULL BOX FOR UNDERGROUND SERVICE ONLY
- ④ BONDING STRAP IN BACKFILL
- ⑤ SIGN SUPPLIED AND INSTALLED BY CITY



REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

SCHOOL FLASHING BEACON ASSEMBLY  
SIDE OF ROAD

ISSUED:

DRAWN BY:

JLT

APPROVED BY:

DRAWING NO:

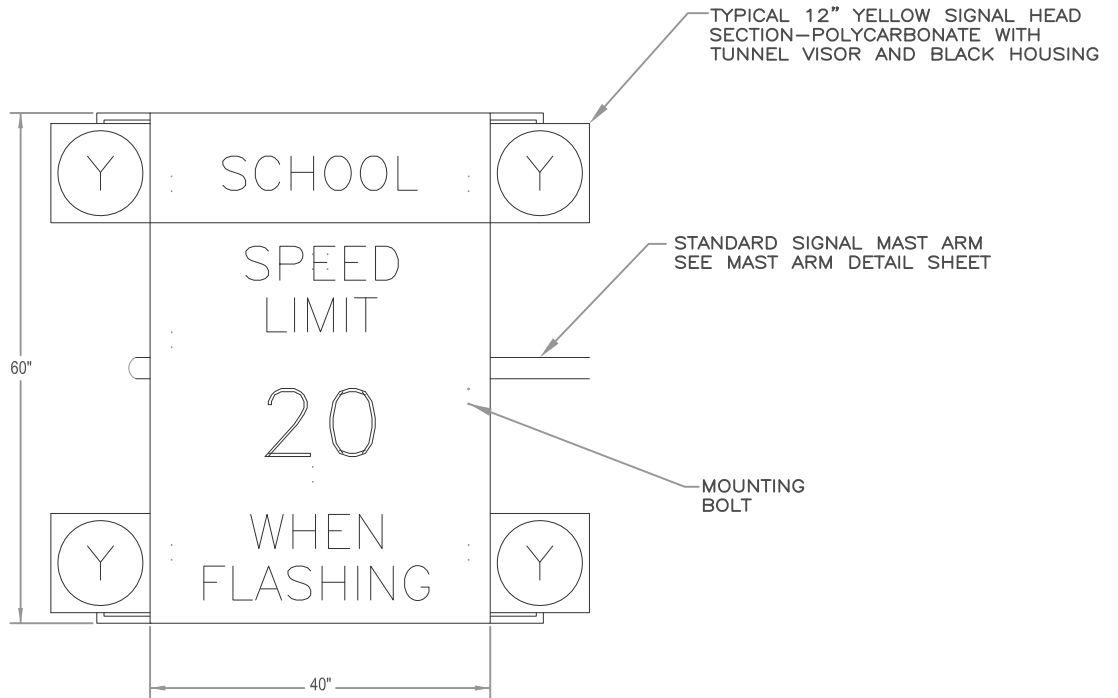
T15

SCALE:

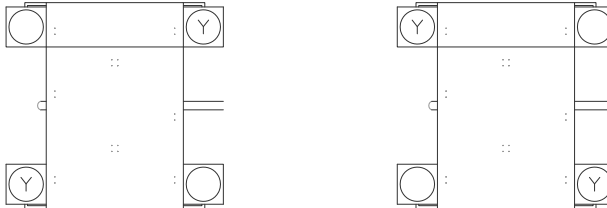
N.T.S.

FRONT VIEW

40"x60" SIGN TO BE SUPPLIED BY THE CITY  
AND INSTALLED BY CONTRACTOR




FLASHING SEQUENCE SHALL BE:

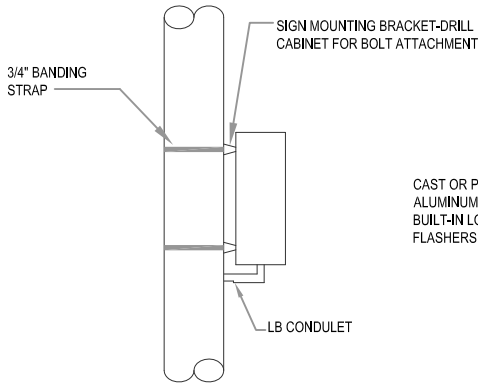


PLACEMENT NOTES:

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.

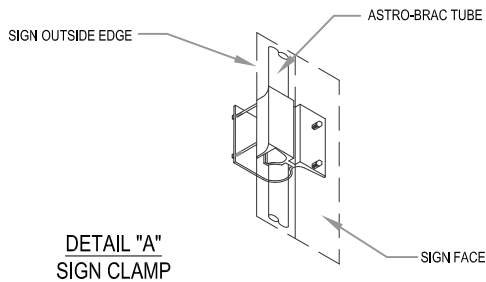
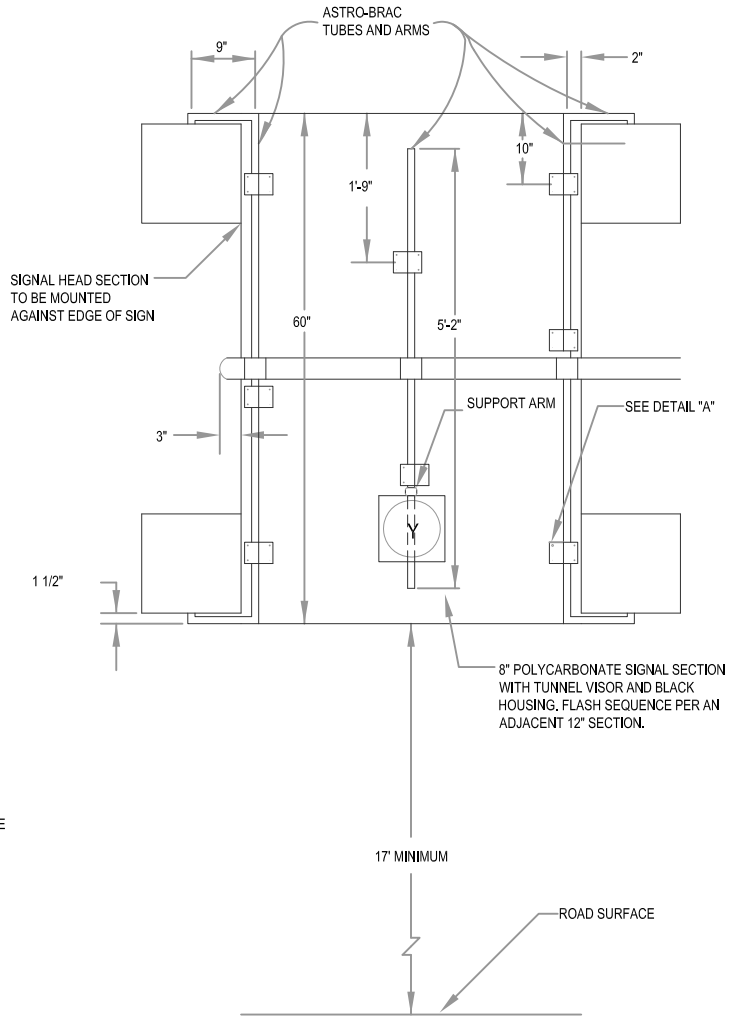
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			SCHOOL FLASHING BEACON ASSEMBLY OVERHEAD	APPROVED BY:		
				DRAWING NO:	T16	
				SCALE:	N.T.S.	

**CABINET AND FLASHER  
DETAIL**



CAST OR POLISHED ALUMINUM CABINET WITH BUILT-IN LOCK, HOUSES FLASHERS AND TIME SWITCH

**BACK VIEW**



REVISIONS		
DATE	ITEM	BY



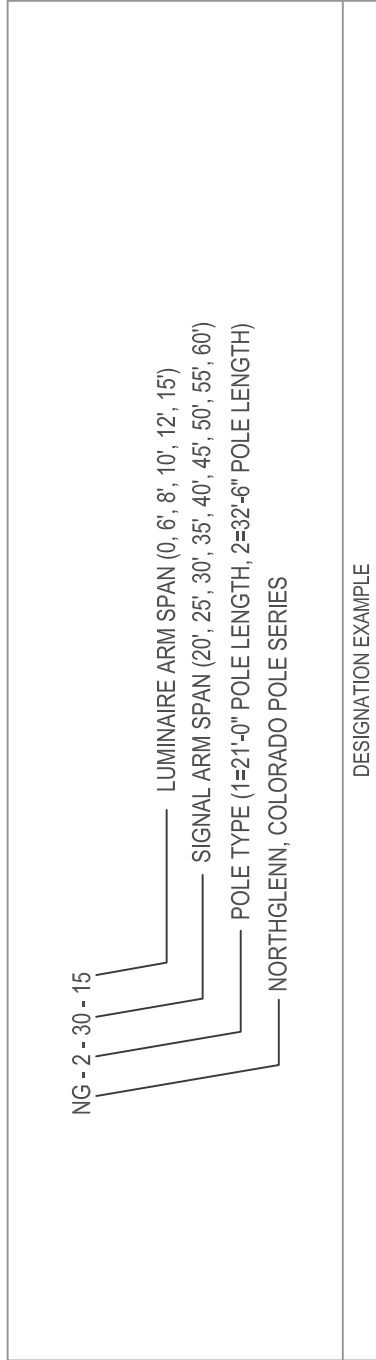
DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

SCHOOL FLASHING BEACON ASSEMBLY  
OVERHEAD - BACK VIEW

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	T17
SCALE:	N.T.S.

TABLE 1: POLE AND SIGNAL ARM DATA

DESIGNATION			POLE TUBE			POLE BASE				ANCHOR BOLT			SIGNAL ARM TUBE					
POLE SERIES	POLE TYPE	SIGNAL ARM SPAN (FT)	LUMINAIRE ARM SPAN (FT)	BASE DIA. (IN)	LENGTH (FT)	GAUGE OR THICK (IN)	SQUARE "S" (IN)	BOLT CIRCLE "Y" (IN)	THK. "M" (IN)	HOLE "Z" (IN)	DIA. "K" (IN)	LENGTH "J" (IN)	HOOK "H" (IN)	THREAD LENGTH "L" (IN)	FIXED END DIA. (IN)	FREE END DIA. (IN)	GAUGE OR THICK (IN)	SPAN (FT)
NORTHGLENN	1 OR 2	20.0	6 THRU 15	13.0	SEE TABLE 4	3	18	17	1.50	1.75	1.5	54	6	8	7.0	4.20	7	20
NORTHGLENN	1 OR 2	25.0	6 THRU 15	13.0		3	18	17	1.50	1.75	1.5	54	6	8	8.0	4.50	7	25
NORTHGLENN	1 OR 2	30.0	6 THRU 15	13.0		3	18	17	1.50	1.75	1.5	54	6	8	9.0	4.80	7	30
NORTHGLENN	1 OR 2	35.0	6 THRU 15	13.0		3	18	17	1.50	1.75	1.5	54	6	8	10.0	5.10	7	35
NORTHGLENN	1 OR 2	40.0	6 THRU 15	15.5		0.25	20	20	1.75	2.00	1.75	84	6	8	10.5	4.90	7	40
NORTHGLENN	1 OR 2	45.0	6 THRU 15	15.5		0.25	20	20	1.75	2.00	1.75	84	6	8	11.5	5.20	7	45
NORTHGLENN	1 OR 2	50.0	6 THRU 15	15.5		0.25	20	20	1.75	2.00	1.75	84	6	8	13.0	6.00	7	50
NORTHGLENN	1 OR 2	55.0	6 THRU 15	16.0		0.25	22	22	2.00	2.25	2.00	84	6	10	12.5	5.15	SEE DET.4	55
NORTHGLENN	1 OR 2	60.0	6 THRU 15	16.0		0.25	22	22	2.00	2.25	2.00	84	6	10	13.0	4.95	SEE DET.4	60



REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

POLE AND SIGNAL ARM DATA

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	T2
SCALE:	N.T.S.



**TABLE 2: MATERIAL DATA**

COMPONENT	ASTM DESIGNATION	MIN. YIELD (KSI)	COMPONENT	ASTM DESIGNATION	MIN. YIELD (KSI)
3 GAUGE-POLE SHAFT	A595 GR. A	55	MAST ARM ATTACHMENT	A36	36
3 GAUGE-POLE BASE	A36	36	MAST ARM CONN. BOLT	A325	—
0.25" WALL-POLE SHAFT	A572 GR. 65	65	LUMINAIRE ARM ATTACH.	A36	36
0.25" WALL-POLE BASE	A572 GR. 42	42	LUM. CONNECTION BOLT	SAE GR.5	—
MAST ARM SHAFT	A595 GR. A	55	GALVANIZING HARDWARE	A153	—
LUMINAIRE ARM	A595 GR. A	55	ANCHOR BOLTS AASHTO M314 GR. 55		


FINISH NOTES:  
 FINISH COAT: TGIC OR URETHANE POLYESTER POWDER  
 VALMONT SPEC: F-264T  
 COLOR:FEDERAL GREEN #14056

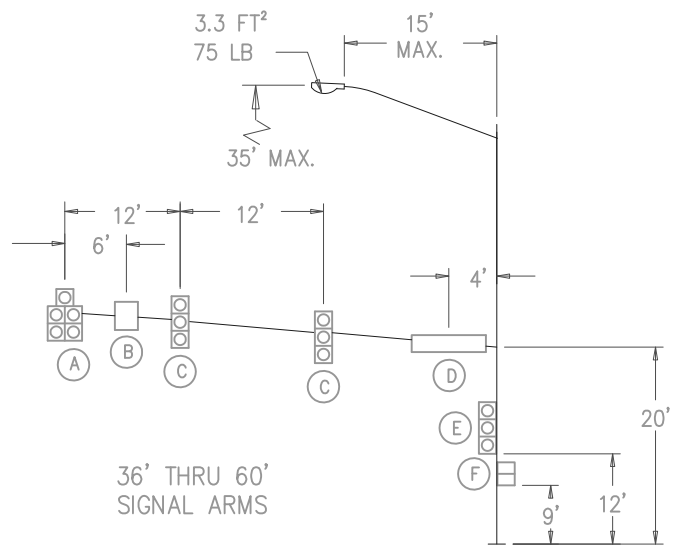
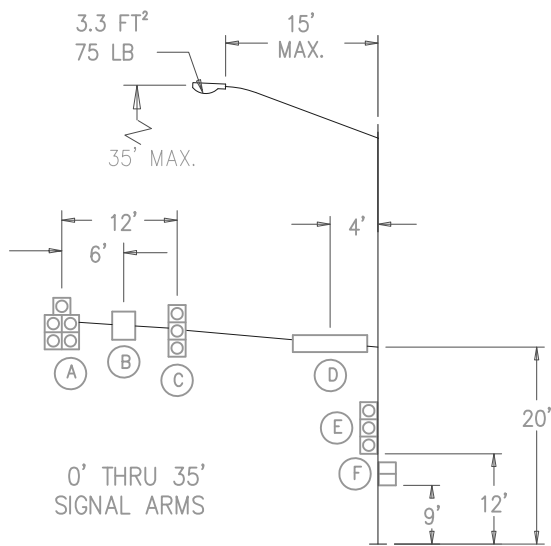
**TABLE 4: POLE LENGTHS**

POLE TYPE	1	2
POLE LENGTH	21'-0"	32'-6"
LUMINAIRE MOUNTING HEIGHT	NONE	35'-0"

**TABLE 3: LUMINAIRE ARM DATA**

ARM SPAN (FT)	FIXED END DIA. (IN)	FREE END DIA. (IN)	GA.	RISE HEIGHT "R"
6	3.39	2.38	11	3'-0"
8	3.63	2.38	11	3'-0"
10	3.89	2.38	11	3'-0"
12	4.16	2.38	11	3'-0"
15	4.58	2.38	11	3'-0"

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			SIGNAL POLE TABLES 2, 3, AND 4	APPROVED BY:		
				DRAWING NO:	T3	
				SCALE:	N.T.S.	




### MAX. LOADING INFORMATION

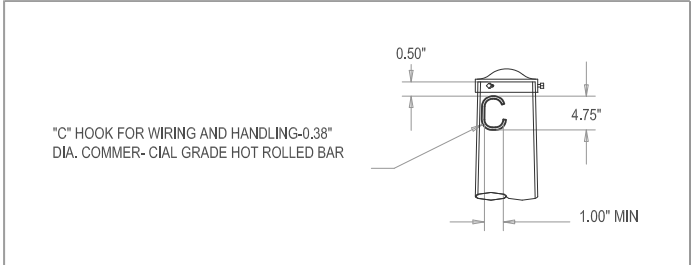
DEVICE	DESCRIPTION	PROJECT AREA (FT²)	WEIGHT (LBS)
(A) SIGNAL	12"-5 SECTION WITH BACKPLATE	12.40	105
(B) SIGN	REGULATORY 3.0' X 3.0'	9.00	20
(C) SIGNAL	12"-3 SECTION WITH BACKPLATE	8.67	75
(D) SIGN	STREET NAME 2.0' X 6.0'	12.00	40
(E) SIGNAL	DUAL 12"-3 SECTION	8.90	130
(F) SIGNAL	DUAL-PEDESTRIAN SIGNAL	3.56	40

#### NOTES:

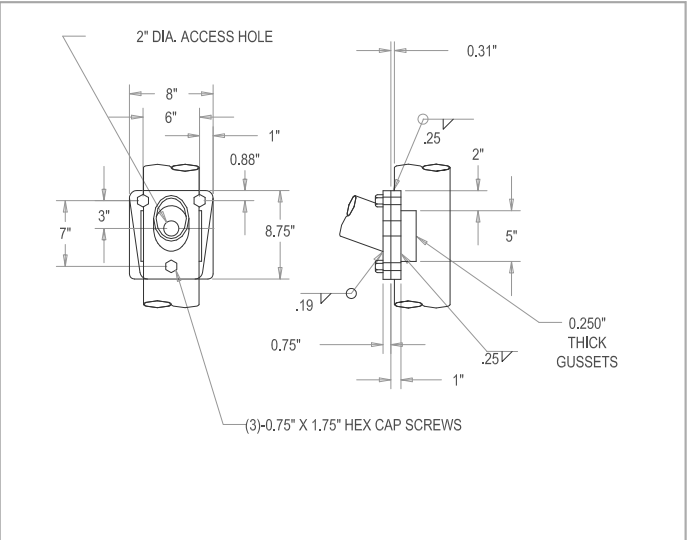
ALL STRUCTURES ARE DESIGNED TO THE 1985 (90 MPH) AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR SIGNS, LUMINARIES, AND TRAFFIC SIGNALS.

MAST ARMS 50 FEET OR LESS IN LENGTH SHALL BE ONE PIECE CONSTRUCTION. BUTT-END WELDS SHALL NOT BE ACCEPTED.

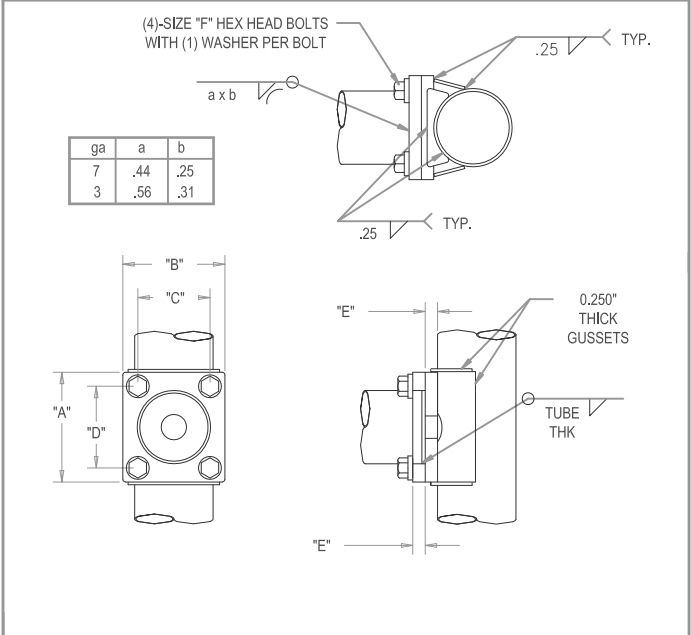
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:
DATE	ITEM	BY		SIGNAL POLE LOADING INFORMATION		DRAWN BY: JLT
						APPROVED BY:
					DRAWING NO: T4	
					SCALE: N.T.S.	



DETAIL 1 POLE TOP

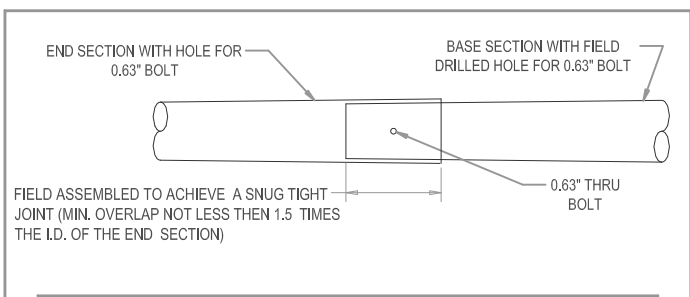


DETAIL 2 LUMINIARE ARM ATTACHMENT



POLE BASE DIA.	"A"	"B"	"C"	"D"	"E"	"F"
13.00"	16.25"	15.00"	11.00"	12.25"	1.50"	1.50" X 3.50"
15.50"	17.25"	16.00"	12.00"	13.25"	1.75"	1.50" X 4.00"
16.00"	17.75"	17.00"	13.00"	13.50"	2.00"	1.50" X 4.25"

DETAIL 3 SIGNAL ARM ATTACHMENT



ARM LENGTH	BASE SECTION		END SECTION	
	LENGTH	GAUGE	LENGTH	GAUGE
55'	50.00'	3	6.83'	7
60'	50.00'	3	11.92'	7

DETAIL 4 SIGNAL ARM SLIP JOINT

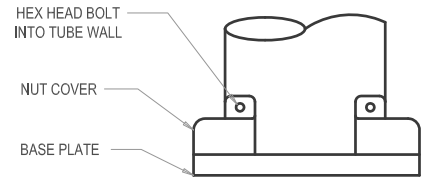
REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

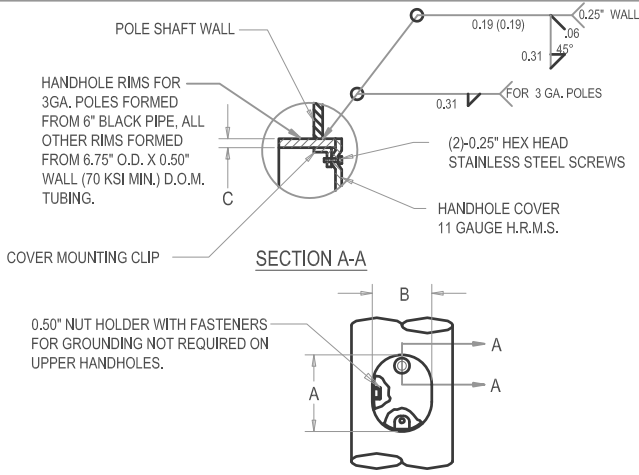
TRAFFIC SIGNAL  
SERIES DETAILS

ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	T5
SCALE:	N.T.S.

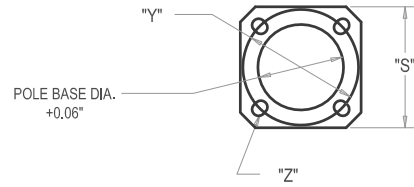
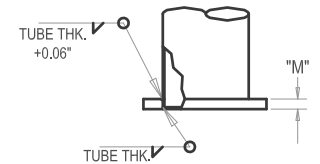


DETAIL 7

NUT COVER

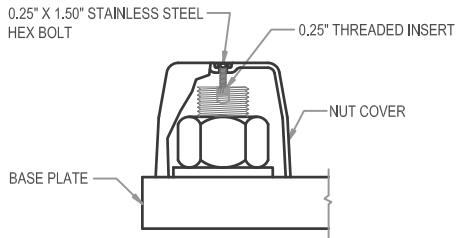


POLE WALL	A	B	C
3 GAUGE	7.56"	5.19"	0.280"
0.25"	7.56"	5.50"	0.500"
DETAIL 5	HANDHOLE		



DETAIL 8

POLE BASE



- INSTALLATION INSTRUCTIONS:
- ANCHOR BOLT PROJECTION ABOVE TOP OF BASE PLATE MUST BE BETWEEN 3" MIN. AND 4" MAX.
  - PLACE COVER OVER ANCHOR BOLT AND SECURE IN PLACE WITH THE 1/4"-20 UNC x 1 1/2" LONG STAINLESS STEEL HEX HEAD BOLT.

REQUIRED ON 16.00" DIAMETER POLES ONLY.

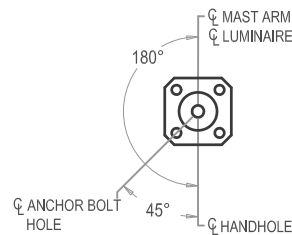
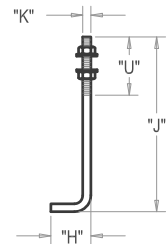
DETAIL 6

NUT COVER

DETAIL 9

ANCHOR BOLT

(4)-ANCHOR BOLTS WITH (2) HEX NUTS AND (2) WASHERS PER BOLT WITH THREADED END GALVANIZED AT LEAST 12".



ALL ANGLES MEASURED CLOCKWISE FROM HAND-HOLE AS VIEWED FROM SMALL END OF POLE

RADIAL INDEX

REVISIONS

DATE	ITEM	BY



DEPARTMENT OF CIP DESIGN & ENGINEERING

TRAFFIC SIGNAL POLE SERIES DETAILS 5 - 9

ISSUED:

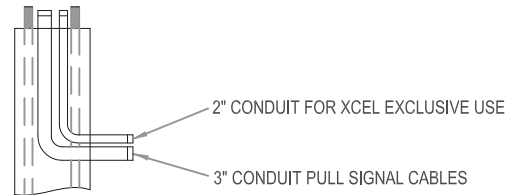
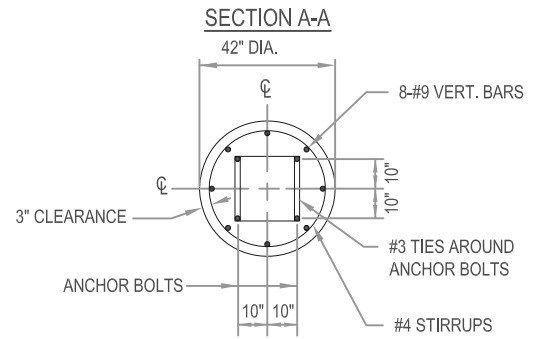
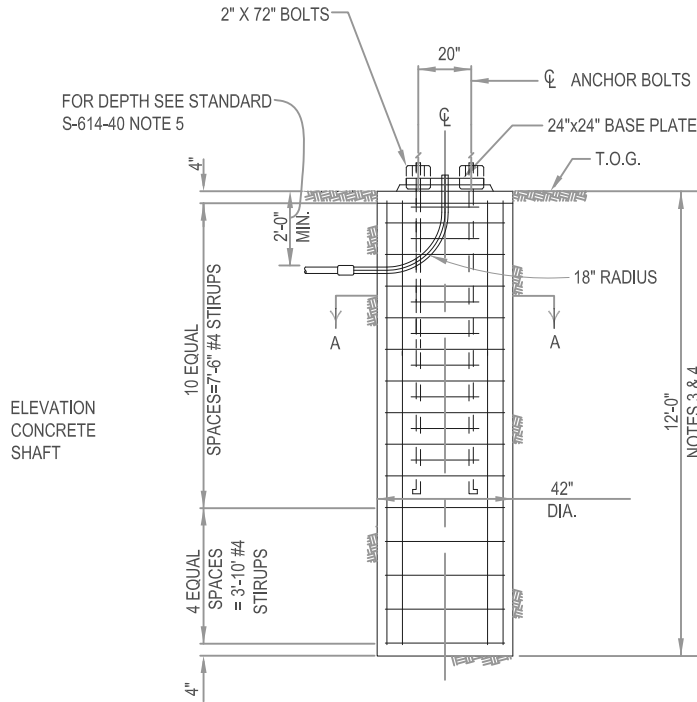
DRAWN BY: JLT

APPROVED BY:

DRAWING NO: T6

SCALE: N.T.S.


# TYPICAL TRAFFIC SIGNAL POLE FOOTING FOR MAST ARM POLES GREATER THAN 50 FEET

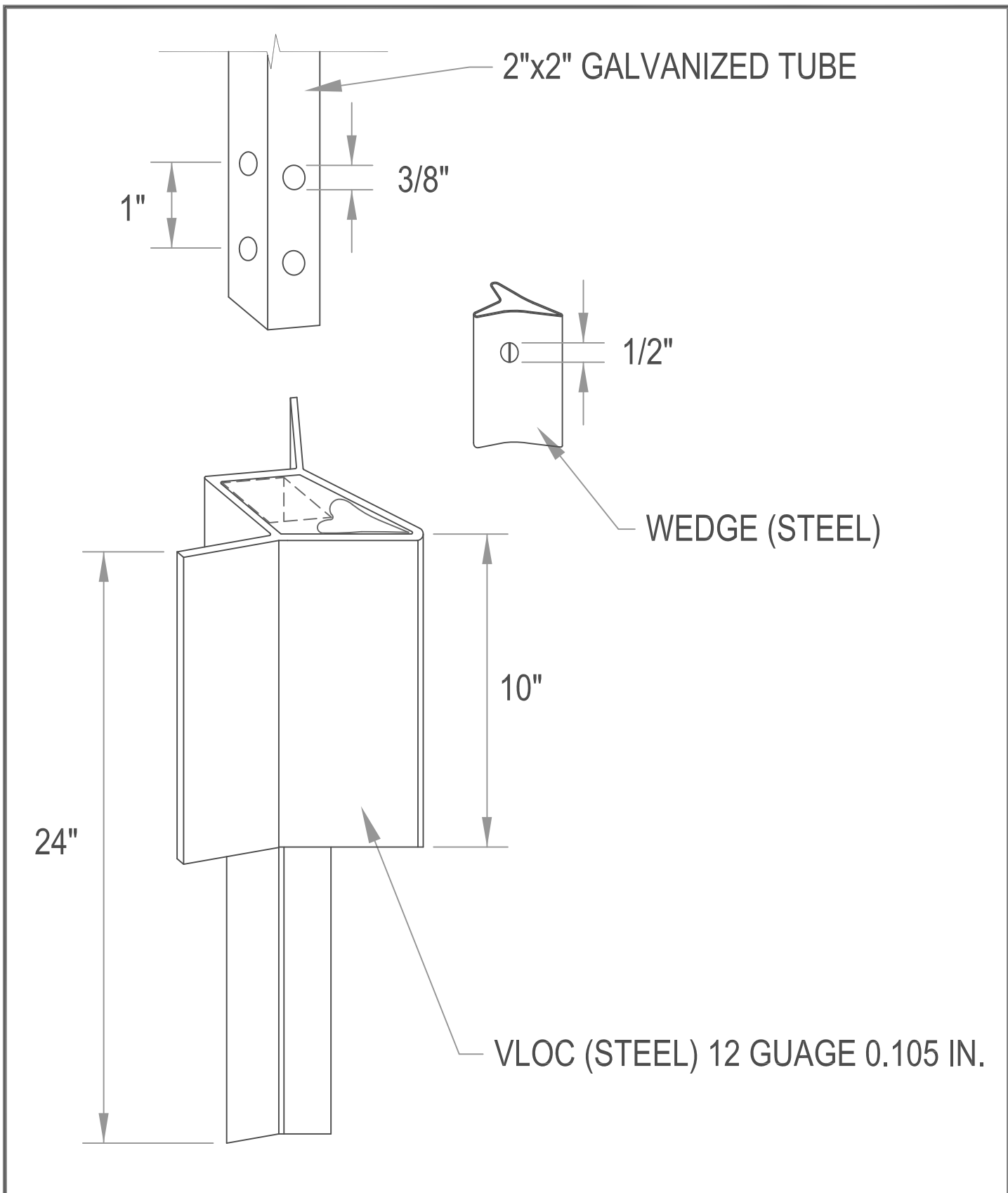



TYPICAL POLE BASE

**NOTES**

1. CONCRETE  $F_c^1$  = CLASS A OR B REINFORCED STEEL: PER AASHTO M31 SPECIFICATION, GRADE 60 FOR #9 & #4 BARS, AND GRADE 40 FOR #3 BARS.
2. SHAFT FOR CONCRETE FOUNDATION TO BE DRILLED BY MECHANICAL AUGER. CASING IF USED IN PLACING CONCRETE SHALL BE REMOVED UPON COMPLETING POUR.
3. FOUNDATION DESIGN REQUIRES THAT THE SHAFT BE FOUNDED IN COMPACT SAND, CLAY, OR SANDY CLAY. THE ALLOWABLE SAFE LATERAL BEARING CAPACITY OF SOIL (AROUND SHAFT) TO BE 1,300 LBS./SQ. FT. MINIMUM AT DEPTH OF 4.0 FT. BELOW TOP OF FOUNDATION. THE AVERAGE FRICTIONAL RESISTANCE OF THE SOIL (AROUND THE SHAFT) TO BE 460 LBS./SQ. FT. MINIMUM ALLOWABLE, UNDER WIND LOADING (TORSION). IF THE SOIL INVESTIGATION (CONDUCTED PRIOR TO CONSTRUCTION) INDICATES THE ABOVE NOTED REQUIREMENTS CANNOT BE MET, OR IF "EXPANSIVE" SOIL IS AN EXISTING PROBLEM, THEN THE FOUNDATION DESIGN SHOWN WILL HAVE TO BE MODIFIED AND APPROVED BY THE ENGINEER.
4. SHOULD ROCK BE ENCOUNTERED, THE SHAFT SHOULD EXTEND 6 FT. MINIMUM INTO ROCK. THE ALLOWABLE SAFE LATERAL BEARING CAPACITY OF ROCK TO BE 4,300 LBS./SQ. FT. THE SOIL (INCLUDING ROCK) SURROUNDING THE SHAFT SHOULD BE INVESTIGATED TO ENSURE IT WILL RESIST THE TORSIONAL MOMENT OF 93,435 FT. LBS.
5. CONCRETE SHALL BE POURED IN LIFTS NOT EXCEEDING 3 FEET IN DEPTH. AT THE POURING OF EACH LIFT, CONCRETE SHALL BE MECHANICALLY VIBRATED TO REMOVE AIR POCKETS.

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	
DATE	ITEM	BY		ISSUED:	
			<b>MAST ARM POLE FOUNDATION DETAILS</b>	DRAWN BY:	JLT
				APPROVED BY:	
				DRAWING NO:	T7
				SCALE:	N.T.S.



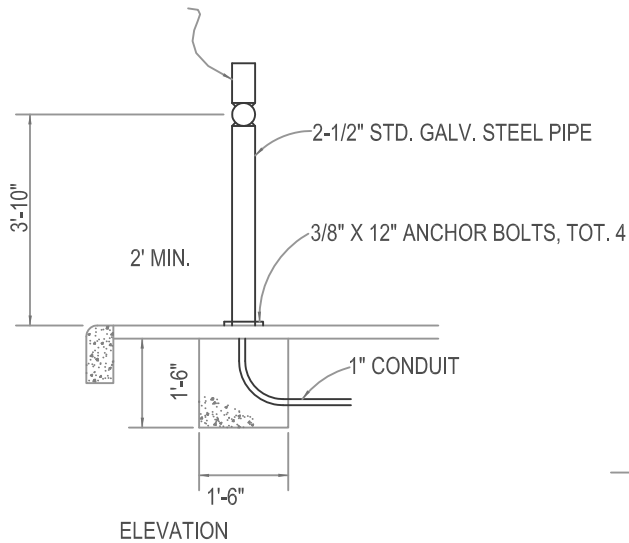
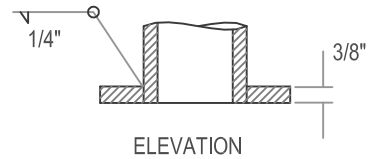
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	
DATE	ITEM	BY		ISSUED:	
			TYPICAL SIGN POST ANCHOR DETAIL	DRAWN BY:	JLT
				APPROVED BY:	
				DRAWING NO:	T8
				SCALE:	N.T.S.



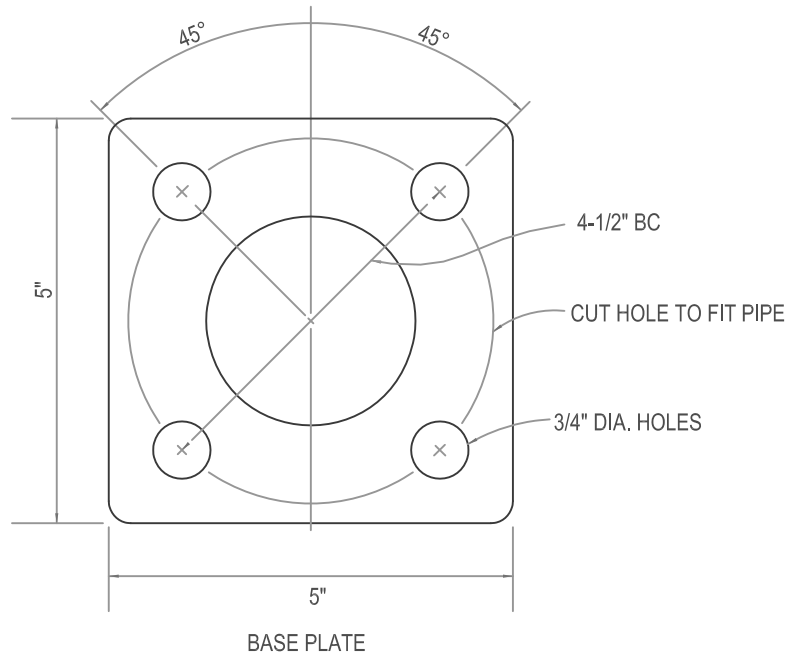
R10-4b  
9"x12"


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.



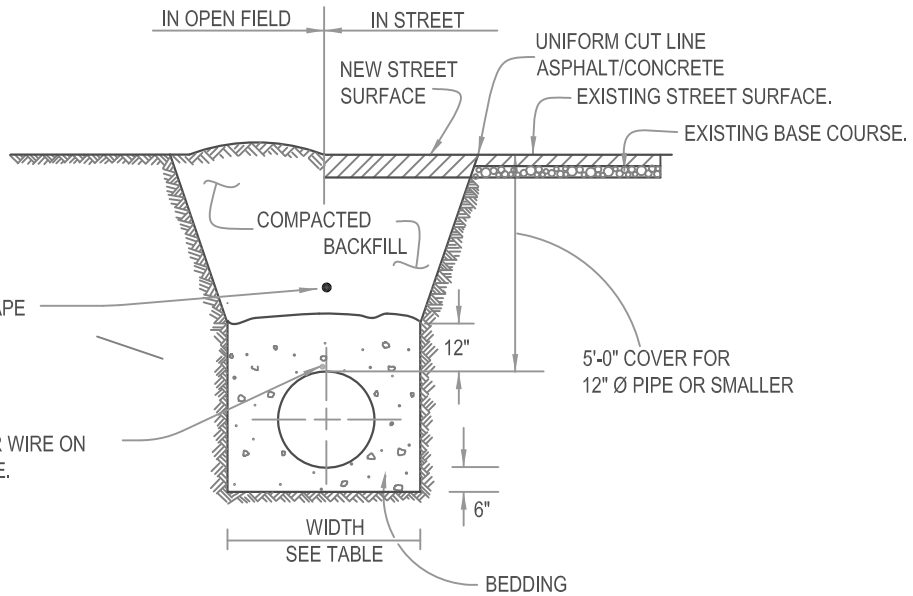
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
				APPROVED BY:		
			PEDESTRIAN PUSH BUTTON POST AND SIGN		DRAWING NO:	T9
					SCALE:	N.T.S.

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

FOR PATCHING IN STREET SURFACE USE FULL DEPTH ASPHALT AS NOTED BELOW OR MATCH EXISTING PLUS ONE (1) INCH, WHICH EVER IS GREATER

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"

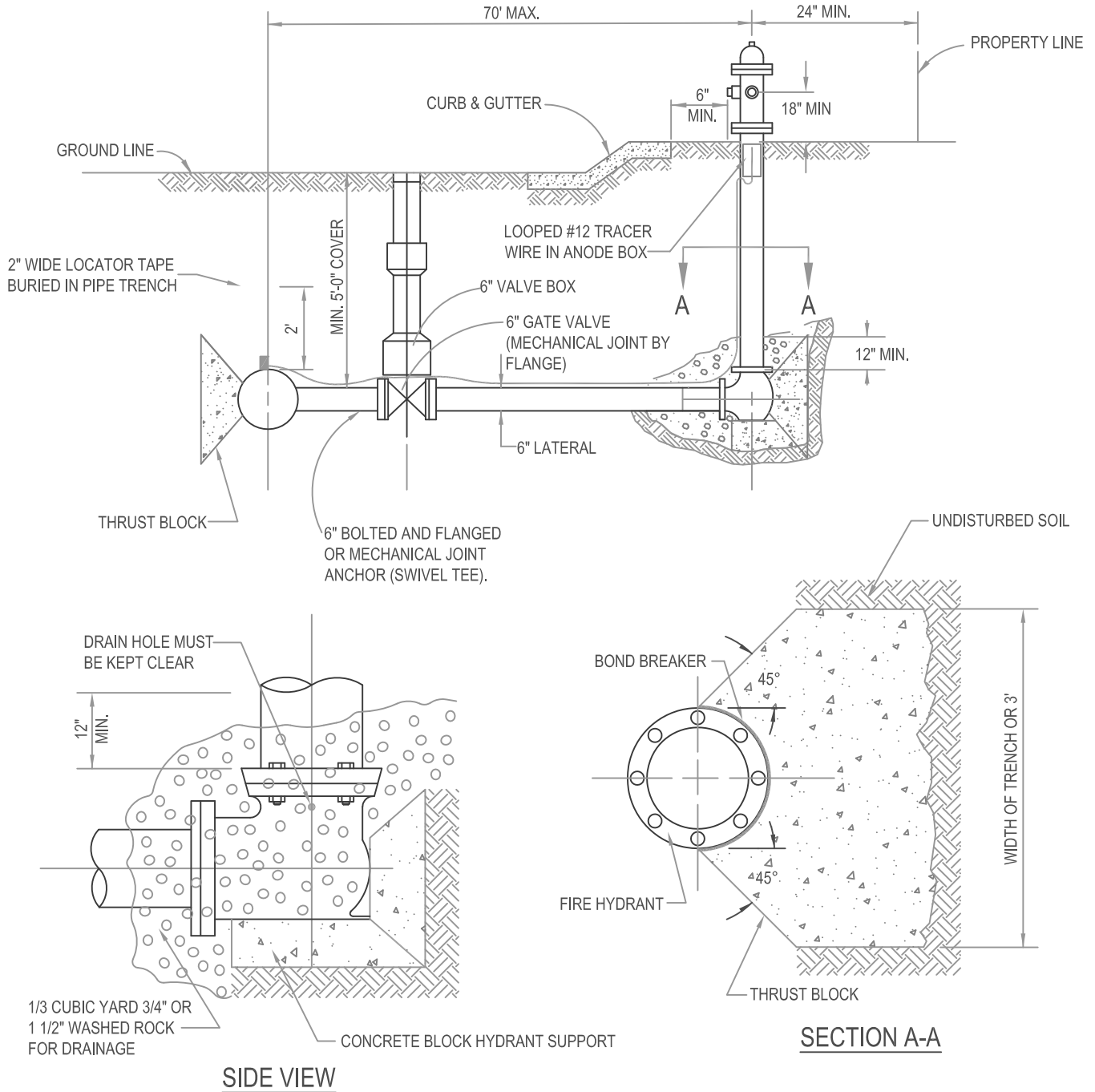
STREET CLASSIFICATION	DEPTH ASPHALT
ARTERIAL	9"
COLLECTOR	7"
LOCAL	6"


REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			TYPICAL TRENCH SECTION PIPE PROTECTION	APPROVED BY:		
				DRAWING NO:	W1	
				SCALE:	N.T.S.	

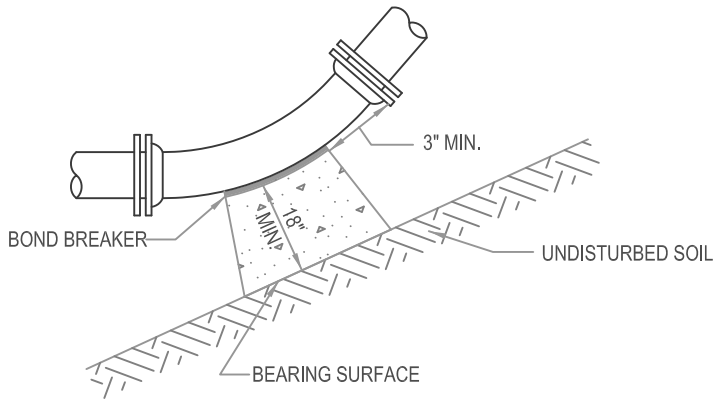


**GENERAL NOTES:**

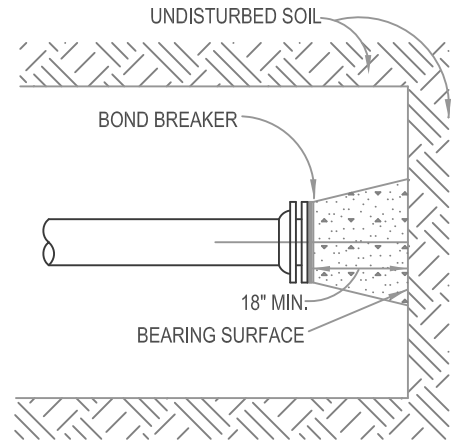
1. ALL FITTINGS AND D.I. PIPE TO BE WRAPPED IN POLYETHYLENE.
2. IN UNSTABLE GROUND THE FIRE HYDRANT SHALL BE RODDED FROM THE TEE TO THE HYDRANT.
3. 5' UNOBSTRUCTED AREA IN FRONT AND ON SIDES WITH A 3' UNOBSTRUCTED AREA BEHIND. AREAS SHALL BE CONSTANTLY MAINTAINED.
4. VALVE NUT SHALL BE AT A DEPTH OPERABLE BY A 6' KEY.
5. THREADS ON HOSE FITTINGS TO BE GREASED.



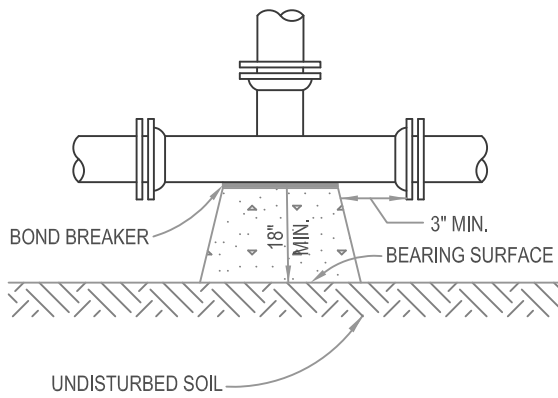
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DATE	ITEM	BY		ISSUED:	
			<b>FIRE HYDRANT INSTALLATION DETAIL</b>	DRAWN BY:	JLT
				APPROVED BY:	
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				SCALE:	N.T.S.



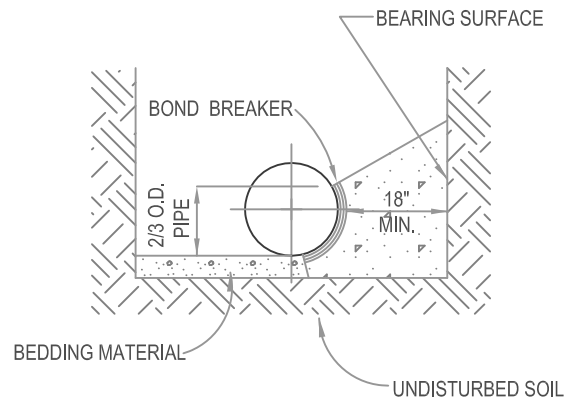
11 1/4°, 22 1/2° AND 45° BENDS



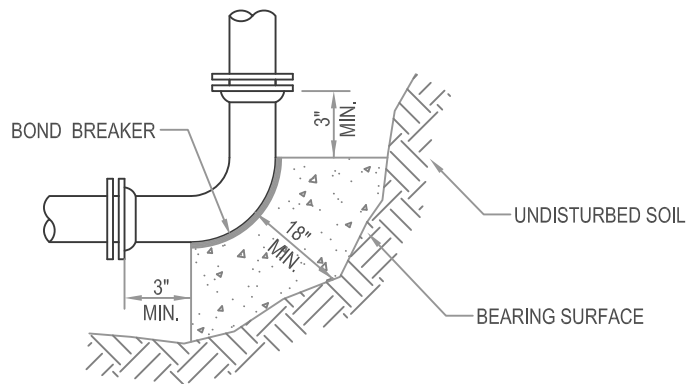
DEAD END




TEE



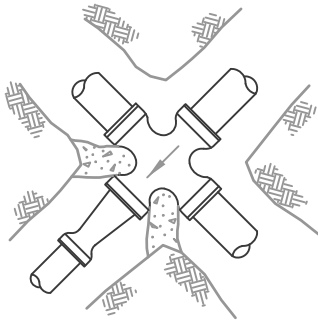
TYPICAL CROSS SECTION



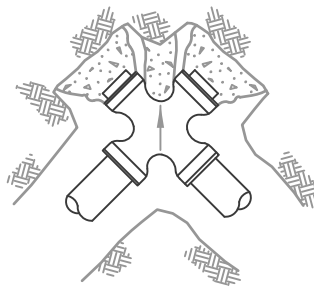
90° BEND

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
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					APPROVED BY:	
					DRAWING NO:	W3
					SCALE:	N.T.S.

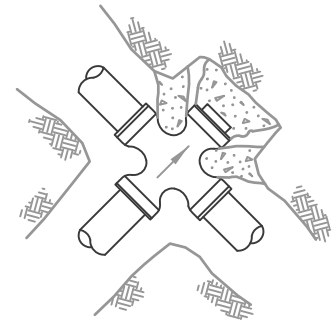
CONCRETE THRUST BLOCKS  
BEARING SURFACES AND INSTALLATION



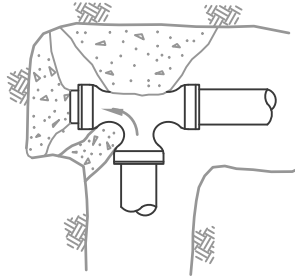
UNBALANCED CROSS



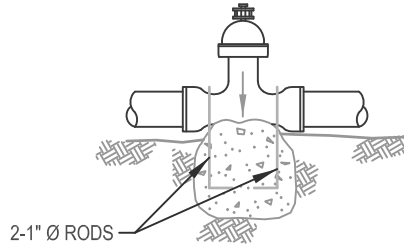
PLUGGED CROSS



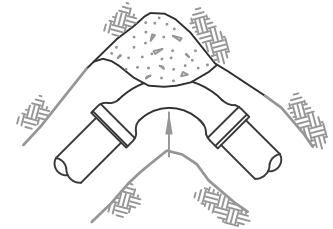
PLUGGED CROSS



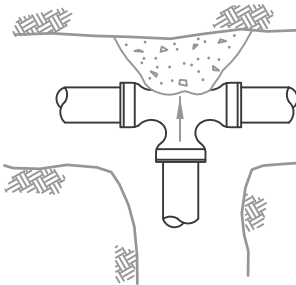
PLUGGED TEE



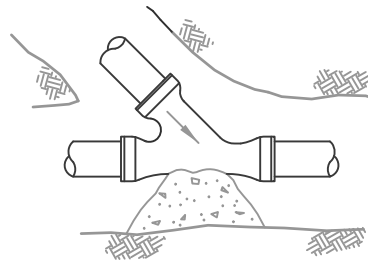
VALVE



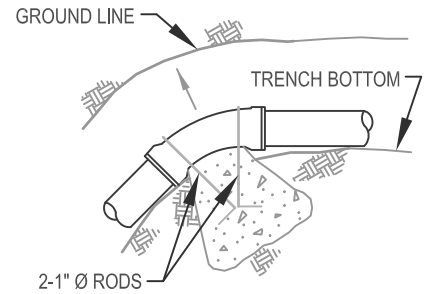
HORIZONTAL BEND



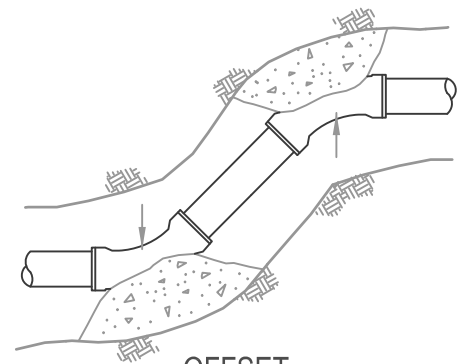
TEE



"Y" BRANCH




VERTICAL BEND

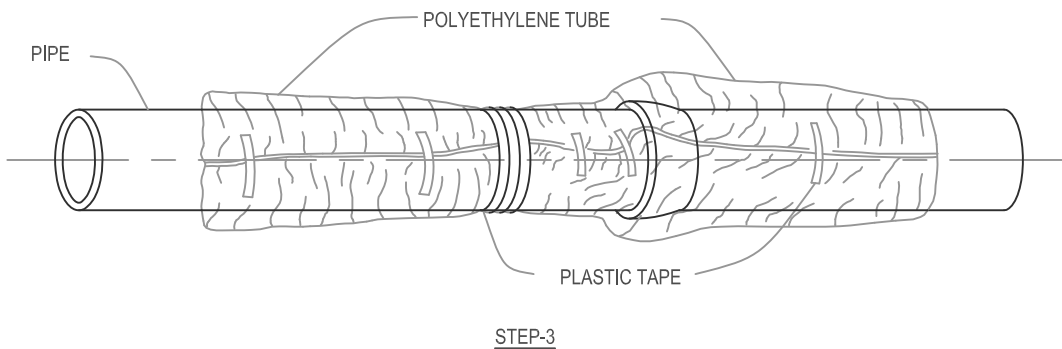
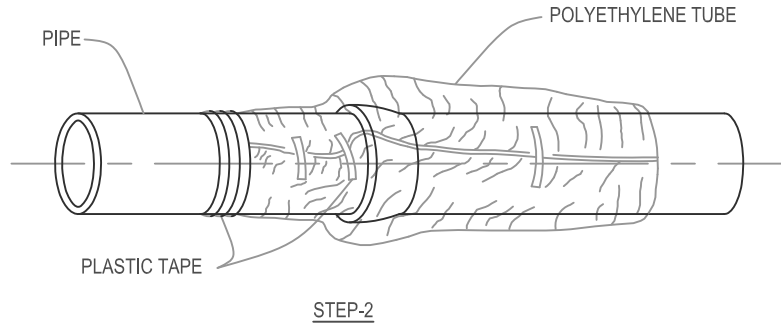
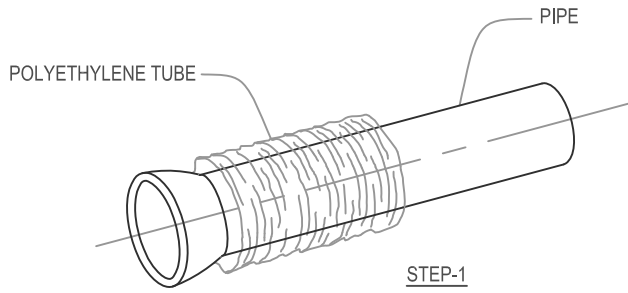


OFFSET

NOTES:

1. SIZE OF BLOCK TO BE A MINIMUM OF 18" THICK.
2. ALL BLOCKING TO BE ON UNDISTURBED MATERIAL.


REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			CONCRETE THRUST BLOCKING FOR UNBALANCED FITTINGS	APPROVED BY:		
				DRAWING NO:	W4	
				SCALE:	N.T.S.	



**FIELD INSTALLATION-POLYETHYLENE WRAP**

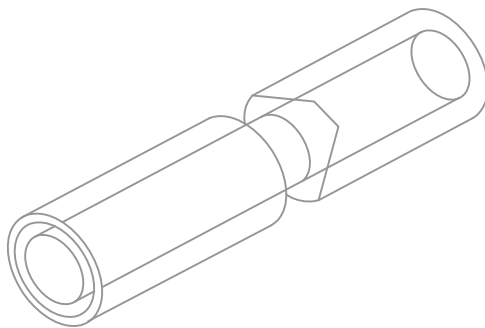
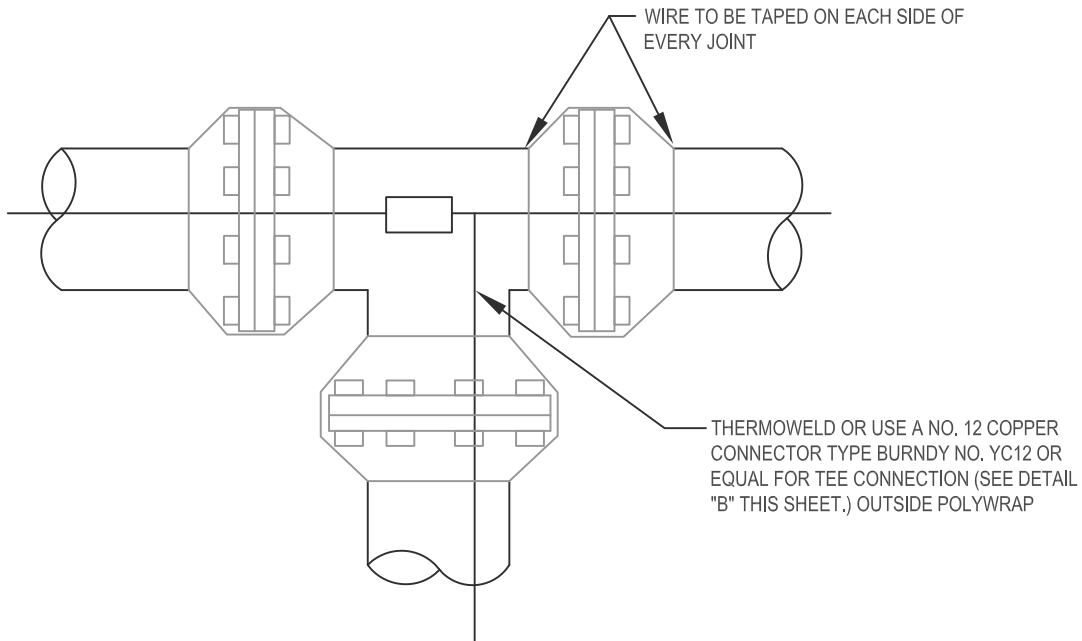
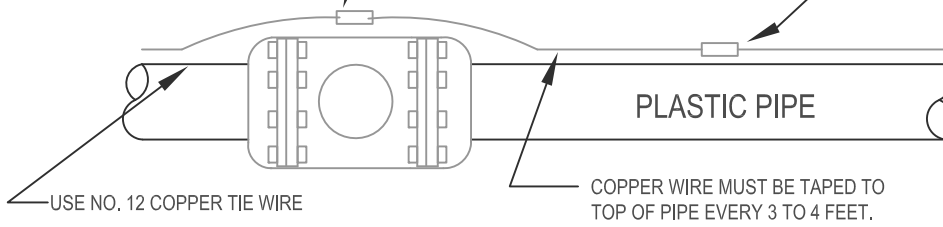
- STEP-1 PLACE TUBE OF POLYETHYLENE MATERIAL AROUND PIPE PRIOR TO LOWERING PIPE INTO TRENCH.
- STEP-2 PULL THE TUBE OVER THE LENGTH OF THE PIPE. TAPE TUBE TO PIPE AT JOINT. FOLD MATERIAL AROUND THE ADJACENT SPIGOT END AND WRAP WITH TAPE TO HOLD THE PLASTIC TUBE IN PLACE.
- STEP-3 OVERLAP FIRST TUBE WITH 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

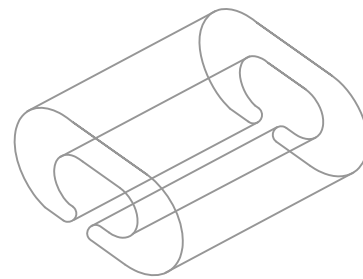
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			POLYETHYLENE WRAP FOR DUCTILE IRON PIPE	APPROVED BY:		
				DRAWING NO:	W5	
				SCALE:	N.T.S.	

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)

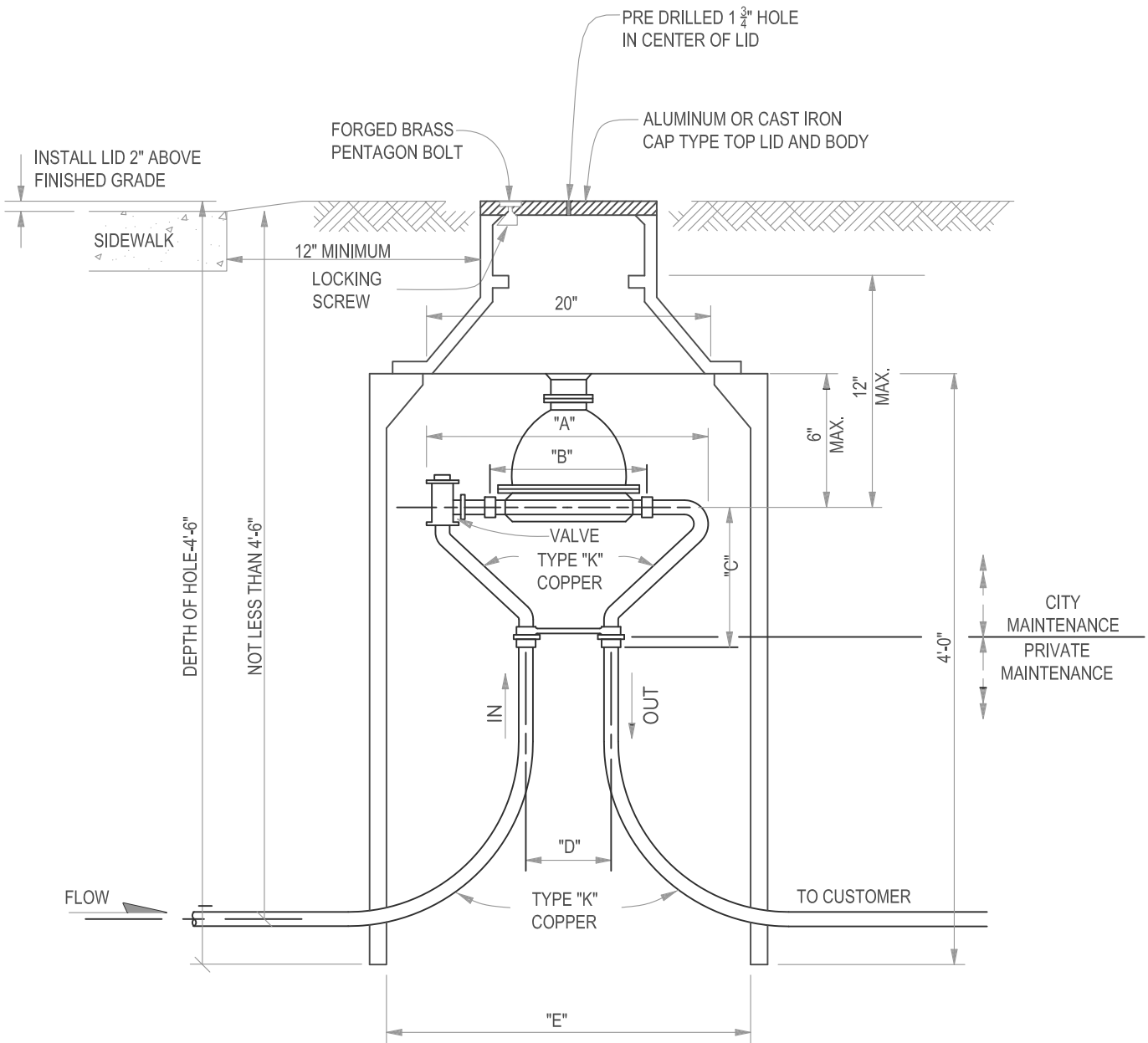


DETAIL A




DETAIL B

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			TRACER WIRE ON PLASTIC PIPE	APPROVED BY:		
				DRAWING NO:	W6	
				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

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:	
DATE	ITEM	BY				DRAWN BY:	JLT
			SETTINGS FOR 5/8" X 3/4" AND 1" METERS	APPROVED BY:		DRAWING NO:	W7
						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 POLYETHELENE.
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 W10.


## IN CASE OF A BROKEN RADIO FREQUENCY METER

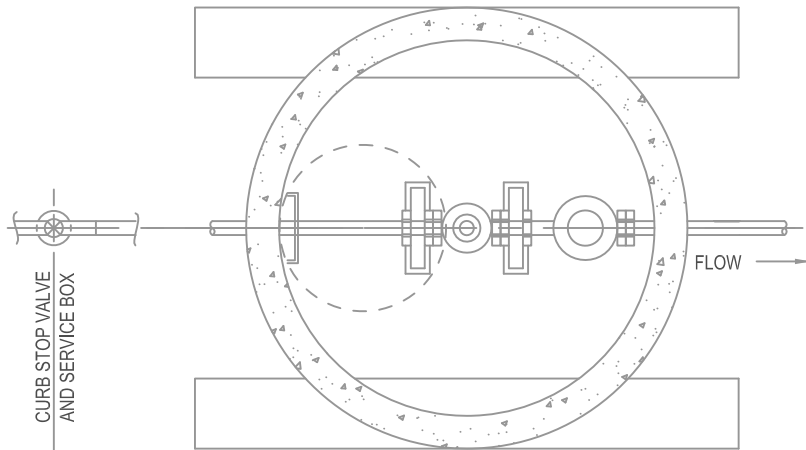
1. REGISTER/HRT TO ORDER A PIT TRANSPONDER W/HRT II WHICH WILL FIT A BADGER MTR MODEL 25, PLEASE CALL NATIONAL METER AT 303-339-9100.
2. RES DOME LTD PURCHASE A CASTING INC. METER LID ONLY (MADE OF CAST IRON).
3. CALL CALL THE CITY CUSTOMER SERVICE. SET UP A MEETING AFTER ALL MATERIALS ARE IN HAND. (THE CITY WILL RE-INSTALL AFTER THE INSPECTION.)

(ESTIMATED COST RANGES FROM \$133 TO \$200)

- 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				DEPARTMENT OF CIP DESIGN & ENGINEERING	
DATE	ITEM	BY		ISSUED:	
				DRAWN BY: JLT	
				APPROVED BY:	
				DRAWING NO: W7A	
				SCALE: N.T.S.	
SETTINGS FOR $\frac{5}{8}$ " X $\frac{3}{4}$ " AND 1" METERS					



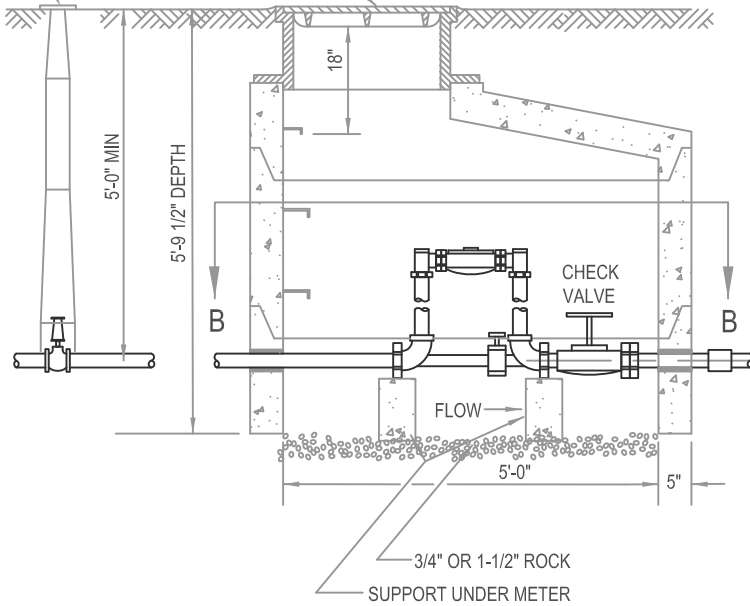
**SECTION B-B**

**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. IF FOOTINGS ARE REQUIRED, THEY SHALL BE AS SHOWN ON SHEET 17 OF 22.
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.

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.



**ELEVATION SECTION**

SIZE	FORD CUSTOM SETTER		MUELLER	
	SIZE	CAT NO	SIZE	CAT NO
1,1/2"	FLANGED ANGLE BALL VALVE	V BB76-12B-11-66 1-1/4" BY_PASS	FLANGED ANGLE BALL VALVE	H-2423
2"	FLANGED ANGLE BALL VALVE	V BB76-18B-11-77 1-1/4" BY-PASS	FLANGED ANGLE BALL VALVE	H-2423

REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

METER SETTING FOR 1 1/2" AND 2"  
METER WITH VALVE AND BYPASS

ISSUED:

DRAWN BY:

JLT

APPROVED BY:

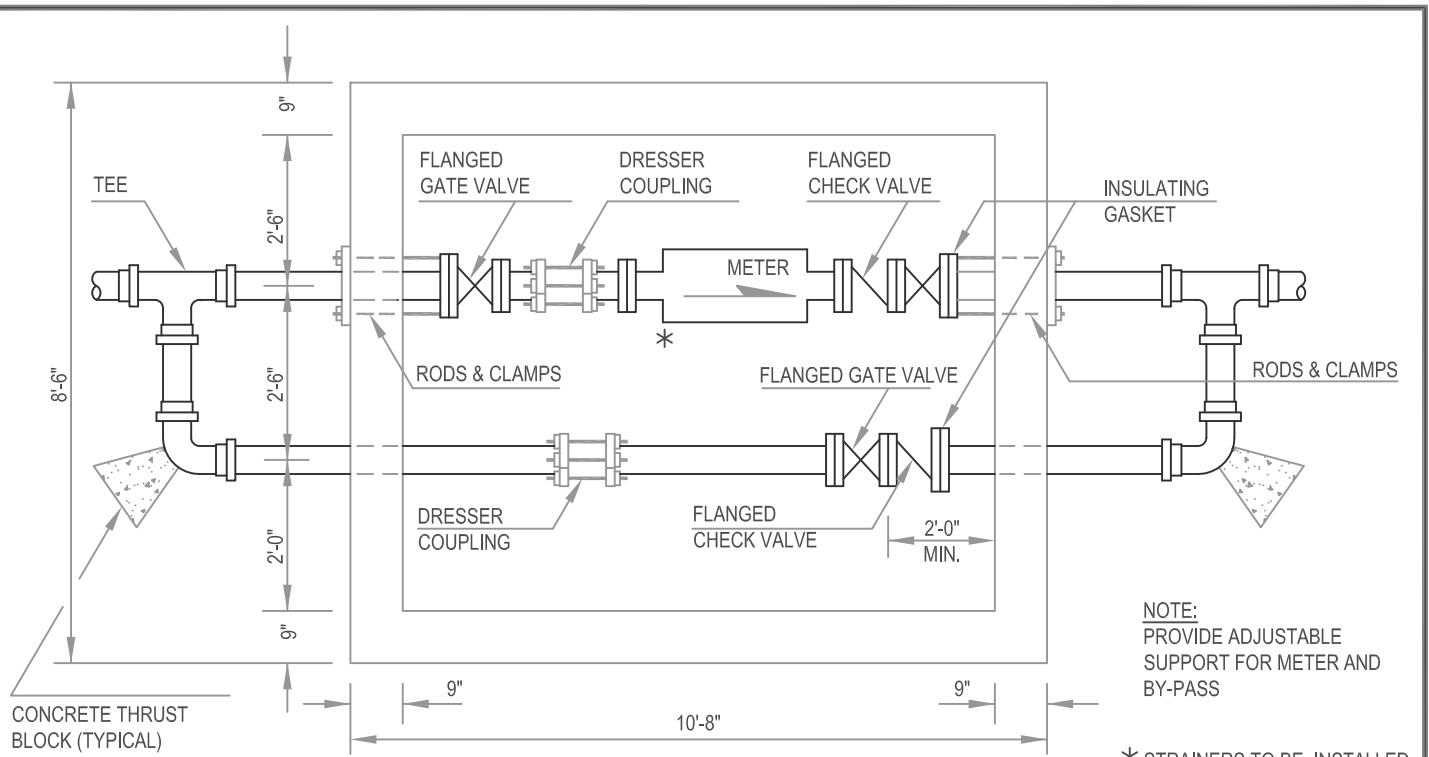
DRAWING NO:

W8

SCALE:

N.T.S.

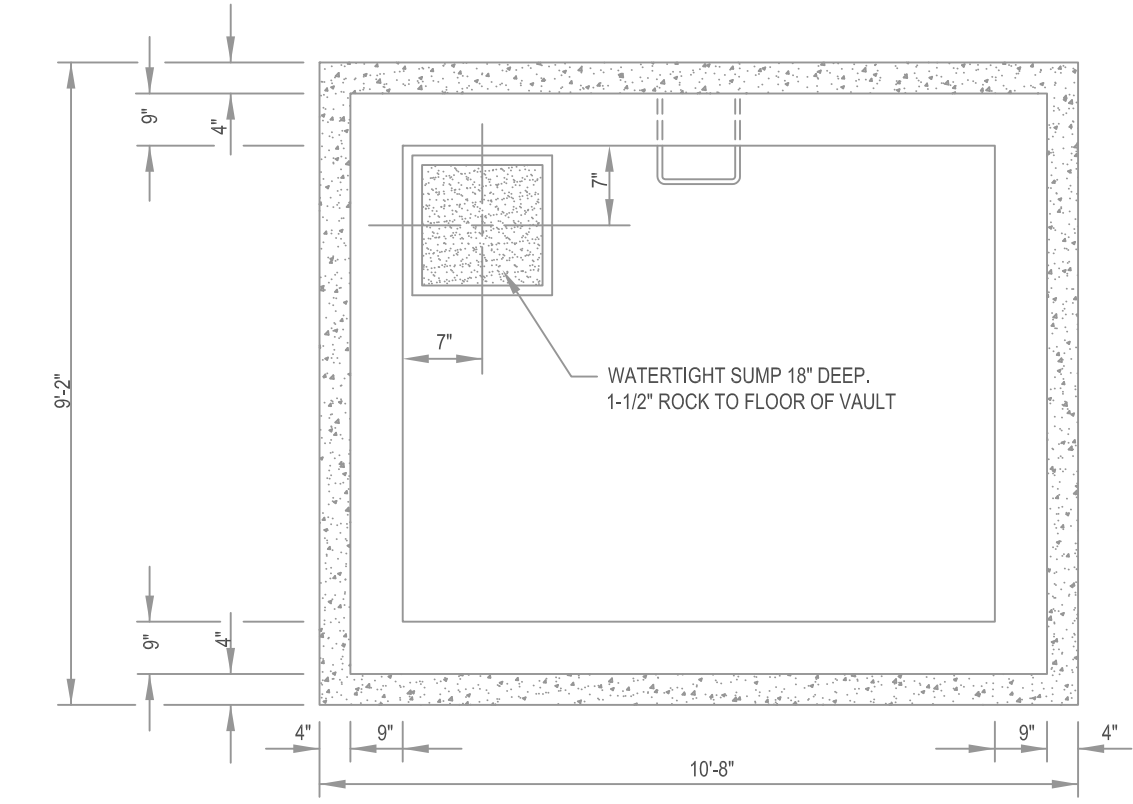




**PLAN OF PIPING**

NOTE:  
PROVIDE ADJUSTABLE  
SUPPORT FOR METER AND  
BY-PASS

\* STRAINERS TO BE INSTALLED  
WITH ALL TURBINE AND  
COMPOUND METERS.



**PLAN OF VAULT**

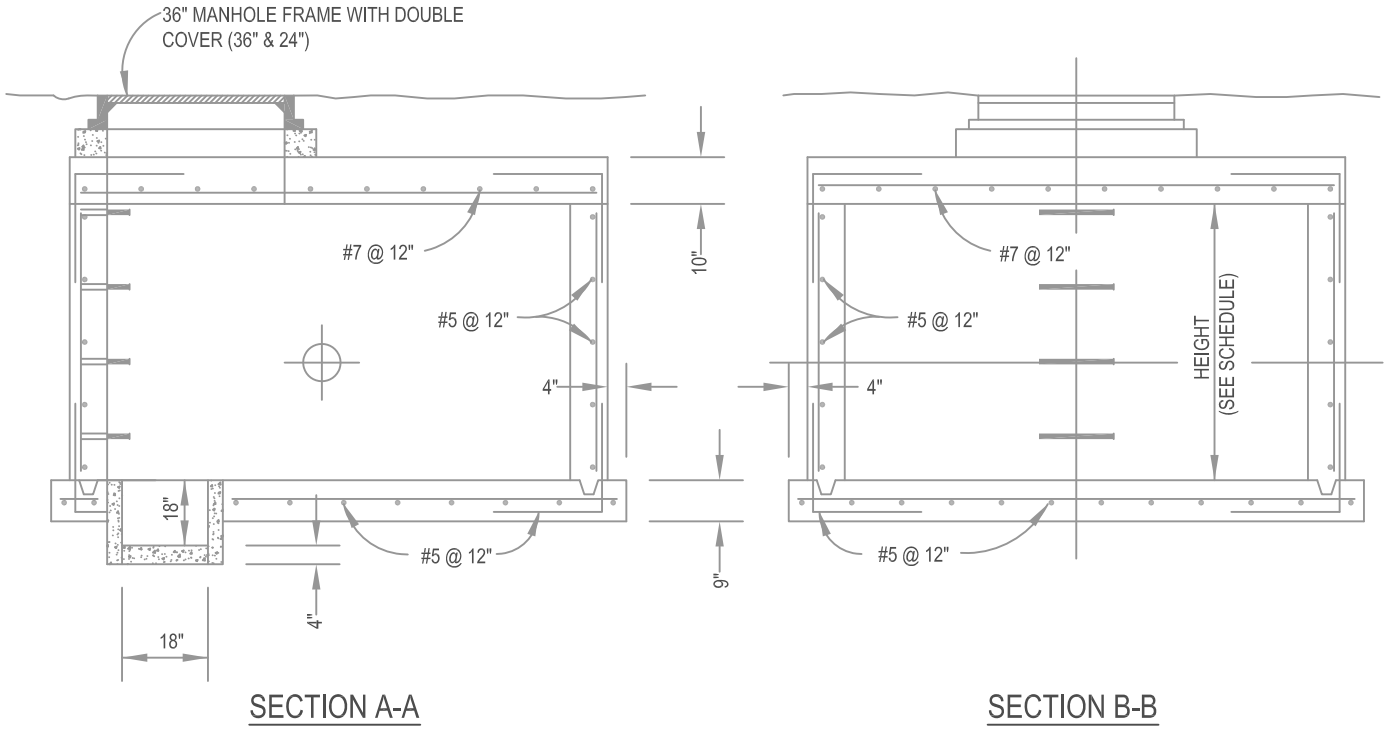
REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING


STANDARD 3" AND 4" METER  
SETTING DETAIL

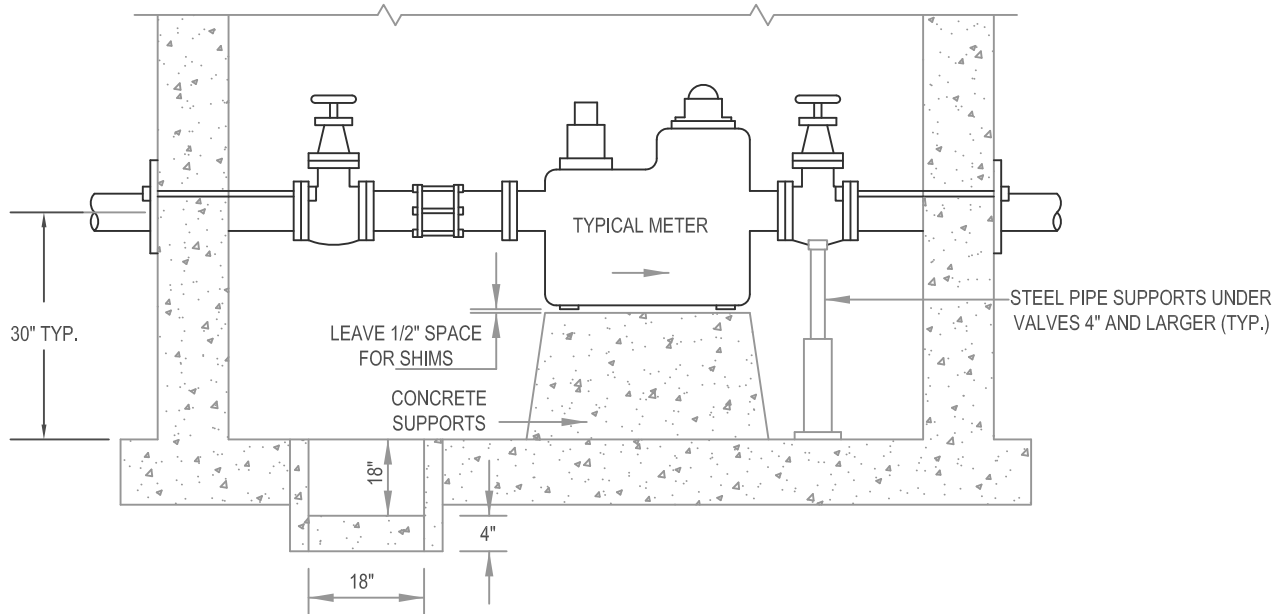
ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	W9
SCALE:	N.T.S.



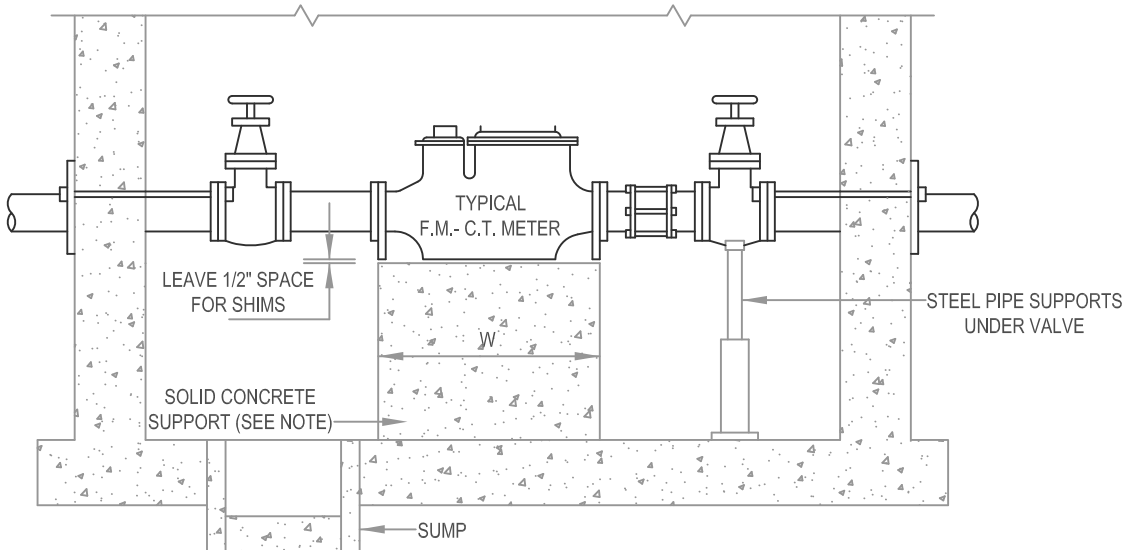
METER VAULT-INSIDE DIMENSION SCHEDULE

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				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:
DATE	ITEM	BY		TYPICAL METER VAULT		DRAWN BY:
						APPROVED BY:
						DRAWING NO:
						SCALE:




**TYPICAL CONC. METER SUPPORTS  
FOR 3", 4", 6", 8", & 10" METERS**

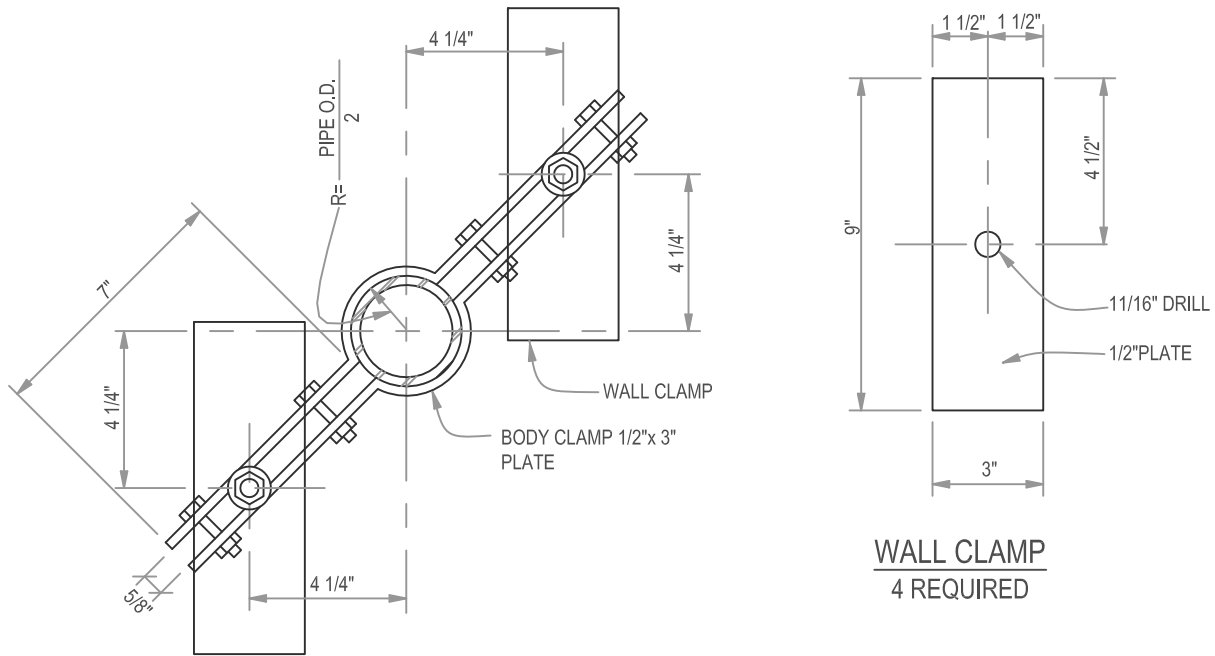


**TYPICAL CONC. METER SUPPORT  
FOR F.M.-M.C.T. OR TURBINE**

- 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.

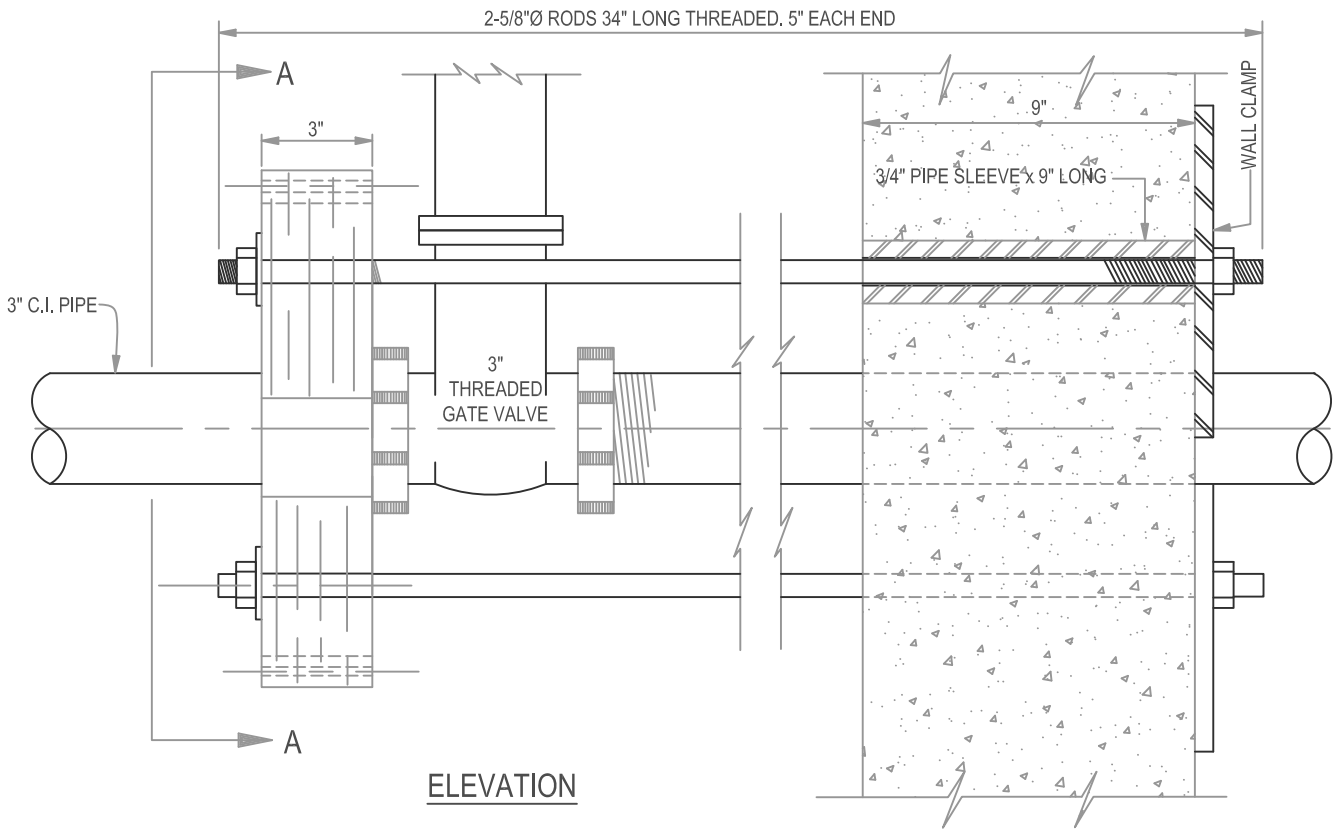
SIZE OF CONCRETE SUPPORT  
 6" F.M.-C.T. W=3'-9" L=3'-0"  
 8" F.M.-C.T. W=4'-5" L=3'-8"  
 10" F.M.-C.T. W=5'-8" L=4'-8"

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	
DATE	ITEM	BY		ISSUED:	
			<b>STANDARD CONCRETE METER SUPPORTS</b>	DRAWN BY:	JLT
				APPROVED BY:	
				DRAWING NO:	W11
				SCALE:	N.T.S.




**SECTION A-A**

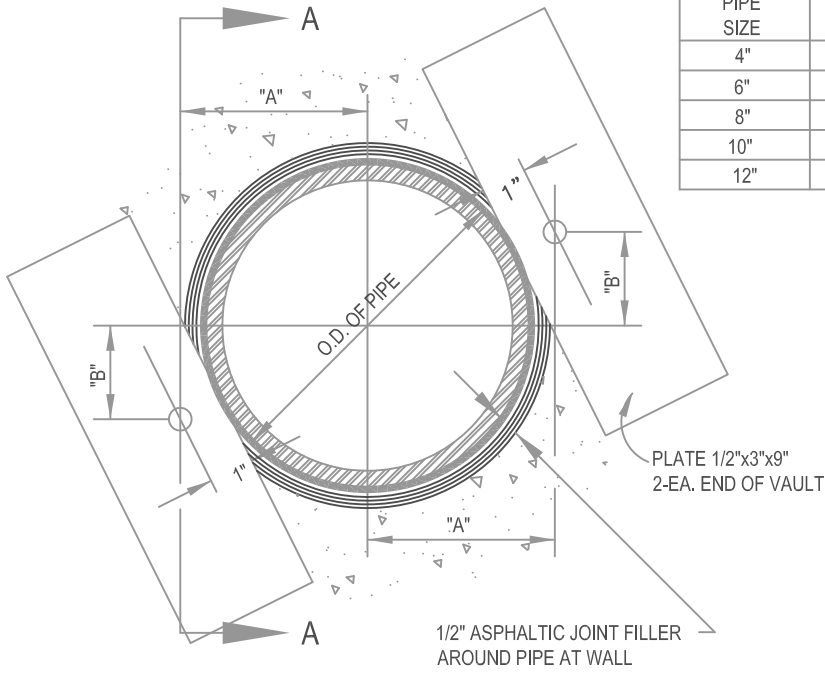
**WALL CLAMP**  
4 REQUIRED



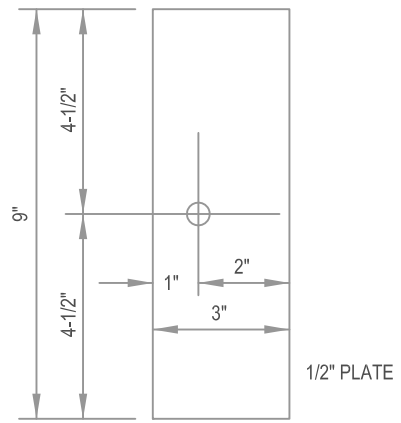
**ELEVATION**

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	
DATE	ITEM	BY		ISSUED:	
			<b>WALL AND BODY CLAMPS 3" METER</b>	DRAWN BY:	JLT
				APPROVED BY:	
				DRAWING NO:	W12
				SCALE:	N.T.S.

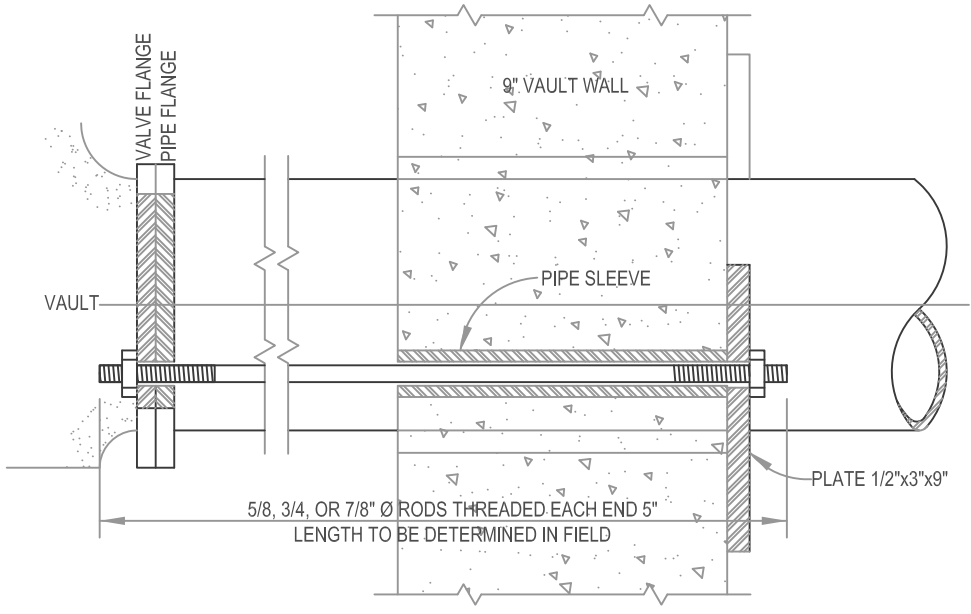
PIPE SIZE	RODS #, SIZE	WALL SLEEVE	"A"	"B"
4"	2-5/8 Ø	3/4x9"	3-1/2"	1-7/16"
6"	2-5/8 Ø	3/4x9"	4-3/8"	1-13/16"
8"	2-3/4 Ø	1"x9"	5-7/16"	2-1/4"
10"	2-7/8 Ø	1-1/2x9"	5-7/8"	3-3/8"
12"	2-7/8 Ø	1-1/2x9"	6-1/2"	3-15/16"




**EXTERIOR ELEVATION**

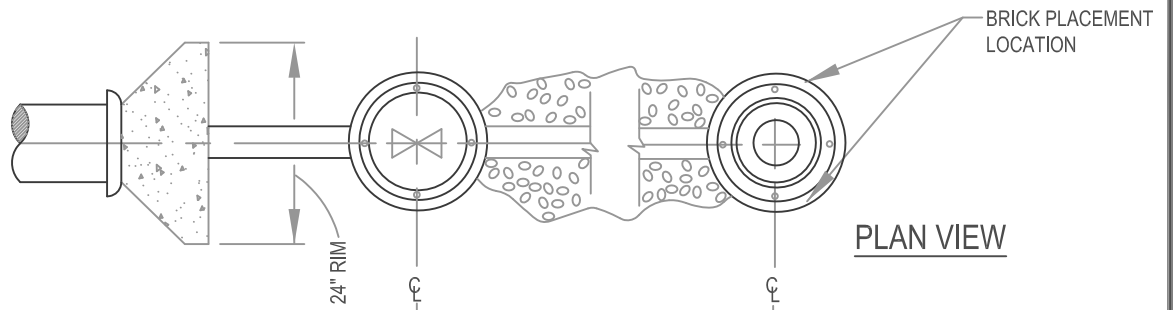


**WALL PLATE**



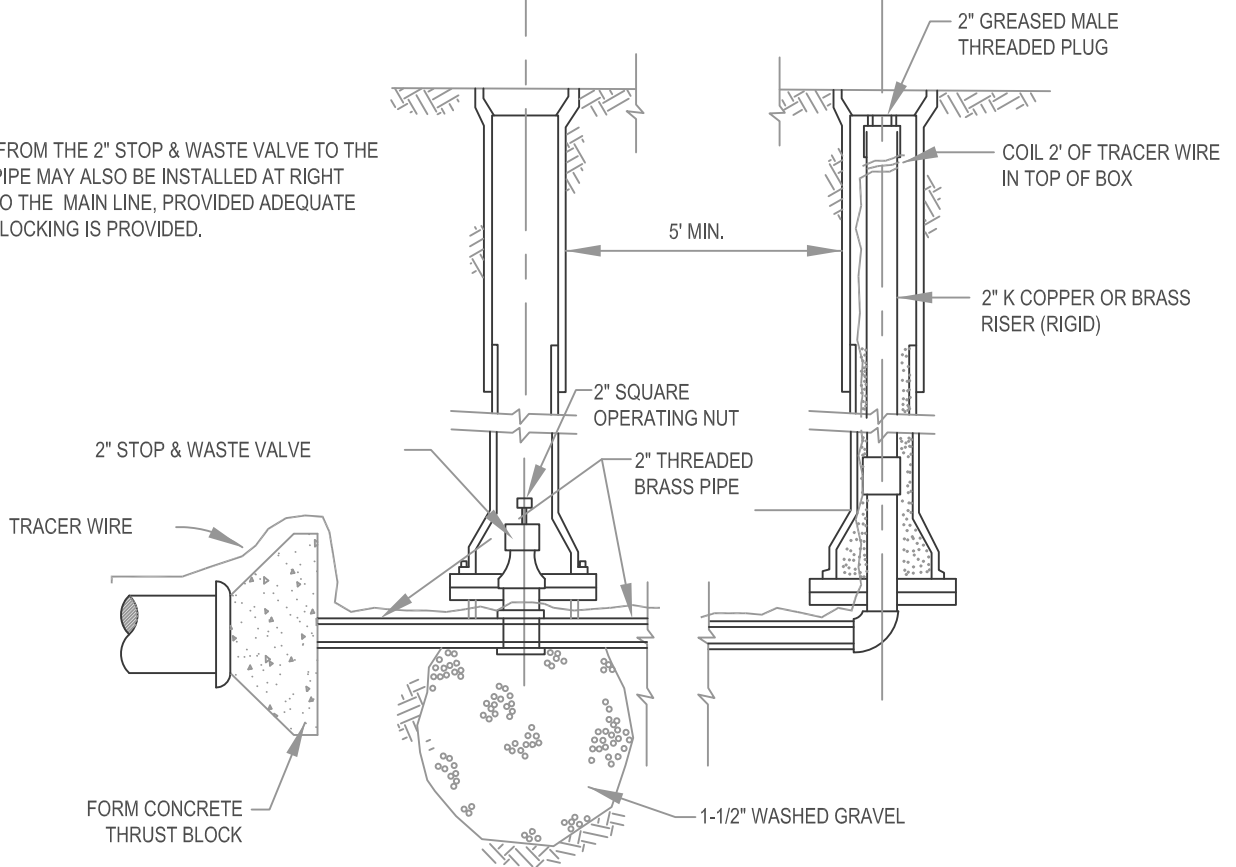
**SECTION A-A**

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:	
DATE	ITEM	BY				DRAWN BY:	JLT
			<b>WALL CLAMPS FOR 4" TO 12" METERS</b>		APPROVED BY:		
					DRAWING NO:	W13	
				SCALE:	N.T.S.		




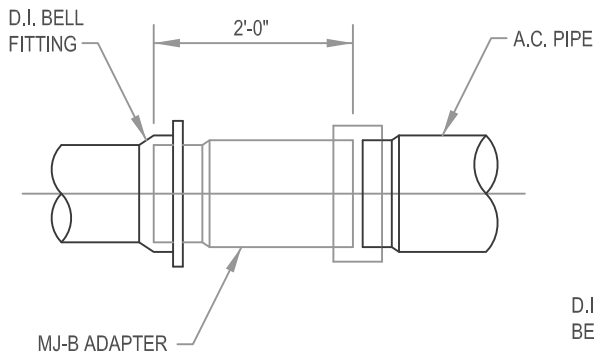
**PLAN VIEW**

**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.

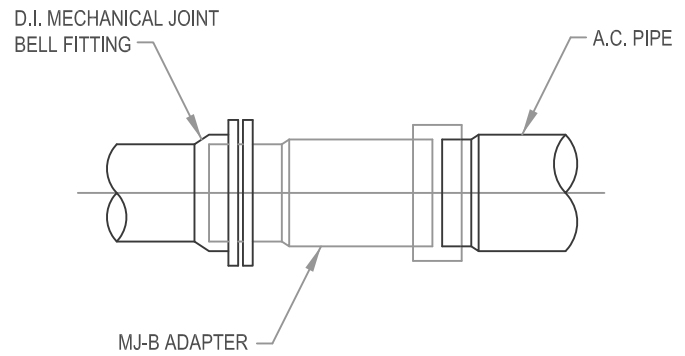


**SECTION A-A**

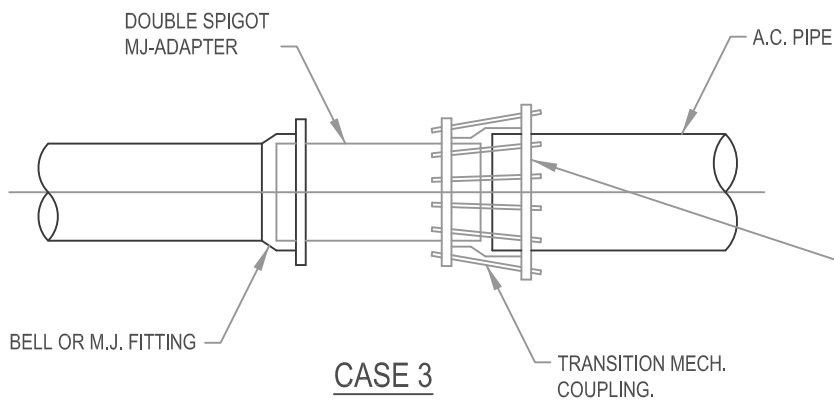
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
				APPROVED BY:		
			<b>STANDARD            BLOW-OFF INSTALLATION</b>	DRAWING NO:	W14	
				SCALE:	N.T.S.	



**CASE 1**




**CASE 2**

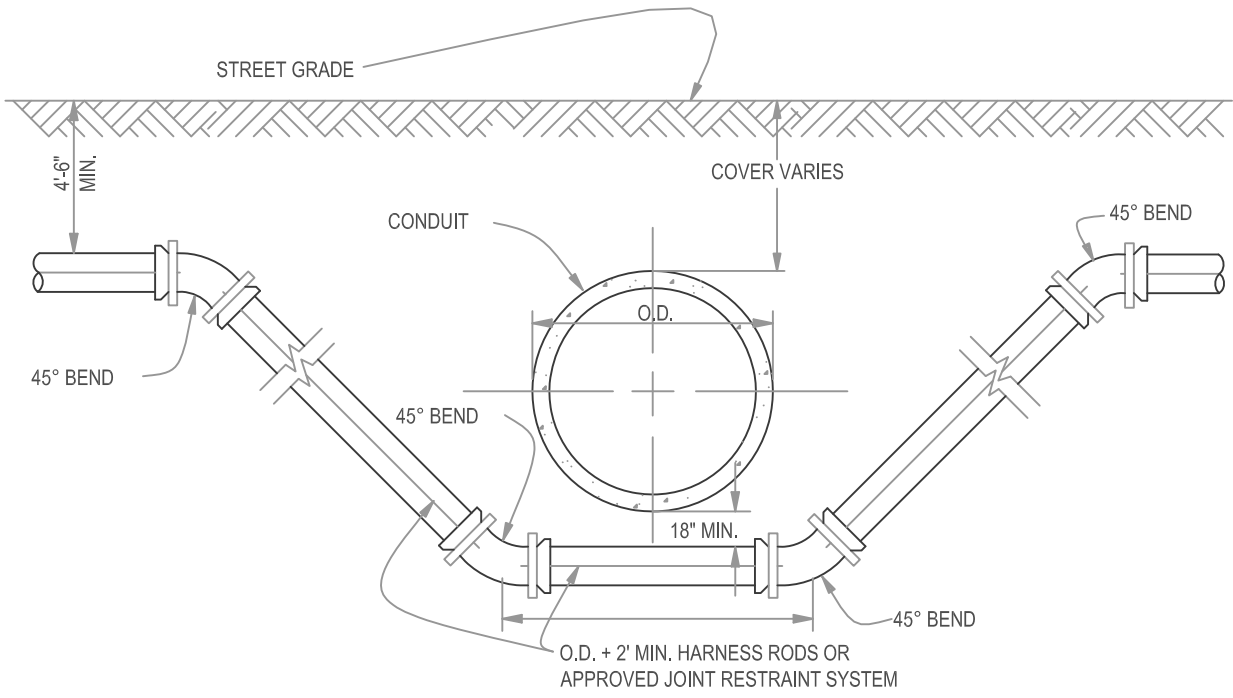


**CASE 3**

- 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				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			A.C. TO D.I. PIPE ADAPTER	APPROVED BY:		
				DRAWING NO:	W15	
				SCALE:	N.T.S.	

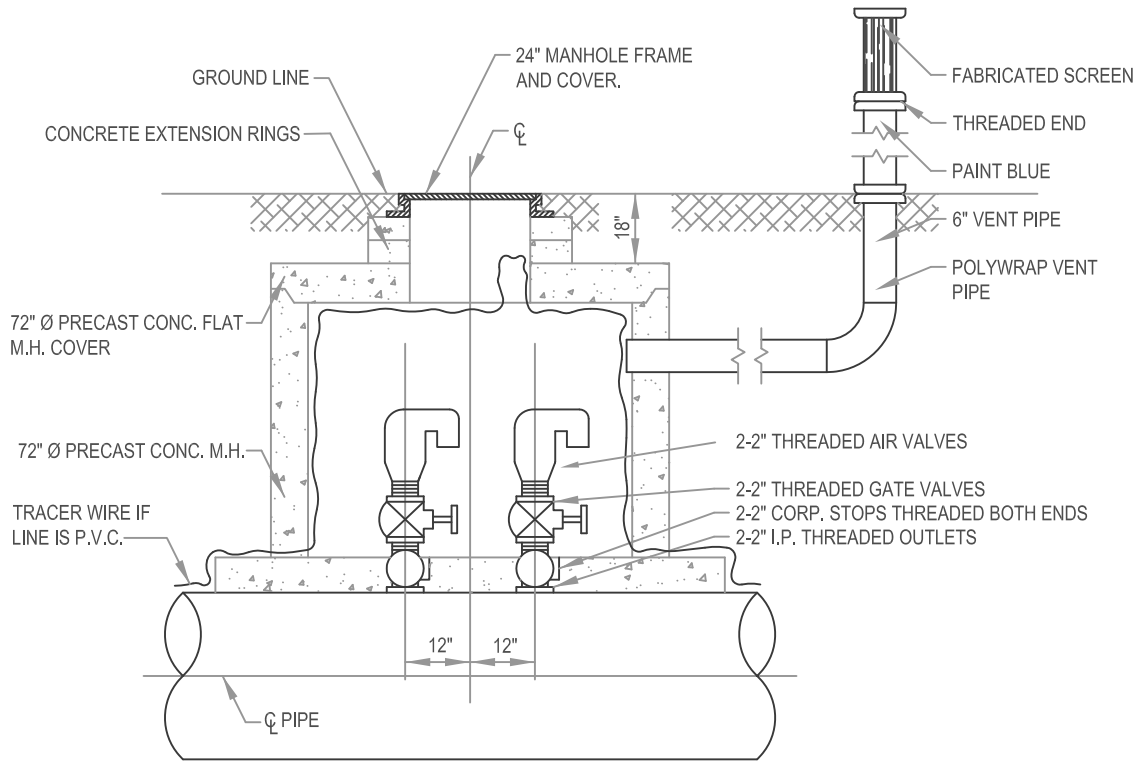


**NOTES:**

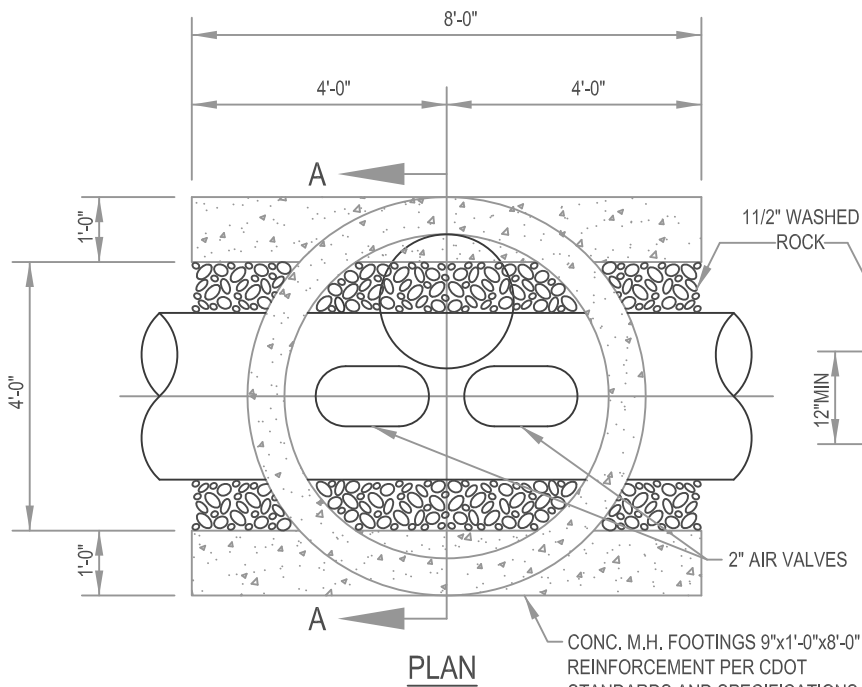
1. SEWER LINES CROSSING ABOVE WATER MAINS SHALL BE DUCTILE IRON PIPE 9' EACH SIDE OF CROSSING (MIN.).
2. MINIMUM CLEARANCE 18" AS SHOWN ABOVE.
3. D.I.P. WILL BE WRAPPED.
4. CONDUIT TO BE PROPERLY SUPPORTED.
5. WHEN HARNESS RODS ARE USED, CONCRETE THRUST BLOCKS SHALL BE INCLUDED.

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:		
DATE	ITEM	BY				DRAWN BY:	JLT	
			CONDUIT CROSSING	APPROVED BY:		APPROVED BY:		
						DRAWING NO:		W16
						SCALE:		N.T.S.

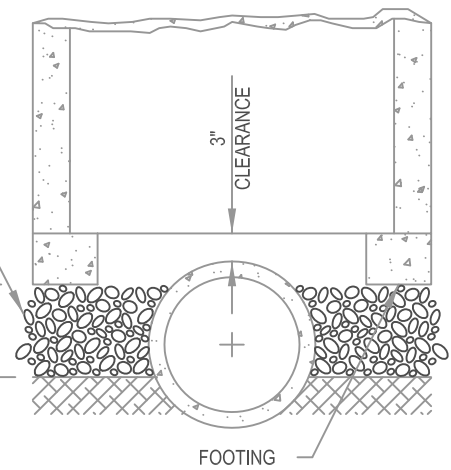





**ELEVATION**



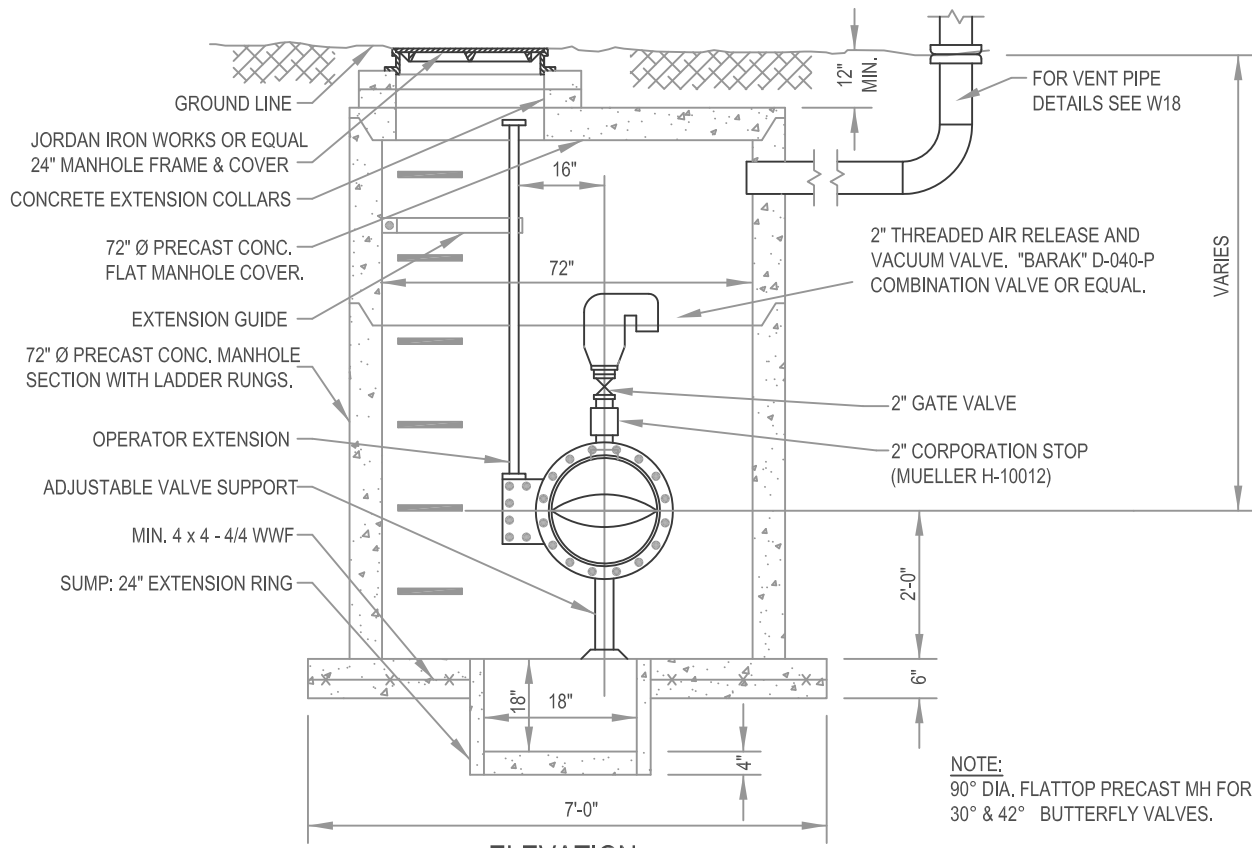
**PLAN**



**SECTION A-A**

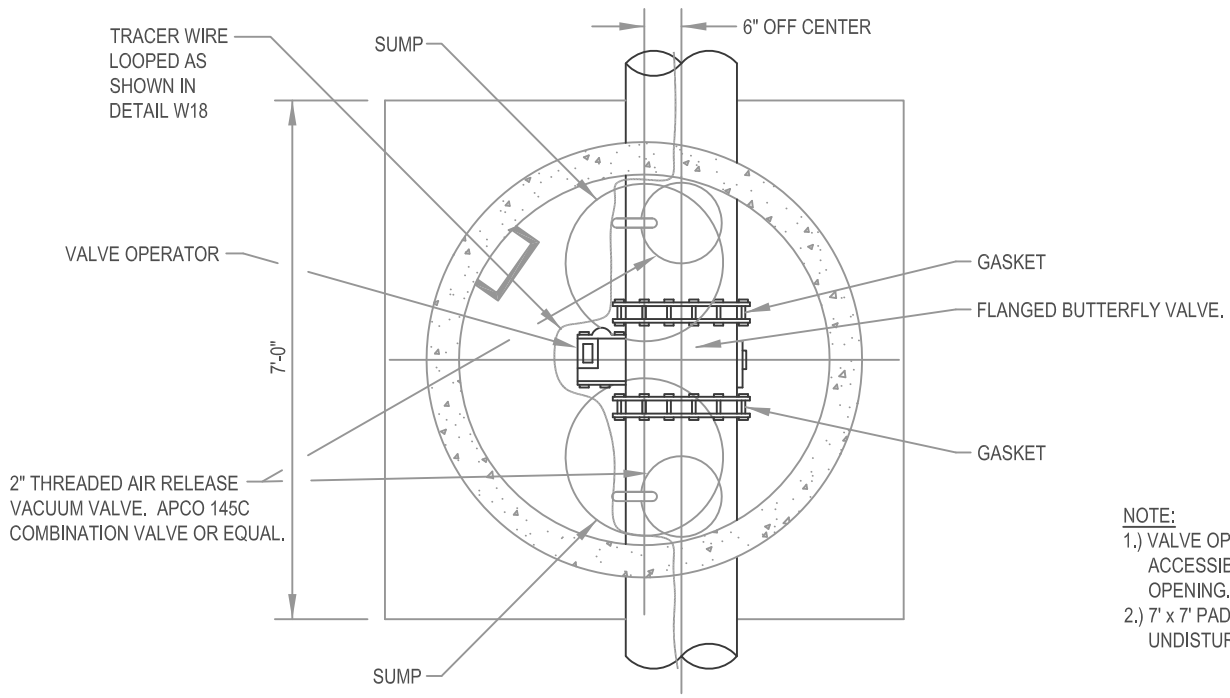
REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING		ISSUED:	
DATE	ITEM	BY				DRAWN BY: JLT	
						APPROVED BY:	
						DRAWING NO: W17	
						SCALE: N.T.S.	

STANDARD  
AIR VALVE INSTALLATION




**ELEVATION**

**NOTE:**  
 90° DIA. FLATTOP PRECAST MH FOR  
 30° & 42° BUTTERFLY VALVES.

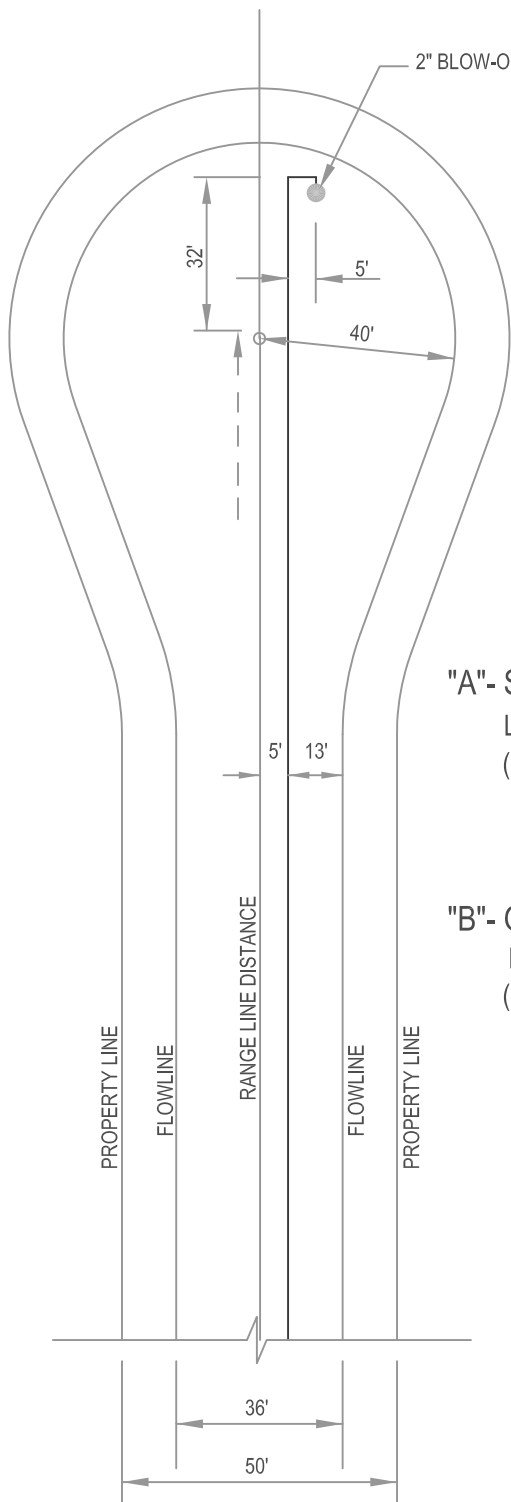


**PLAN**

**NOTE:**  
 1.) VALVE OPERATOR SHALL BE ACCESSIBLE THRU MANHOLE OPENING.  
 2.) 7' x 7' PAD TO REST ON UNDISTURBED SOIL.

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
					APPROVED BY:	
					DRAWING NO:	W18
					SCALE:	N.T.S.

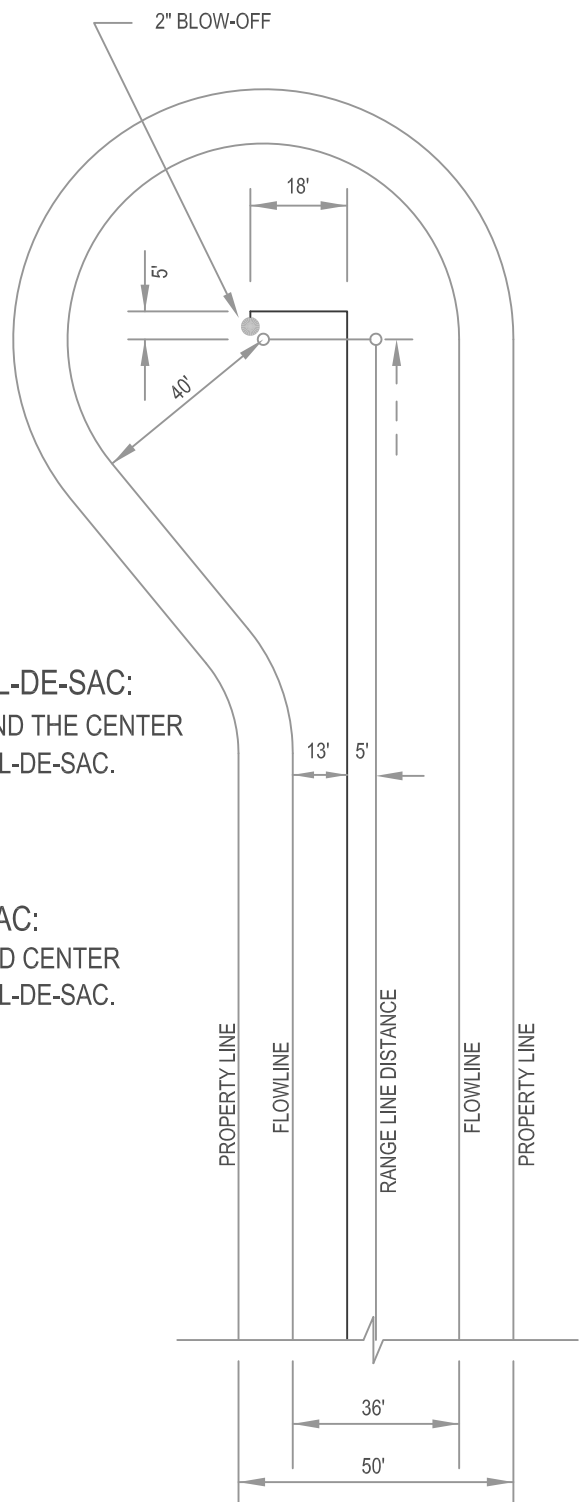
**BUTTERFLY VALVE INSTALLATION  
 IN WATER MAINS 16" OR LARGER**




"A"

"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.



"B"

REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	
DATE	ITEM	BY		ISSUED:	
			WATER DISTRIBUTION SYSTEM TYPICAL PLAN FOR CUL-DE SACS	DRAWN BY:	JLT
				APPROVED BY:	
				DRAWING NO:	W19
			SCALE:	N.T.S.	

6 RUNNERS PER SPACER

CARRIER PIPE

SPACER OR APPROVED EQUAL  
A.P.S., R.A.C.I., OR P.S.I.

STEEL CASING PIPE

STEEL CASING

SECTION VIEW

TYPE C PULL-ON OR TYPE W  
WRAP AROUND END SEAL (TYP.)

TRACER WIRE

EACH END OF JOINT

1'

1'

8' MAX. BETWEEN  
SPACERS

DOUBLE SPACERS AT EACH  
END OF CASING

A.P.S., P.S.I., OR R.A.C.I.  
HIGH DENSITY POLYETHYLENE  
SPACER OR APPROVED EQUAL

SIDE VIEW

JOINT RESTRAINTS

REVISIONS

DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

BORING DETAIL

ISSUED:

DRAWN BY:

JLT

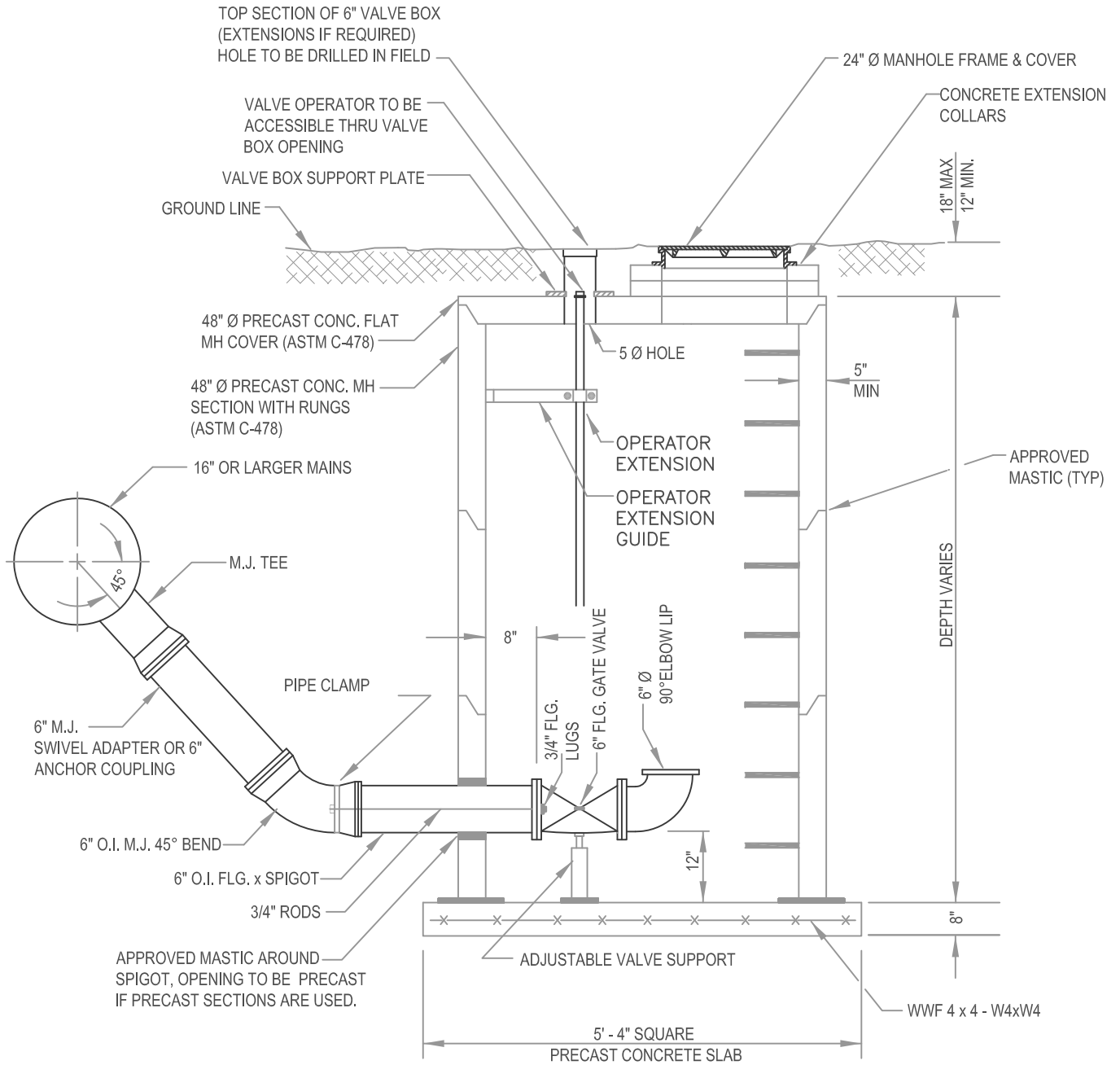
APPROVED BY:

DRAWING NO:

W20

SCALE:

N.T.S.



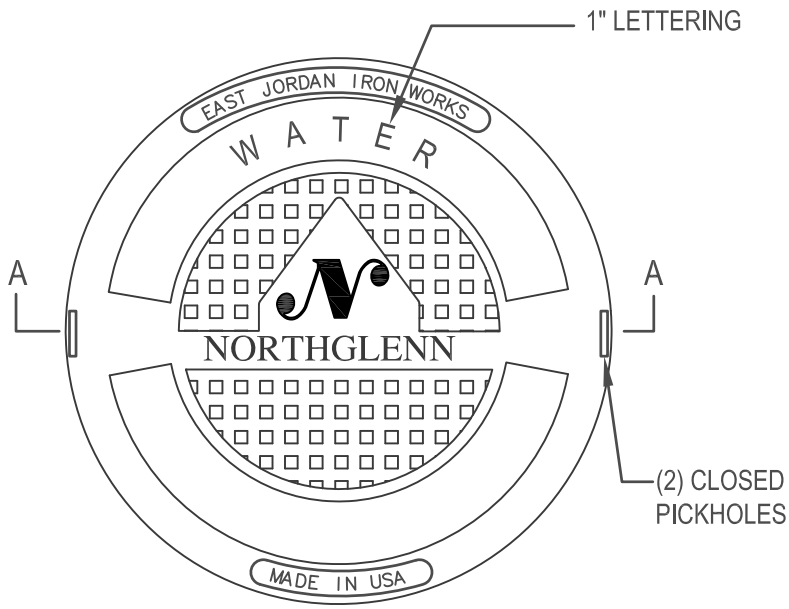
REVISIONS		
DATE	ITEM	BY



DEPARTMENT OF  
CIP DESIGN &  
ENGINEERING

TRANSMISSION MAIN  
BLOW-OFF INSTALLATION

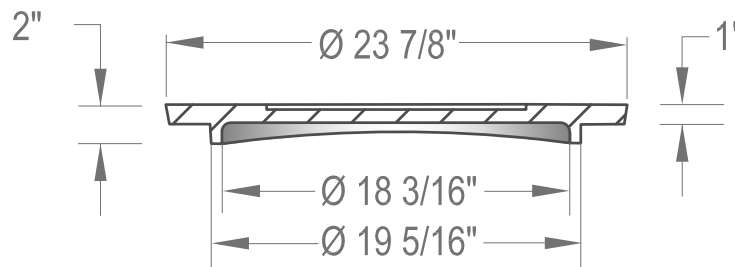
ISSUED:	
DRAWN BY:	JLT
APPROVED BY:	
DRAWING NO:	W21
SCALE:	N.T.S.



TOP OF COVER




BOTTOM OF COVER



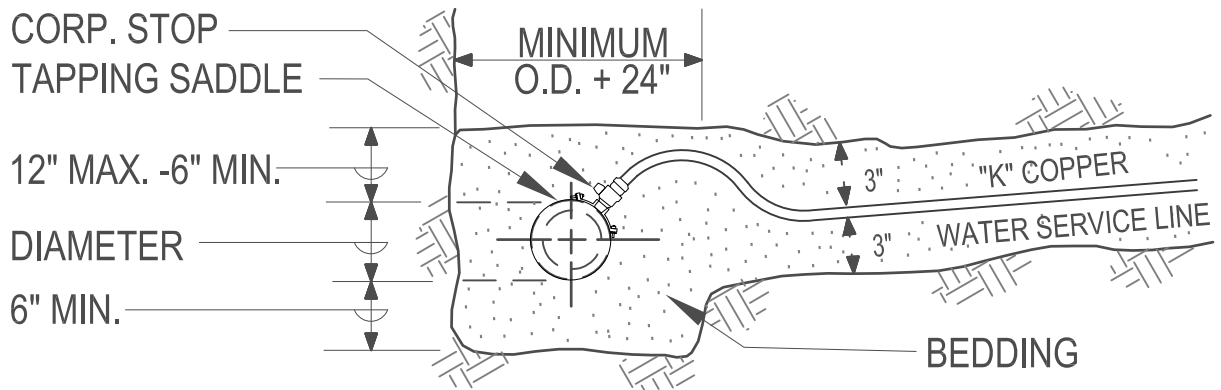
SECTION A-A

COVER: GRAY IRON ASTM A 48 CL35 B  
 LOAD RATING: HEAVY DUTY  
 WEIGHT: 135LBS. (61kg)  
 MACHINED SURFACE  
 EAST JORDAN IRON WORKS PRODUCT


REVISIONS				DEPARTMENT OF CIP DESIGN & ENGINEERING	ISSUED:	
DATE	ITEM	BY			DRAWN BY:	JLT
			WATER MANHOLE COVER DETAIL	APPROVED BY:		
				DRAWING NO:	W22	
				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
			RESIDENTIAL SERVICE TAP	APPROVED BY:	DHW	
				DRAWING NO:	W23	
				SCALE:	N.T.S.	