2025 STANDARD CONSTRUCTION SPECIFICATIONS
AND
STANDARD DETAILS

FOR

CITY OF PUEBLO, COLORADO

DEPARTMENT OF PUBLIC WORKS
211 EAST “D” STREET
PUEBLO, COLORADO

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PREFACE

The specifications contained herein have been prepared by the Department of Public Works of the City of Pueblo in accordance with Title XII of the 1970 Code of Ordinances, adopted by Resolution Number 15819 of the City Council and amended by Resolution Number 15985 of the City Council.

These specifications shall apply to the construction of all public improvements within the public right-of-way of the City of Pueblo, City owned property, and to those improvements on private property which have been made a requirement of any subdivision improvement agreement.

Methods of measurement and payment specified herein shall only apply to City contracts.

Where the term “Engineer” is used in these specifications it shall mean the Director of Public Works or his authorized representative.

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ABBREVIATIONS

Whenever in these specifications the following terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as follows. Reference to a specific standard or specification shall mean the latest edition or amendment in effect on date of invitation to bid. In those cases where work is being performed which is not contracted for directly by the City, then the latest standard in effect at the time the work is being done shall apply.

AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADA	Americans with Disabilities Act of 1990
ADAAG	Americans with Disabilities Act Accessibility Guidelines
AI	Asphalt Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
ATSSA	American Traffic Safety Services Association
AWG	American Wire Gauge
AWS	American Welding Society
BMPS	Best Management Practices
CBR	California Bearing Ratio
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CFRP	Carbon Fiber Reinforced Polymer
CLSM	Controlled Low Strength Materials
CRS	Colorado Revised Statutes, 1973 as amended
CRSI	Concrete Reinforcing Steel Institute

CY	Cubic Yard
FRP	Fiber Reinforced Polymer
GFRP	Glass Fiber Reinforced Polymer
GPH	Gallons Per Hour
HP	Horsepower
ISSA	International Slurry Surfacing Association
LP	Pound
LL & PI	Liquid Limit / Plasticity Index
MPH	Miles Per Hour
MUTCD	Manual of Uniform Traffic Control Devices
NACE	National Association of Corrosion Engineers
NSF	National Sanitation Foundation
NTPEP	National Transportation Product Evaluation Program
O.D.	Outside Diameter
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PLS	Pure Live Seed
PSIG	Pound Per Square Inch Gauge
PVC	Polyvinyl Chloride
RAP	Recycled Asphalt Product
RC	Recycled Concrete
RE	Removability Modulus
SWMP	Stormwater Management Plan
UL	Underwriter's Laboratories
WWPA	Western Wood Products Association

MEASUREMENT AND CALCULATED QUANTITY ACCURACY

All quantities for payment shall be field measured (where applicable), calculated and rounded to the degree of accuracy given below.

UNIT	ACCURACY
Lump Sum (%)	x.
Each	x.
Linear Foot	x.x
Square Feet	x.x
Square Yard	x.x
Cubic Yard	x.x
Gallon	x.
Ton	x.x
Acre	x.x

Rounding of numbers shall be as follows:

0.1 thru 0.4 - round down to zero
0.5 - round up if it makes the whole number even, down if the whole number is even
0.6 thru 0.9 - round up to next whole number

Examples: 93.3 rounds to 93
93.5 rounds to 94
94.5 rounds to 94
93.7 rounds to 94

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ARTICLE 4
CONCRETE

4.1 GENERAL

4.1.1 DESCRIPTION

The work under this section shall consist of the furnishing of all labor and materials necessary for the placing and finishing of concrete in accordance with these specifications and conforming to the lines, grades, and dimensions shown on the drawings (approved by the Engineer) or the City Standard Details. Concrete shall consist of Portland cement, fine and coarse aggregates, and water, together with any specified additives or admixtures proportioned and mixed in conformity with the following specifications.

4.1.2 SUBMITTALS

4.1.2.1 General

Concrete submittals outlined below are required on all City contracts and any other project within the public right-of-way. All ready-mix suppliers furnishing concrete for placement within any City right-of-way shall furnish to the City once every two years, concrete mix designs for concrete intended to be used for placement within the right-of-way.

4.1.2.2 Mix Design

Unless a mix design has been previously approved as required under Section 4.1.2.1, the Contractor shall submit copies of all concrete mix designs to the Engineer for approval prior to placing any concrete. Separate mix designs shall be submitted for each type of concrete to be used in the project. Submittals shall include all information used in designing mixes, including admixture manufacturer's information.

4.1.3 QUALITY ASSURANCE

4.1.3.1 Plant Access

The Engineer shall be allowed access to the ready-mix batching plant at all times that the work is in progress. If required by the Engineer, samples of all concrete ingredients may be taken at the plant.

4.1.3.2 Record of Work

The Contractor shall keep a written record listing approximate locations, time and date of placement of all concrete for the project. Such record shall be kept until completion of the project and shall be available to the Engineer for review at any time.

4.1.3.3 Codes and Industry Standards

The Contractor is responsible for ensuring that all materials, formwork, and finishes comply with all applicable codes and industry standards as prescribed by ASTM, AASHTO, and/or ACI.

4.2 MATERIALS

All concrete shall be ready-mixed conforming to AASHTO M 157-13 (2017). No jobsite mixed concrete will be permitted unless written permission is granted by the Engineer.

4.2.1 GENERAL

4.2.1.1 Cement

Portland Cement shall conform to the specifications for Portland Cement (ASTM C-150) and specifications for air-entrained Portland Cement (ASTM C-175 or C-595) and shall otherwise be Type II cement unless sulfate conditions allow otherwise. Refer to Table 2.3 in Chapter 2.2 of ACI 201 for cement recommendations for sulfate resistances. In addition to the standard chemical requirements for Portland cement in ASTM C-150, the maximum percent of alkali shall be specified in Table 2 of ASTM C-150 for low alkali cement. Other types of cement or admixtures are only to be used upon approval by the Engineer.

Type II (6 Sack), Type IP, or Type IL is required for all sidewalks, driveways, curb and gutter, drainage pans, headwalls, wingwalls, and concrete paving. Type II (7 Sack), Type IP (HS), Type IL (HS) (in lieu of type V cement) will be acceptable for cast-in-place inlets and cast in place manhole bases. Type II (7 Sack), Type IP (HS), or Type IL (HS) is required for all *precast* box culverts, inlets, manhole bases, manhole barrel sections, and manhole cone sections.

4.2.1.2 Fly Ash and Natural Pozzolan FLY

Use of fly ash or natural pozzolan (ASTM C-618 **Class F; or Class N**) ~~for~~ as a partial substitute (25% maximum by weight) for Type I/II, Type IP (HS), Type IL (HS), or Type V cement may be used with written permission from the City Engineer. Fly ash or natural pozzolan shall conform to the requirements of ASTM C-618 – **Class F** or **Class N,** respectively. Cement containing **Class C** fly ash shall not be used for any concrete where these specifications are applicable.

4.2.1.3 Aggregate

(a) Fine Aggregate

Fine aggregate shall conform to ASTM C-33. Fine aggregate shall be natural sand composed of clean, hard, durable, uncoated grains, preferably of siliceous materials. Fine aggregate shall be thoroughly washed to remove shale, coal, mica, clay, loam, alkali, organic matter, or other deleterious matter.

(1) Deleterious Substances. The percentage of deleterious substances in the washed aggregate shall not exceed the values in Table 4.1

Table 4.1. Maximum percentage of deleterious substances in the washed fine aggregate

Material	ASTM	Limit
Material finer than 200 mesh sieve	C117	3% by weight
Shale	Petrographic analyses	1% by weight
Coal & Lignite	C123	0.5% by weight
Clay lumps and friable particles	C142	3% by weight
Organic Impurities	C40	Plate 3
Sulfate Soundness	C88	10% by weight (Sodium Sulfate) 15% by weight (Magnesium Sulfate)

The sum of the percentages of the above deleterious substances shall not exceed 5% by weight.

(2) Gradation. Fine aggregate shall be well graded and conform to AASHTO M6 as shown in CDOT Specifications Section 703, Table 703-1 and Table 4.3 below.

(b) Coarse Aggregate

Coarse aggregate shall conform to ASTM C-136. Coarse aggregate shall consist of crushed limestone, trap rock, granite, washed gravel, or other approved inert materials having clean, hard, strong, durable pieces, free from adherent coating, and conforming to the requirements of these specifications. Coarse aggregate shall be thoroughly washed of clay, loam, bark, sticks, alkali, organic matter, shale, coal, mica, or other deleterious material.

(1) Deleterious Substances. The percentage of deleterious substances in the washed aggregate shall not exceed the values in Table 4.2.

Table 4.2. Maximum percentage of deleterious substances in the washed coarse aggregate

Material	ASTM	Limit
Material finer than 200 mesh sieve	C117	1% by weight
Lightweight fragments (specific gravity < 2.4)	C123	3% by weight
Coal and lignite (specific gravity < 2.4)	C123	0.5% by weight
Clay lumps and friable particles	C142	3% by weight
Abrasion	C131/C535	50% by weight
Sulfate Soundness	C88	12% by weight (Sodium Sulfate) 18% by weight (Magnesium Sulfate)

Non-aggregate materials such as wood, sealant, and backer-rod are considered deleterious substances. The sum of the percentages of the above deleterious substances shall not exceed 5% by weight.

(2) Gradation. Coarse aggregate shall be well graded and conform to AASHTO M43 and CDOT Specifications Section 703, Table 703-1. The gradation shall be in compliance with designation No. 67 per Table 4.3.

Other gradations may be used when approved by the Engineer.

Table 4.3 Concrete Aggregate Gradation Table (Percent Passing Sieve Sizes)

Sieve Size	Fine aggregate No. M6, Class A	Coarse aggregate No. 67
1”	-	100%
3/4”	-	90-100%
1/2"	-	-
3/8”	100%	20-55%
No. 4	95-100%	0-10%
No. 8	80-100%	0-5%
No. 16	50-85%	-
No. 50	10-30%	-
No. 100	2-10%	-

4.2.1.4 Air Entraining Admixtures

All air-entraining admixtures shall comply with AASHTO M-154.

4.2.1.5 Chemical Admixtures

All chemical admixtures for concrete shall comply with AASHTO M-194. The use of calcium chloride as an accelerator is prohibited.

4.2.1.6 Water

Water used in mixing, curing, or other applications shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable matter, or any other substance injurious to the finished product. Concrete mixing water shall comply with ASTM C1602. Water known to be of potable quality may be used without further testing.

4.2.1.7 Curing Materials

Curing materials shall conform to the requirements in Table 4.4.

Table 4.4 Concrete curing materials

Material	Requirement
Burlap Cloth made from Jute or Kenaf	AASHTO M-182
Liquid Membrane-Forming Compounds for Curing Concrete	ASTM C309
Sheet Materials for Curing Concrete	AASHTO M-171*

*Only the performance requirements of AASHTO M-171 shall apply.

4.2.1.8 Expansion Joint

Expansion joints shall be constructed with 1/2″ preformed expansion joint filler, conforming to Federal Specifications MR-F-341 or wood board conforming to AASHTO Designation M-90.

4.2.1.9 Joint Sealant, Backer Rod & Expansion Joint

The joint sealant for all sawed longitudinal and transverse joints shall be a silicone joint sealant meeting ASTM D5893. ASTM C1193 provides guidance for the use of joint sealants.

Blocking medium shall be an expanded closed cell polyethylene foam backer rod or non-plastic rope that is compatible with the joint sealant material and meets ASTM C1330, Type C or ASTM D5249.

Polyethylene expansion joint materials shall be flexible, low density, expanded extruded polyethylene plank formed by the expansion of polyethylene base resin, extruded as a multicellular, closed cell, homogeneous foamed polyethylene. Laminations shall not be permitted. The joint material shall conform to ASTM D1751, ASTM D1752, or ASTM D8139.

4.2.2 QUALITY OF CONCRETE

The proportioning of aggregate to cement shall be such as to produce a good workable mix and the slump shall be a maximum of 5″ as per ASTM C-143 or as approved by the Engineer. The equipment for batching of the aggregates, cement, water, and air-entraining agent shall be such that accurate control can be held over the various constituents.

Ready-mixed concrete shall comply with ASTM C-94 for ready-mixed concrete and the following specifications:

4.2.2.1 Time of Haul

Concrete transportation in truck mixers or truck agitators shall be delivered to the site of work and completely discharged within a period of 90 minutes after the cement comes in contact with the mixing water or with the combined aggregates when the combined aggregates contain free moisture in excess of 2% by weight. If hot weather exists causing the temperature of the concrete to rise above 90° F, then the time of haul shall be within a period of 60 minutes.

4.2.2.2 Production and Delivery

The production and the delivery of ready-mixed concrete shall be such that placing and finishing shall be continuous so long as the operations require.

4.2.2.3 Concrete Mix Design

Concrete mix shall be designed per Tables 4.5, 4.6 or 4.7 based on the design criteria

Table 4.5. 6-Sack Concrete Mix

Specification	Requirement
Specified Compressive Strength at 28 Days	4,000 PSI
Minimum Cement Content per Cubic Yard	564 LBS (6 Sack)
Maximum Water/Cement Ratio by Weight	0.45
Air Content	6% +/- 1.5%
Slump	3″ – 5″

Table 4.6. 7-Sack Concrete Mix

Specification	Requirement
Specified Compressive Strength at 28 Days	4,500 PSI
Minimum Cement Content per Cubic Yard	658 LBS (7 Sack)
Maximum Water/Cement Ratio by Weight	0.45
Air Content	6% +/- 2.0%
Slump	3″ – 5″

Table 4.7. Caisson Concrete Mix

Specification	Requirement
Specified Compressive Strength at 28 Days	4,000 PSI
Minimum Cement Content per Cubic Yard	610 LBS/CY
Maximum Water/Cement Ratio by Weight	0.45
Air Content	N/A
Slump	6″ – 9″

See CDOT specification 601.02, Class BZ for additional requirements.

4.2.3 CONTROLLED LOW STRENGTH MATERIALS (CLSM)

The term CLSM used in this Section shall mean the same as Removable CLSM or flowable backfill. This material is covered in detail due to the many time saving and engineering benefits of this type of backfill material. CLSM does not need compacting, or moisture density compaction testing. Only a few physical tests of the CLSM properties are needed to assure durability and future removability with light excavating equipment. A low strength is desired so that surrounding utilities or structures will be accessible without causing damage if the CLSM must be removed in the future. Air entrainment is required to prevent damage and heave displacement of trench patches due to freeze-thaw damage.

In addition, CLSM may be used for other applications apart from trench or street cut backfill. These include filling voids due to pipe abandonment or undercutting of excavation in caving or normal soils. CLSM offers quick restoration of the trench and improving other subgrade conditions for roadway or structure support in a rapid time frame without the need for traditional soil backfill testing requirements or when a quick strength is needed to support upper layers. These benefits may outweigh the extra costs vs. using traditional methods that require compaction and testing.

Other applications include: backfilling behind retaining walls and abutments, filling void areas including pipe abandonment, annular spaces, undercut areas and other approved void filling applications. Other suitable applications include structural support for utilities and replacement of unstable subgrade during pavement repairs. Utility types that can utilize CLSM include: conduits or pipes for electrical, wired or fiber optic communications, traffic signal or other utilities such as gas and water lines, sanitary and storm sewer lines, and other types of utilities under

existing pavements or ground surfaces to be built upon or improved later.

The objectives of requiring the use of the CLSM specified below, instead of reusing excavated soils, is to provide a self-leveling, frost heave-resistant, non-settling, controlled low-strength material (defined by American Concrete Institute in ACI 229 as a CLSM), that does not normally require compacting and compaction testing. Traditional use of compacted soil or aggregate materials for trench backfill shall require City approval and testing for acceptance.

4.2.3.1 Requirements for CLSM

This requirement specifies two distinct CLSM material products: Flashfill and Flow-Fill. The Flashfill products will allow trench backfill, temporary or permanent pavement restoration and traffic access to occur more quickly than Flow-Fill. The term 'CLSM' in this section shall mean either or both.

A **high slump** is required to aid in the self-leveling and void filling objective. The visual consistency may appear to range in appearance from thin batter or mud to thick water. It must be foremost removable with light machinery in the future, and quickly stabilize to support paving operations and traffic.

Minimum air contents are required in the top 4' of CLSM fill to limit permanent frost heave. This air content requirement should be used for the entire depth, to aid in the ability to remove or excavate CLSM in the future. The air content requirement may be forbidden by some utility applications, such as for thrust blocks or for pipe bedding normally used for lateral support of pressurized pipes.

A **Removability Modulus (RE)** is specified at a maximum 1.5 and is based on compressive strength and unit weight of the CLSM backfill.

4.2.3.2 CLSM Materials

(a) Flow-Fill

Shall consist of a controlled low strength, self-leveling concrete material composed of various combinations of cement, fly ash, aggregates, water, chemical admixtures and/or cellular foam for air-entrainment. Generally, Flow-Fill may be placed in a maximum of 3′ thick layers, allowing bleed water to rise and divert away from placement before another layer may be added.

The Flow-Fill shall be limited to a maximum Removability Modulus of 1.5 to ensure ability to excavate in the future. Slumps of less than 7″ will not be permitted for placement, since the flowability to fill voids and avoid future settlement is impaired, and strengths may increase beyond specified removability limits.

Submit a mix design for approval by the City Engineer prior to placement. The mix design shall be supported by laboratory test data verifying compliance with air content, slump, strength, and removability (RE) requirements.

Table 4.8. Flow-Fill requirements

Flow-Fill property	Flow-Fill specification
Air Content, ASTM C-231	15-25%
Compressive Strength, ASTM D-4832	125-150 psi at 28 days
Slump, ASTM C-143	7-10″
Removability Modulus, RE	1.5 MAX

See CDOT Section 206 for additional requirements for usage of Flow-Fill.

(b) Flashfill

Flashfill shall consist of a controlled low-strength, self-leveling cementitious material composed of various combinations of fly ash, water, chemical admixtures and/or cellular foam for air-entrainment. No aggregate or sand is usually needed. It shall have a minimum specified air content to provide suitable resistance to frost-heave. Flashfill may generally be placed without lift thickness limits.

Higher strengths may be permitted over Flow-Fill; however, the Flashfill shall still be limited to a maximum removability (RE) of 1.5. Slumps of less than 8″ or spreads of less than 8″ will not be permitted for placement, since the flowability to fill voids and avoid future settlement is impaired, and strengths may increase beyond removability limits.

Submit a mix design for approval by the City Engineer, prior to placement. The mix design shall be supported by laboratory test data verifying compliance with air content, slump, strength, and removability (RE) requirements.

Table 4.9. Flashfill requirements

Flashfill property	Flashfill specification
Air Content, ASTM C-231, or by Section 2D volumetric calculations	15 MIN
Compressive Strength, ASTM D-4832	100-300 psi at 28 days
Slump, ASTM C-143 (one lift, no rodding)	8-11″
Removability Modulus, RE	1.5 MAX
Spread, ASTM D-6103	8-12″, or greater

See CDOT Section 206 for additional requirements for usage of Flashfill.

4.2.4 CURBS AND GUTTERS

4.2.4.1 General

This work shall consist of constructing curbs and gutters of the form and dimensions shown on the plans.

4.2.4.2 Materials

Concrete for construction of combination curbs and gutters shall be a 6-sack mix design per Table 4.5.

4.2.5 SIDEWALK AND CURB RAMPS

4.2.5.1 General

Sidewalks shall be 4″ in thickness and a minimum of 5′ in width for residential and 6′ in width for commercial/industrial, unless approved by the City Engineer. Curb ramps shall be 6″ in thickness. Sidewalks at driveway approaches shall have a minimum thickness of 6″ (residential) and 7″ reinforced (commercial) for the full width. Sidewalks shall have a maximum of 2% cross slope (1:50). All sidewalks and curb ramps shall be constructed to conform to the most current version of the Public Rights-of-Way Accessibility Guidelines (PROWAG) and these specifications.

4.2.5.2 Materials

Concrete for construction of sidewalks and pedestrian ramps shall be a 6-sack mix design per Table 4.5.

4.2.6 CROSSPANS

4.2.6.1 General

Minimum crosspan bases shall be 8′ wide with a 45° angle slope on each side allowing 6′ of exposed concrete surface. The crosspan shall be sloped from each edge to the middle at the slope rate of 1/4″ per foot maximum. The depth of concrete shall be 7″ using #4 @ 18″ O.C. Longitudinal and 24″ O.C. Transverse.

Concrete for construction of crosspans shall be as specified in Section 4.2.2.3. One inch (1″) smooth steel dowls with sleeves or caps shall be installed at expansion joints, and when pouring half pans, spacing shall be @ 1′ O.C. See ARTICLE 5 – STRUCTURAL CONCRETE for specifications.

4.2.6.2 Materials

Concrete for construction of crosspans shall be a 6-sack mix design per Table 4.5.

4.2.7 DRIVEWAY APPROACHES

4.2.7.1 General

Driveway approaches shall be of two types:

(a) Alley & Driveway (Attached Sidewalk). Shall be constructed from cuts in 6″ vertical curb. The curb head shall be transitioned from 6″ to 1-1/2″ at a distance of 4′. See detail SD6.

(b) Alley & Driveway (Detached Sidewalk). Shall be as the Alley & Driveway (Attached Sidewalk), except the sidewalk is detached and 5′ wide. See detail SD5.

4.2.7.2 Materials

Concrete for construction of drive approaches shall be a 6-sack mix design per Table 4.5. Depth of concrete shall be 6″, except for commercial driveways in which case the depth shall be 7″ reinforced minimum.

4.3 CONSTRUCTION REQUIREMENTS

4.3.1 GENERAL

(a) All concrete construction in the City right-of-way requires that a concrete permit be obtained from the office of the Director of Public Works prior to start of construction. Permits will only be issued to Contractor's possessing a valid concrete license from the Pueblo Regional Building Department. When curb and gutter construction is incidental to a site upon which a building permit has been issued, that Contractor who was issued the building permit may be issued a permit for curb and gutter at the discretion of the Director of Public Works.

(b) Provide ample notice (24-hour minimum) to the Engineer to allow for the examination of all forms and reinforcing before concrete is placed and to observe the placement of all concrete. Concrete may not be placed until approval has been given by the Engineer.

(c) All concrete construction within the City Right-of Way shall be inspected and approved by a City Inspector. Inspections are scheduled by calling (719) 553-2295 or online at www.pueblo.us/PLACE.

(d) This section provides for the operations and construction of concrete combination curbs and gutters, valley gutters, crosspans, driveway approaches, and sidewalks to be constructed within the City right-of-way except patterned concrete median.

(e) No concrete shall be placed adjacent to concrete that has taken its initial set unless the specified expansion joint is provided.

(f) No more concrete shall be poured in one day than can be finished before dark, the same day. No concrete that has begun to set shall be deposited in the forms.

(g) When concrete pavement, curb & gutter, crosspans, or sidewalk are removed, the removal shall be to an existing joint or to a sawed joint which is made prior to removal. See Section 4.3.6.4 Sawcutting for specific requirements.

(h) The final edge of asphalt removal for the 2′ cut back shall be along a straight edge line sawed to full depth, prior to removal of the pavement, unless otherwise approved by the City Engineer.

(i) The edges of the concrete or asphalt paving shall extend 1′ beyond the excavation. Where flowable fill is used as backfill, extension is not required.

(j) The final edge of asphalt removal for the 2′ cut back shall be cut along a straight line, in an approved manner, to allow removal without disturbing adjacent asphalt or concrete. When the adjacent asphalt or concrete has been disturbed by the removal process, the Permittee shall replace all disturbed asphalt or concrete as directed by the City Engineer.

4.3.2 EXCAVATION

4.3.2.1 General

Excavation will include excavation of all materials encountered. Excavation shall be made to subgrade elevations and to a width equal to the width of the concrete to be placed plus 2′ beyond the outer edges of the concrete to be placed or as directed by the Engineer.

If, after the excavation has been made to subgrade for the full width required, the top 6″ of the cut have a relative density of less than that required by Section 6.3.3 COMPACTION, it shall be reworked to obtain such density.

4.3.2.2 Excavation of Unsuitable Material

No excavation shall be made below the specified elevation except to remove soft or saturated soils, organic matter or other unsuitable material, as ordered by the Engineer. In the event the Contractor does excavate below the specified elevation, and said excavation was not directed by the Engineer, the excavated material shall be replaced with material satisfactory to the Engineer. The material shall be thoroughly compacted, at the contractors' expense.

Whenever excavation below the specified elevation to remove soft or saturated soils, organic matter, or other unsuitable material is ordered by the Engineer, the Contractor shall remove and replace the excavated material with material acceptable to the Engineer.

The replacement material shall be placed according to Section 6.3.3 COMPACTION.

4.3.6 PREPARATION FOR PLACEMENT

4.3.6.1 General

(a) Before placement, all equipment for mixing and transporting the concrete shall be cleaned, and all debris and ice shall be removed from the places to be occupied by the concrete. Forms shall be thoroughly oiled, and masonry filler units that will be in contact with concrete shall be water saturated (except in freezing weather). The reinforcement, placed according to Article 5 – REINFORCEMENT FOR STRUCTURAL CONCRETE, shall be free of ice, dirt, rust, mill scale, or other coatings.

(b) Water shall be removed from place of deposit before the concrete is placed unless otherwise permitted by the Engineer. All laitance and other unsound material shall be removed from hardened concrete before additional concrete is added.

(c) Preparation prior to concreting includes compacting, trimming, and moistening the subgrade, erecting the forms, and setting the reinforcing steel. A moist subgrade is especially important

in hot weather to prevent extraction of water from the concrete.

(d) Forms shall be clean, tight, adequately braced, and constructed of materials that will impart the desired texture to the finished concrete.

(e) Sawdust, nails, and other debris shall be removed before concrete is placed. Wood forms shall be oiled before placing concrete.

(f) When concrete placed on earth surfaces is necessary, the surfaces shall be free from frost, ice, mud and water.

4.3.6.2 Preparation of Subgrade

Where soils are encountered with an R-value less than 32, and a California Bearing Ratio (CBR) less than 15, the soils engineer will decide on the requirement for base course under concrete based upon recommendations contained in the soils report. Select base course materials and/or subgrade shall be compacted to not less than 95% of maximum dry density, in accordance with AASHTO T-99 (Standard Proctor) or 95% of the maximum dry density in accordance with AASHTO T-180 (Modified Proctor) and at the moisture content as specified in the soils or pavement design report. If the moisture content is not specified, the soil shall be compacted at +/-2%.

When the temperature of the surrounding atmosphere is 50° F or above, the sub grade and/or base course shall be lightly moistened immediately before the placement of the concrete. See ARTICLE 7 – EARTHWORK for additional requirements.

4.3.6.3 Removal of Obstructions

Whenever an existing driveway or entrance walk must be removed to provide space for forms, the Contractor shall remove those to the nearest joint, or as the Engineer may direct. A sawed joint shall be required for said removal. Replacement will be done on a unit price basis.

4.3.6.4 Sawcutting

(a) All concrete removal shall be to a sawcut joint unless it can be demonstrated that an existing joint is of such character that removal can be accomplished to a neat line.

(b) Sawcutting will be done to a depth equal to at least half the depth of the concrete.

(c) In no case will a piece of concrete be left which is closer than 5′ to the nearest control joint.

(d) All existing joints other than expansion joints shall be sawed prior to removal. A sawed joint will not be permitted within 5′ of an existing joint.

(e) Where water service line renewals cross existing concrete sections that have been previously saw-cut to less than 5′ minimum distance to a joint, these sections shall be removed and replaced to meet the 5′ minimum requirement to a joint.

(f) The final edge of asphalt removal for the 2′ cut back shall be cut along a straight line, in an approved manner, to allow removal without disturbing adjacent asphalt or concrete. When the adjacent asphalt or concrete has been disturbed by the removal process, the Permittee shall replace all disturbed asphalt or concrete as directed by the Engineer.

4.3.6.5 Removal of Tree Roots

Whenever a section of concrete is being replaced that has been uplifted by a tree root, the root shall be cut 12″ behind the concrete to prevent the damage from reoccurring. Any roots within 6″ of finished sub grade shall also be removed. If, in the opinion of the Engineer, cutting the root may seriously injure the tree, then the Engineer may order the removal of the tree. Except for City contracts with a tree removal bid item, the cost of the tree removal shall be at the adjacent property owner's expense. Prior to cutting the tree roots, the Engineer shall be consulted to determine the proper removal of the root and/or tree.

4.3.6.6 Placement on Hardened Concrete

When fresh concrete is placed on hardened concrete, certain precautions shall be taken to secure a well-bonded and watertight joint. The hardened concrete should be fairly level, reasonably rough, clean, and moist. Some coarse aggregate particles shall be exposed, and any laitance or soft mortar shall be removed from the top surface of the hardened concrete. For structures requiring more than one lift, the top of the lower course shall be broomed, just before it sets, with a steel or stiff fiber broom. The surface shall be level but heavily scored and free of laitance. It must then be protected and thoroughly cleaned just before the grout coat and top course are placed. Hardened concrete shall be moistened thoroughly before new concrete is placed on it. Where the surface has dried out it shall be saturated for 24 hours. No pools of water shall be left standing on the wet surface when the new concrete is placed.

4.3.6.7 Placement on Rock

Where concrete is to be placed on rock, all loose material should be removed and the rock should be thoroughly cleaned before concrete is placed. Concrete shall be placed to fill all irregularities in its surface.

When rock must be cut out, the surfaces in general should be vertical or horizontal rather than sloping.

4.3.7 FORMS

4.3.7.1 General

Forms shall be thoroughly cleaned of all dirt, mortar, and foreign matter before being used. Unit lengths of forms shall be jointed in advance of the time of placing concrete. Forms that are bent, twisted, warped, broken, or forms that have battered or splintered top faces shall be removed from the job. Repaired forms shall not be used until they have been inspected and approved by the Engineer. The top and face of a form shall not vary from a true plane by more than 1/4″ in 10′.

Wood forms shall not be less than 1/2" thick after being surfaced. Metal forms shall be approved section and shall have a flat surface on the top of not less than 1-3/4″. Steel stakes shall not be spaced more than 6′ apart. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms.

The building of pedestals of earth or other materials upon which to rest the forms to bring them to the grade will not be permitted. Sufficient forms shall be provided so that they may remain in place 72 hours or more after the concrete has been placed before it is necessary to move and reuse them. Forms shall be cleaned and oiled before concrete is placed against them. The alignment and grade of forms shall be checked and approved immediately before placing the concrete.

Forms which show a variation exceeding 1/2" from the alignment shall be reset or removed as directed.

Forms for concrete shall be used for all vertical surfaces, mortar type, true to required lines and grades, and of sufficient strength to maintain shape during the placing of the concrete and the mechanical finishing without springing or settling.

4.3.7.2 Removal of Forms

Remove forms in such a manner as to ensure the complete safety of the concrete. Forms in general may be removed from vertical surfaces after 24 hours from the time of placing the concrete and 72 hours for horizontal surfaces (i.e. structural slabs). Additional time may be required as specified in Section 4.3.7.2 PROTECTION IN COLD AND FREEZING WEATHER when directed by the City Engineer. Any damages or injuries resulting from premature formwork removal are the sole responsibility of the Contractor. After the forms have been removed, no honeycomb or minor defects will be acceptable by the City Engineer, unless acceptable repairs are made.

4.3.8 JOINT SEALING

Sealing material shall be applied in strict accordance with the manufacturer’s directions. All expansion joints shall be sealed.

4.3.9 CONVEYING, PLACING AND FINISHING

4.3.9.1 Conveying

Each load shall be accompanied by a batch plant ticket with the following minimum information:

Supplier Name
Date
Truck Number
Project Name
Time Batched
Cubic Yards Batched
Type, and amount of cement
Design Mix Designation

Destination

Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of materials. The practice of moving concrete from one point to another using vibrators is expressly forbidden. Vibrators shall be used to consolidate the concrete, not to transport it.

Equipment for tramming, chuting, pumping, and pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery end without separation of materials.

4.3.9.2 Placing

Concrete shall be placed, as practicable, in its final position to avoid separation due to rehandling or flowing and shall be placed at a rate that it maintains plasticity at all times. No concrete that has partially hardened or been contaminated by foreign materials shall be deposited on the job site nor shall retempered concrete be used. All concrete shall be thoroughly consolidated during placement. It shall be thoroughly worked around reinforcements and embedded fixtures and into the corners of forms.

Concrete shall not be free dropped from more than 4′.

Concrete shall be placed in horizontal layers of uniform thickness. The minimum layer thickness should be 4″ for flatwork and 6″ for walls and footings.

In depositing concrete against the forms, care shall be taken to work the fine portions of the aggregate surface to leave the surface in a uniform and smooth condition.

After placement in the forms, the concrete shall be thoroughly spaded or mechanically vibrated so that there will be no air spaces in the mass. The concrete shall be worked sufficiently to produce a dense mass.

Curb and gutter shall be brought to the proper surface by running a straightedge over the steel templates with a sawing motion, to fill all holes and depressions.

Crosspans shall be brought to the proper surface by wood floating to fill all holes and depressions.

Driveway approaches shall be brought to the proper surface by running a straightedge over the forms with a sawing motion to fill all holes and depressions.

Immediately after using the straightedge, the surface shall be floated with a wood float, trowel led with a steel trowel and edged with an approved edger. Finishing with a steel trowel shall be accomplished without adding water to the surface. Excessive water, laitance or other inert material shall be floated from the surface.

No more concrete shall be poured in one day than can be finished before dark the same day. No concrete that has begun to set shall be deposited in the forms.

4.3.9.3 Finishing

Just before the concrete takes its initial set, the surface shall first be troweled, then brushed with a soft bristle brush, except that pedestrian ramps shall be brushed with a coarse hair push broom, to remove all trowel marks and leave a uniform appearance.

Brushing shall be as follows:

(a) At right angles to the centerline of the sidewalk or curb line,
(b) parallel with the scoring for pedestrian ramps, or
(c) parallel to the center line of the crosspan.

4.3.9.4 Contractor Stamp

The contractor shall mark in every 50 linear feet of sidewalk and curb & gutter, and in every crosspan, valley gutter and driveway by stamping their name and the year of construction. The stamped letters shall be 1″ high and 1/4″ deep.

4.3.10 FIELD TESTING

The preparation, handling, storage, and testing procedures of all samples shall be in conformance with the applicable ASTM and AASHTO standards. Field testing may be done by either an independent testing firm, contracted by the City, or hired by the contractor/developer. The testing and frequencies listed in the table below shall be conducted to verify applicable standards and specifications are met.

Table 4.10. Minimum testing requirements

Standard	Requirement	ASTM
Compressive Strength	One set (5 cylinders) per 100 cubic yards and at least one set per day	C31 C39
Air Content	First three trucks each day, then one test per 50 cubic yards and at least one test per day	C231
Slump	First three trucks each day, then one test 50 cubic yards and at least one test per day	C143
Unit Weight	First three trucks each day, then one test per 300 cubic yards and at least one test per day	C1064

Failure of the concrete to pass any of the above tests may cause the rejection of the load and/or removal of concrete. The Contractor shall furnish the concrete for the tests at no expense to the City. Except for City projects, the expense of testing the concrete shall be paid by the contractor/developer. Privately funded projects within the City of Pueblo right-of-way shall be sampled and tested in accordance with the above table.

Additional cylinders or tests may be required at the direction of the Engineer. If additional tests are required, the financial burden will be borne by the contractor/developer if the testing results fail to meet minimum city specifications. If the testing results meet or exceed the city

specifications the additional testing costs will be paid for by the requesting entity.

Compressive strength tests shall consist of at least five cylinders cast and cured in accordance with ASTM C31. Unless otherwise directed by the Engineer, one cylinder shall be broken at the end of seven days, two cylinders shall be broken at the end of 28 days, and the remaining cylinders shall be stored until its disposition is determined by the Engineer. Testing must be accomplished by AC1 Field Testing Grade 1 certified technician.

The Engineer reserves the right to stop all future concrete work, when the 7- or 28-day tests indicate unsatisfactory results, until in the opinion of the Engineer proper corrective measures have been taken to ensure quality concrete in future work or all corrections deemed necessary have been made.

If the 28-day compressive strength tests produce results less than the specified required minimum compressive strength, then any concrete represented by those tests shall be removed and replaced at the Contractor's expense. In lieu of removal, the Contractor has the option of having additional strength tests taken by an approved laboratory at the Contractor's expense to satisfy the Engineer that the concrete in question has achieved the required strength. The location, number and type of tests shall be subject to review by the Engineer prior to start of testing.

4.3.11 CURING AND PROTECTING

All concrete shall be cured for a period of seven days or until the concrete has reached 80% of the design compressive strength. Concrete shall be kept moist for at least five days after placement. The curing medium used shall be applied to prevent checking and cracking of the finished surface of the concrete immediately after the finishing operation is completed, and it shall be maintained to prevent loss of water from the surface and edges of the concrete for the entire duration of the curing period.

4.3.11.1 Curing Compounds

If curing compounds are used, they shall be thoroughly agitated during use and shall be uniformly sprayed in a single coat. Application shall be on all concrete surfaces at a rate not to exceed 150 square feet per gallon in place. Application shall be made as soon as all surface water sheen has disappeared from the concrete surface. If concrete surfaces become partially dry, they shall be thoroughly moistened with water immediately prior to the application of the compound. If in the opinion of the Engineer pinholes exist, a second coat shall be immediately applied at right angles to the first in the affected area. Under no circumstances shall curing compound be used on surfaces to which new concrete is to be bonded. All curing compounds shall conform to ASTM C-309.

If, at any time during the curing period any of the forms are removed, a coat of curing compound shall be applied immediately to the exposed surface.

4.3.11.2 Protection in Cold and Freezing Weather

Cold weather is defined as a period when, for more than three consecutive days, the following conditions exists:

(a) The average air temperature is less than 35˚F, and

(b) The air temperature is not greater than 45˚F for more than one half of any 24-hour period.

The Contractor is responsible for the strength and quality of the concrete placed during cold weather. Before starting paving operations, the Contractor shall be prepared to protect the concrete from freezing.

The placing of concrete will be permitted only when the temperature of the concrete placed is between 55˚F and 90˚F. Cold weather concrete placement shall follow the requirements and recommendations of the American Concrete Institute (ACI) 306R-10 (or the most current revision).

Concrete may be placed when the air temperature in the shade is 40˚F and rising. No concrete shall be placed regardless of the present temperature, when the National Weather Service forecast predict weather to be below 32˚F 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.
The Contractor shall protect the concrete from falling below 55˚F surface temperature until the concrete has developed a compressive strength of at least 3,500 psi or 80% of the required 28-day concrete design strength.

If concrete placement is performed when the temperatures are below or are projected to fall below 15°F for more than 24 hours, the Contractor shall measure the internal temperature of the concrete at regular intervals during the curing using automated sensors provided by the Contractor. Data obtained shall be provided to City Engineering Division. The Contractor shall be responsible for the placement, protection, and maintenance of all measuring devices. Locations where measuring devices are installed shall be protected in the same manner as the rest of the concrete.

The following procedures shall be followed if the temperature of the concrete falls below 32°F before the concrete reaches 3,500 psi or 80% of the required 28-day concrete design strength:

(a) The Contractor will take cores at locations designated by the Engineer.

(b) The Engineer will take immediate possession of the cores and submit the cores to a petrographer for examination in accordance with ASTM C856.

(c) All costs associated with coring, transmittal of cores, and petrographic examination shall be borne by the Contractor regardless of the outcome of the petrographic examination.

(d) Pavement damaged by frost as determined by the petrographic examination, shall be removed and replaced at the Contractor's expense.

Under no circumstances shall the placement of concrete be permitted, regardless of temperature conditions, if the supporting ground is frozen or contains frost. Use of salt or other additives to prevent concrete from freezing is not permitted. Concrete that has been frozen will

be completely removed and replaced as directed by, and to the satisfaction of, the City Engineering Division. Additional field testing may be directed by the City Engineering Division per Section 4.3.6 of this document.

4.3.11.3 Hot Weather Placement

When the air temperatures are expected to exceed 100˚F, the Contractor shall obtain approval from the Engineer on the procedures to be used in protecting, depositing, finishing and curing of concrete. A concrete retarding agent may be used upon approval of the Engineer. The use of fog sprays is prohibited. The time allowed for hauling and placement shall be reduced to 60 minutes. Concrete shall not be placed when the temperature of the mix exceeds 90˚F. Any concrete placed when the ambient temperature is 100˚F or greater will be at the contractor's risk, regardless of any prior verbal authorization.

4.3.12 PATCHING

Patch all voids, tie holes, honeycombs, or damaged areas. Cut or chip out large defective areas a minimum of 1 ½″ deep or 1 ½″ below the reinforcement, if present, until sound and clean concrete is exposed, and patch as required. Add white cement to patching grout as required to match color of existing concrete where patches are exposed to view.

When allowed by the Engineer, spalls in curb and gutter or sidewalk shall be patched with a product from the CDOT approved list for the appropriate application. Grout color shall match that of concrete being patched. Contractor shall submit Material Data Sheets for City review prior to application.

4.3.13 TRENCH BACKFILL WITH CLSM

Except as otherwise provided or approved by the City, after the pipe or conduit is laid, trenches shall be backfilled with CLSM 24" below the asphalt. The Utility Owner shall dictate any variance to these CLSM separation distances. Where depths of Flashfill exceed 3′ over wastewater mains please contact Pueblo Wastewater or Stormwater Departments for bedding depths.

CLSM should be well mixed and discharged directly from the truck into the space to be filled, or by other methods approved by the City. When used as backfill in the pipe zone, care should be taken to prevent flotation or misalignment of the pipe by means of straps, soil anchors or other approved means of restraint. Material may be placed in stages with initially lesser flowability, to prevent movement or flotation of pipe. CLSM shall not be placed when the trench bottom or walls are frozen or contain frozen materials.

Compaction of CLSM shall not be performed.

The maximum layer thickness for Flow-Fill shall be determined by the Contractor. Additional layers shall not be placed until the backfill has lost sufficient moisture to be walked on without indenting more than 2″. Allow bleed water to rise and divert away from placement area before another layer may be added. Do not place CLSM on top of bleed water or on any water above the bearing layer. Any damage resulting from placing Flow-Fill in layers that are too thick or from not allowing sufficient strength gain time between placement of layers shall be repaired at the

CONTRACTOR's expense.

The maximum layer thickness for Flashfill is not restricted except to prevent flowing or running into undesired areas.

Contractor shall observe all other Construction Requirements as provided in CDOT Section 206 for placement of CLSM.

4.3.14 STREET SURFACING AND PATCHING

Placement of pavement materials for vehicle traffic shall not be allowed until the removable CLSM backfill has cured 24 hours (Flow-Fill only) or achieved sufficient resistance to allow paving. CLSM (either type) should be subjected to standard proof roll criteria, or penetration resistance tests. CLSM should achieve a penetration resistance of at least 3.6 tsf (tons per square foot) (equivalent to 50 psi) using a hand-held soil penetrometer, typically pushed to 1/4″ depth, in accordance with the penetrometer manufacturer's instructions. Alternately, penetration resistance shall be considered achieved when a person weighing 100 pounds by use of their body weight as an axial load, cannot penetrate the CLSM backfill with the square cut end of a 1/2″ diameter (#4) steel reinforcing bar.

4.3.15 TOLERANCES

Finished horizontal concrete surfaces shall not vary from a true plane by more than 3/16″ in 10′ and the upstanding face shall not vary from a true plane by more than 1/4″ in 1′. Any concrete not adhering to these tolerances may be rejected by the City and shall be replaced by the Contractor's at expense.

4.3.16 EMBANKMENTS

Embankments shall be constructed of suitable excavated, borrow or select materials approved by the Engineer, placed in successive layers no greater than 6″ in thickness, parallel to the finished subgrade. Each layer of embankment placed shall contain the amount of moisture necessary to obtain a minimum density outlined in Section 6.3.3 COMPACTION, when thoroughly compacted with the proper equipment.

In fill sections the material shall be placed for the full width of the concrete to be placed plus 2′ beyond the outer edges of the concrete to be placed and shall slope to the existing ground on a 2:1 slope.

4.3.17 POST CONSTRUCTION

4.3.17.1 Backfilling After Construction

In fill sections, a 2′ minimum wide berm shall be constructed against the back of the curb or sidewalk if applicable and sloped to the existing ground at a 2:1 slope, unless shown otherwise on the drawings.

In cut sections, a level bench shall extend from the back of the curb a distance of 7′ before the cut slope extending to daylight, or as shown on the drawings. The void behind the back of the

curb and gutter shall be backfilled after the removal of the back form and the concrete has attained a minimum strength of 3,000 psi. Care should be exercised during this operation so that the alignment or grade of the sections shall not be disturbed. Any that are shifted, cracked, or in any way damaged, shall be removed and replaced at the Contractors own expense.

4.3.17.2 Asphalt Patch

Where asphalt and base have been removed for the gutter face form, the patch shall have a minimum width of 2′ when a cut back is required. The patch shall be constructed using asphalt conforming to the requirements of ARTICLE 8 – PAVEMENT and having an asphalt thickness equal to that of the adjacent street except that a minimum thickness of 6″ shall be maintained.

4.3.17.3 Site Restoration

Restoration of the area behind the new concrete shall include, but not be limited to replacing sod, shrubs, gravel, asphalt, concrete, irrigation components, and other landscaping items. Restoration is considered subsidiary to the concrete construction and shall not be paid as a separate item, unless noted otherwise in the Special Provisions.

4.3.18 SPECIFIC CONSTRUCTION TYPES

4.3.18.1 Curbs and Gutters Construction

(a) General. No concrete shall be placed if there is not enough to completely fill one complete 5′ curb and gutter section. No concrete shall be deposited adjacent to concrete that has already taken its initial set (90 minutes or older), unless the specified expansion joint is provided.

(b) Expansion Joints. Expansion joints of 1/2″ wide shall be constructed in curbs and gutters at 100′ intervals, at each side of structures, and at the ends of all curb returns; except that expansion joints shall not be installed within 20 feet of an island nose. Expansion joints shall be filled with joint filler strips 1/2″ thick conforming to 4.2.1.8 Expansion Joint requirements. The filler for the joint shall be furnished in a single piece for the full depth and width required for the joint. Filler strips shall be secured to forms or subgrade to avoid displacement while or after concrete is placed; or attached to a bulkhead. Expansion joint filler shall be shaped to the cross section of the curb and gutter. Expansion joints shall be constructed at right angles to the line of curb and gutter.

(c) Contraction Joints. Contraction joints shall be installed every 10′ and shall be inserted by a 1/8″ thick steel template at right angles to the curb and 1-1/2″ deep into the concrete.

(d) Forms. All forms shall have dimensions of the City of Pueblo specified curb and gutter sections. Flexible, curbed, or wood forms of the proper radii shall be used for curbs having a radius of less than 200′.

(e) Finished Work. The work shall be performed in a manner which results in a curb and gutter constructed to a specified line and grade, uniform in appearance and structurally sound. Curbs found with unsightly bulges, ridges, low spots in the gutter or other

defects shall be removed and replaced at the Contractor's expense. When checked with a 10′ straightedge, grade shall not deviate more than 1/4″ inch and alignment shall not vary more than 3/8″.

(f) Backfill. Immediately after the curb and gutter have been properly cured, backfill shall be placed and compacted against the back of the curb to the satisfaction of the Engineer, to prevent any movement of the curb and/or gutter during the placing of the street pavement. Placement of asphalt paving shall be no sooner than three days after placing of concrete except when threat of erosive rains exists.

4.3.18.2 Sidewalk and Curb Ramps Construction

(a) Expansion Joints. Transverse expansion joints 1/2″ wide shall be constructed at all sidewalk returns and in-line with expansion joints in the adjacent curb. Where the curb is not adjacent, expansion joints shall be constructed at intervals of 100′. Expansion joints shall coincide with curb and gutter control joints. Expansion joints shall have joint filler strips placed between or within pours. The filler shall be 1/2″ thick conforming to 4.2.1.8 Expansion Joint requirements. The filler for the joint shall be furnished in a single piece for the full depth and width required for the joint unless otherwise authorized by the AGENCY. The joint filler shall be placed with the top edge 1/4″ below the concrete surface and shall be held in place by means of steel pins driven into the subgrade and spaced sufficiently close to prevent warping of the filler during floating. Upon completion of floating, the pins shall be removed and when finishing operations have been completed, the joint shall be edged with an edging tool having a radius of 1/8″.

(b) Contraction Joints. Contraction joints shall be installed every 5′ and shall be at least 1-1/2″ deep into the concrete.

(c) Tolerance. The top face of the slab shall not vary from the true grade and alignment by more than 1/4″ in 10′ when checked with a straightedge. Slope of the grass portion of the parkway shall be 1/4" to 1-1/2″ per foot above the top of curb. Slope of sidewalk shall be maximum 2% cross slope (1:50). Curb ramps shall have a maximum running slope of 8.33%. The counter slope of the gutter or street at the foot of the ramp run shall be 5% maximum. The maximum difference in grades between the curb ramp and the adjacent gutter pan shall be 13.3%. The transition between the two surfaces shall be flush.

(1) Where applicable, turning spaces shall be provided with the curb ramps and shall have a maximum slope of 2% in all directions (1:50). The counter slope of the gutter or street at the turning space shall be 5% maximum. The maximum difference in grades between the turning space and the adjacent gutter pan shall 13.3%. The transition between the two surfaces shall be flush.

(2) Detectable warnings (Tactile band) shall extend a minimum of 2′ in the direction of pedestrian travel and extend the entire width of the curb ramp. Detectable warnings shall be cast iron castings containing truncated domes. Castings shall comply will all provisions of the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and the Public Rights-of-Way Accessibility Guidelines (PROWAG) with Supplements.

a. Castings shall be cast-in-place truncated dome tactile system, Neenah R-4984, East Jordan Iron Works 700571 (4′ ramp), 700721 (5′ ramp), or approved equal, at the sizes denoted on the plans. Radial castings shall be East Jordan Iron Works 700621 (20′ radius), 700625 (25′ radius), 700631 (30′ radius) or approved equal, at the sizes denoted on the plans.

b. Finish shall be Natural Patina or Colonial Red (FED 20109).

(3) Sidewalk, curb ramps, and portions of the curb that are determined to be out of the acceptable tolerances shall be removed and replaced by the Contractor at no additional cost to the City.

4.3.18.3 Crosspans

Expansion Joints. Expansion joints shall be placed completely through the section at 50′ intervals and at curb returns. One-inch (1”) smooth steel dowels with sleeves or caps at 2′ centers shall be placed in the joint.

4.3.18.4 Driveway Approaches

(a) Expansion Joints. Expansion joints shall be placed between drive approaches and either existing sidewalk or the driveway beyond the property line.
(b) Contraction Joints. Contraction joints shall be installed every 10′ and shall be insertion of a 1/8″ thick steel template at right angles to the curb and 1-1/2″ deep into the concrete.

4.4 METHOD OF MEASUREMENT

4.4.1 CURB AND GUTTER

Curb and gutter to be measured in linear feet.

4.4.2 SIDEWALK AND CURB RAMPS

All sidewalk and pedestrian ramps shall be measured in square feet.

4.4.3 CROSSPANS

Crosspans shall be measured in square feet.

4.4.4 DRIVEWAY APPROACHES

Driveway approaches shall be measured in square feet.

4.5 PAYMENT

4.5.1 CURB AND GUTTER

Shall be paid for at the contract unit price, per linear foot, for the actual length of authorized curb and gutter constructed. This item includes all materials such as concrete, forming and form removal, finishing and curing of concrete, grading, compaction, and any other work items required by the plans and specifications.

4.5.2 SIDEWALK AND CURB RAMPS

Payment will be based on the number of square feet constructed in place at the contract unit price per square foot, unless otherwise noted in the bid proposal.

4.5.3 CROSSPANS

Crosspans shall be paid for at the contract unit price for each unit installed by project end. Each gutter apron with a monolithic curb radius shall be paid for separately. This item includes forming and form removal, purchase and placement of concrete, finishing and curing of concrete, grading, compaction, and any other work items required by the plans and specifications.

4.5.4 DRIVEWAY APPROACHES

Driveway Approaches shall be paid for at the contract unit price for each unit installed by project end. This item includes forming and form removal, purchase and placement of concrete, finishing and curing of concrete, grading, compaction, and any other work items required by the plans and specifications.

ARTICLE 5

REINFORCEMENT FOR STRUCTURAL CONCRETE

5.1 GENERAL

5.1.1 DESCRIPTION

The work under this section includes the furnishing of all labor and materials necessary for the construction (placement) of the reinforcement for structural concrete according to the plans and these specifications. Structural concrete shall be defined as mass concrete with reinforcement exceeding 0.3% of the concrete cross-sectional area.

5.2 MATERIALS

5.2.1 SUBMITTALS

(a) Engineered shop drawings and schedules shall require original Colorado engineer's or architect's stamp, for all reinforcement.

(b) The submittals shall be made in ample time to be reviewed, and to permit corrected drawings to be delivered to the Engineer a minimum of seven days prior to work.

(c) These drawings shall show the size, number, exact position and spacing of reinforcement and the exact location of all openings, framing, or special conditions affecting the work.

(d) Detailing of reinforcement shall conform to ACI 315.

5.2.2 REINFORCEMENT

The reinforcing bars shall be in conformity with ASTM A-615 SI Grade 40 and Grade 60 and the general notes on the structural drawings. Dowels, conforming to the requirements of ASTM A-15, shall be intermediate grade plain bars rolled from billet stock. Glass Fiber Reinforced Polymer (GFRP) and Carbon Fiber Reinforced Polymer (CFRP) reinforcing bars may be used with prior approval of the Engineer.

(a) Welded Wire Fabric shall not be permitted for use with structures within the City right-of-way.

(b) Fiber-Reinforced Concrete shall not be permitted for use with structures within the City right-of-way.

(c) Reinforcing Bars, #3 to #18, shall conform to AASHTO M31 Grade 60 (ties and stirrups may be Grade 40). Epoxy coated reinforcing shall conform to AASHTO M284.

(d) The usage of GFRP and CFRP shall conform to ACI 440.1R-06 *Guide for the Design and Construction of Structural Concrete Reinforced with FRP Bars (or most current version)*. Do not use CFRP reinforcing bars in contact with steel reinforcing, metal lifting devices or other embedded metal items. Use the nominal diameters, nominal cross-sectional areas, and the

mechanical properties of Fiber Reinforced Polymer (FRP) reinforcing bars in accordance with CDOT Specifications for the design of structural concrete.

5.2.3 CLEANING

Reinforcement, prior to placement of concrete, shall be free from rust, scale, oil, ice, or other coatings that will destroy or reduce the bond, including mortar from previous concrete pours.

5.2.4 MATERIALS FOR ACCESSORIES

Where the concrete surface will be exposed to the weather in the finished structure, the portions of all accessories in contact with the formwork shall be galvanized or shall be made of plastic. Where the concrete surface will be exposed to plant water, all accessories in contact with formwork shall be stainless steel or plastic.

5.2.5 EXPANSION DOWELS

Smooth steel dowels conforming to AASHTO M183 with gage metal or PVC sleeves. Size, number and spacing as noted on the drawings.

5.2.6 CONCRETE

Conform to the requirements of *ARTICLE 4 - CONCRETE*. Calcium chloride shall not be used in reinforced concrete.

5.3 CONSTRUCTION REQUIREMENTS

5.3.1 GENERAL

See *Article 4 – CONCRETE* for construction requirements for the concrete portion of structural concrete.

5.3.2 REBAR PREPARATION

5.3.2.1 Tie Bars, Bar Supports and Wire Ties

Place reinforcement to maintain minimum coverage as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

5.3.2.2 Bending

Reinforcement shall be bent cold. **The use of heat in bending bars shall not be permitted.** Bars shall be full length required and accurately bent to details. All bent bars shall be manufactured in accordance with the recommendations of the Concrete Reinforcing Steel Institute (CSRI). No bars partially embedded in concrete shall be field bent except as shown on the drawings or specifically permitted by the Engineer.

5.3.2.3 Placing

For details and reinforcement placement and supports comply with Concrete Reinforcing Steel Institute's (CRSI's) recommended practice for "Placing Reinforcing Bars," for details and reinforcement placement and supports, and as specified. Reinforcement shall be accurately located in forms and firmly held in place before and during the depositing of concrete by means of metallic supports, metal chairs, spacer bars, tie wire or other devices adequate to ensure against displacement during construction.

Exposed reinforcing bars intended for bonding with future extensions shall be protected from corrosion by adequate covering.

5.3.2.4 Preventing Displacement

All reinforcing bars shall be positioned, supported, secured and wired together to prevent displacement by construction loads or the placing of concrete. On the ground, and where necessary, supporting concrete blocks shall be used. Over formwork, bar chairs, metal chairs, runners, bolsters, spacers, and hangers shall be furnished, as approved by the Engineer.

5.3.2.5 Offsetting Bars

Vertical bars in columns shall be offset to permit the bars to be adjacent and in contact at all splices.

5.3.2.6 Splicing

Wherever it is necessary to splice reinforcement other than as shown on the drawings, the character of the splice shall be approved by the Engineer on the basis of allowable bond stress in the reinforcement at the splice. Splicing shall not be made at points of maximum stress nor shall adjacent bars be spliced at the same point. Laps in tension splices shall be 36-bar diameters or 30bar diameters in compression, or as specified.

5.3.2.7 Cover

The minimum clear cover for reinforcing steel shall be as specified in ACI 301, Section 5.5, and as shown below, unless otherwise shown on the plans.

Table 5.1. Minimum clear cover

Location	Minimum Cover
Bottom bars on soil bearing foundation and slabs	3″
Bars adjacent to surfaces exposed to weather on earth backfill:	
Bars more than 3/4″ diameter	2″
Bars 3/4″ or less in diameter	1-1/2″
Interior Surfaces: Slabs, walls, joints with 1-3/8″ diameter or smaller bars	3/4″

5.4 METHOD OF MEASUREMENT

The contract quantities to be paid for under this item shall be according to *Article 4 – CONCRETE Section 4.4 METHOD OF MEASUREMENT.*

5.5 BASIS OF PAYMENT

The basis of payment shall be according to *Article 4 – CONCRETE Section 4.5 BASIS OF PAYMENT.*

ARTICLE 6

AGGREGATE BASE COURSE

6.1 GENERAL

6.1.1 DESCRIPTION

The work under this article shall consist of furnishing, placing and compacting one or more courses of base or sub-base material to provide a firm foundation for subsequent construction. Aggregate base course shall conform with the lines, grades, and cross-sections shown on the plans and shall comply with these specifications.

6.1.2 SUBMITTALS

Aggregate Base Course submittals outlined below are required on all City contracts and any other project within the public right-of-way. All aggregate suppliers furnishing aggregate for placement within any City right-of-way shall furnish to the City once every two years, aggregate gradation analysis for aggregate intended to be used for placement within the right-of-way.

6.2 MATERIAL

6.2.1 BASE AND SUB-BASE MATERIALS

The aggregate for base or sub-base material shall be composed of crushed stone, crushed gravel, or natural gravel which conforms to the quality requirements of AASHTO M 147 (latest revision).

The use of recycled asphalt product (RAP), recycled concrete (RC) not blended or mixed other material, or Fly-Ash blended with Class 6 aggregate base, may not be used unless approved by the City Engineer. At least 50% by weight of the material retained on the No. 4 sieve, and larger, shall have at least one fractured face. This material shall also conform to the following gradation requirements.

Table 6.1. Gradation requirements (Percent Passing Sieve Sizes by weight)

Sieve Size	Sub-base	Base Course	
	Class 1	Class 5	Class 6
4”	-	-	-
3”	-	-	-
2 ½”	100%	-	-
2”	95-100%	-	-
1 ½”	-	100%	-
1”	-	95-100%	-
¾”	-	-	100%
No. 4	30-65%	30-70%	30-65%
No. 8	-	-	25-55%

No. 200 (AASHTO T-11)	3-15%	3-15%	3-12%
Liquid Limit (AASHTO T-89)	35 MAX	30 MAX	30 MAX
Plasticity Index (AASHTO T-90)	6 MAX	6 MAX	6 MAX

The aggregate shall have a Los Angeles Abrasion Test (AASHTO T-96) percentage of wear not exceeding 45% (excluding Class 1). Class 1 material shall have a minimum R value of 69, or a minimum CBR of 40 when tested in accordance with AASHTO T-190 or T-193, respectively. Class 5 & 6 material shall have a minimum R value of 77, or a minimum CBR of 60.

6.2.2 CLASS 1 STRUCTURE BACKFILL

Class 1 structure backfill shall meet the following gradation requirements:

Sieve Size	Mass Percent Passing Square Mesh Sieves
50 mm (2 inch)	100
4.75 mm (No. 4)	30-100
300 µm (No. 50)	10-60
75 µm (No. 200)	5-20

In addition, this material shall have a liquid limit not exceeding 35 and a plasticity index of not over six when determined in conformity with AASHTO T 89 and T 90 respectively.

6.2.3 CLASS 2 STRUCTURE BACKFILL

Class 2 structure backfill shall be composed of suitable materials developed on the project. To be suitable for use under this classification, backfill shall be free of frozen lumps, wood, or other organic material. If the material contains rock fragments that, in the opinion of the Engineer, will be injurious to the structure, the native material shall not be used for backfilling and the Contractor shall furnish Class 1 structure backfill material at the contract unit price. If contract unit price does not exist for Class 1 structure backfill, it will be paid for in accordance with subsection 104.03.

6.2.4 CLASS 3 STRUCTURE BACKFILL

Class 3 structure backfill or squeegee shall be a sandy gravel and meet the following gradation:

Sieve Size	Mass Percent Passing Square Mesh Sieves
9.5 mm (3/8 inch)	90-100
4.75 mm (No. 4)	45-80
0.075 mm (No. 200)	5-12

6.3 CONSTRUCTION REQUIREMENTS

6.3.1 SUBGRADE PREPARATION

Care shall be exercised in the hauling and placing of base/subgrade course materials to avoid segregation of the coarse and fine aggregates and to avoid contamination of the base/subgrade course materials with undesirable materials. Any ruts, holes, defects or soft yielding areas which occur in the subgrade for any cause shall be corrected and compacted to the required density and stability before an aggregate base course is placed. These repairs shall be made at the expense of the contractor. Subsequent base course layers shall be placed within 24 hours of the approval of the subgrade or moisture and density shall be reconfirmed at the expense of the Contractor.

6.3.2 PLACING AND MOISTURE CONDITIONING

The aggregate shall be uniformly deposited on the approved subgrade by means of the hauling vehicle with or without spreading devices. Aggregate shall be distributed over the surface to the depth specified on the plans or as established by the City Engineer. The maximum loose lift thickness shall be no more than 8”.

Care shall be exercised in the hauling and placing of the course materials to avoid segregation of the coarse and fine aggregates and to avoid contamination of the course materials with undesirable materials.

After the base course materials have been deposited, the course shall be thoroughly blade-mixed to the full depth of the layer by alternately blading the entire layer to the center and back to the edges of the road. It shall then be spread and finished to the required cross section by means of a self-propelled tired motor grader.

Water shall be applied prior to and during all blading and processing operations to moisten the material sufficiently to prevent segregation of the fine and coarse particles. Water shall be applied during the compaction in sufficient amounts to assist in compaction and prevent raveling.

The contractor shall be responsible for ensuring that their hauling operations do not cause excessive track out of dirt/mud onto paved streets adjacent to the work zone. All tracked out materials shall be promptly removed by the contractor at their sole expense. At a minimum, a sweeper operation shall be performed daily.

6.3.3 COMPACTION

Compaction shall immediately follow the spreading operation. If the compacted depth of the course exceeds 6”, the course shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6”.

Each layer shall be compacted to a density of not less than 95% of the maximum density in accordance with AASHTO T-180. Field, in-place density tests will be in accordance with Table 6.2. The finished surface of each layer shall have a uniform texture. Water shall be

uniformly applied over the materials during compaction in the quantity necessary for compaction. Moisture conditions shall be within 1% of optimum moisture content. It is to be expected that a loss of density in the upper portions of the material may occur due to a lapse in time, elements, or other reasons. Moisture conditioning and recompaction to the specified density will be required prior to placement of any subsequent layer and no additional compensation will be allowed for such work. Testing shall be completed within 24 hours of the placement of the next course. Base shall be retested if the next course is delayed beyond 24 hours or if exposed to precipitation.

6.3.4 PROOF ROLL

Prior to placing any base material, the subgrade shall be proof rolled in accordance with ARTICLE 7 – EARTHWORK Section 7.3.15.1. Any unsuitable areas shall be corrected to the satisfaction of the City Engineer.

Prior to placing any pavement, the base shall be proof rolled. Any unsuitable areas shall be corrected to the satisfaction of the City Engineer with density testing provided by the contractor. Following placement of material, if environmental conditions warrant, the material shall be retested for moisture/density and proof rolling at the contractor's expense.

6.3.5 SURFACE AND THICKNESS TOLERANCES

The surface of the prepared base course material shall be free from depressions exceeding 1/4″ in 10′ when measured with a straight edge. Spot checks should not vary more than 1/2″ up or down from the calculated elevation (plan grade). The surface of the base of the sub-base course shall be smooth and true to the established crown, grade and thickness. Any areas not within these tolerances shall be reworked until compliance is achieved. The required compacted thickness shall be as specified on the construction drawings.

6.3.6 QUALITY CONTROL

All samples and tests described herein shall be made in accordance with approved ASTM/AASHTO procedures. The owner/developer shall provide for all testing laboratory services in connection with tests verifying conformance of proposed materials with project requirements. The owner/developer shall also provide for testing laboratory services in connection with tests on materials after incorporation into the project.

Additional tests may be required at the direction of the Engineer. If additional tests are required, the financial burden will be borne by the contractor/developer if the testing results fail to meet minimum city specifications. If the testing results meet or exceed the City specifications the additional testing costs will be paid for by the requesting entity.

Prior to installation of base or sub-base course materials, the owner/developer shall provide the City Engineer with a copy of the R-value test results, gradation analysis, Atterberg Limits (Liquid Limit /Plasticity Index), and moisture/density curve for the proposed base or sub-base course materials. Laboratory testing should be completed on samples taken from the plant site or proposed borrow.

Testing should be completed per the below schedule of testing. If, in the opinion of the City Engineer, the material being used on the jobsite is not at any time in conformance with approved laboratory mix designs or test reports, conformance tests shall be run. If this material does not meet the specifications, testing shall be paid for and the problem remedied at the expense of the Contractor.

During placement of aggregate base and/or sub-base, testing shall be completed on a regular basis to verify specification compliance. Required laboratory testing shall be completed on samples secured from the jobsite.

Table 6.2. Schedule of testing

Testing	Frequency
Gradation Analysis	1/Project Site or material change
Atterberg Limits (LL & PI)	1/Project Site or material change
Moisture/Density Curve	1/Project Site or material change
In-place density tests (AASHTO T-191, 205, 238) Includes thickness measurement	1/200 L.F. per lane

6.4 METHOD OF MEASUREMENT

Aggregate base course construction described herein will be measured as a separate pay item. Measurement shall be by the ton as evidenced by weight tickets for each truckload or fraction thereof.

6.5 BASIS OF PAYMENT

Base course material, when directed by the City Engineer, used as replacement for unsuitable material will be paid as “Subgrade Stabilization” and shall include all costs associated with the excavation, removal and disposal of unsuitable materials and all costs associated with furnishing, placing and compacting the aggregate base material. This payment shall be full compensation for all materials, tools, equipment, and labor necessary to complete the work under this section in accordance with the plans and specifications.

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ARTICLE 7

EARTHWORK

7.1 GENERAL

7.1.1 DESCRIPTION

The work to be performed under this section of the specifications shall consist of the excavation and disposal of all materials taken within the limits of work: construction of embankments, shaping and compaction of street sections, and other sections within the public rights-of-way and public easements as necessary to prepare the subgrade for subsequent construction, as specified herein, and as directed by the Engineer.

7.2 MATERIALS

7.2.1 EMBANKMENT MATERIALS

Embankment material shall consist of earth, sand, or gravel. Embankment materials shall be free from organic matter, frozen soil, ice, snow, mud or other deleterious material. All fill material shall be approved by the Engineer prior to placement.

7.3 CONSTRUCTION REQUIREMENTS

7.3.1 PERMITS

(a) Any excavation within the public right-of-way, including new subdivisions, shall require an excavation permit. This permit shall be obtained from the City of Pueblo Public Works Department office or online at www.pueblo.us/PLACE. Permit fees shall be in accordance with the latest fee schedule, adopted by the City Council. Permits will only be issued to Contractors licensed under the Provisions of Chapter 4, Title XII, of the Code of Ordinances to do excavation work, and who post bonding and insurance certificates as required by sections 12-6-10 and 12-6-11 of the Code of Ordinances. Permits (“no fee”) may be issues for publicly funded projects, state funded projects and/or the Board of Water Works and school districts; however, contractors working for either agency are not exempted from the permit fees.

(b) If the work involves removal and replacement of existing concrete features (curb & gutter, sidewalk, crosspan, etc.), then a concrete permit must be obtained from the City of Pueblo Public Works Department office. Permits will only be issued to licensed concrete contractors.

(c) Where pavement removal is associated with an excavation permit, the applicant shall pay all Pavement Impact Fees as required by Section 12-6-4.1 Pavement Impact Fee of the Pueblo Municipal Code of Ordinances, unless otherwise waived by the Director of Public Works.

7.3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph 7.3.17 FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill and unsatisfactory excavated material as specified in paragraph 7.3.5 DISPOSAL OF MATERIAL. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times.

7.3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on Construction Drawings. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, and in no case allow material to be deposited within 4′ from the edge of a ditch. Maintain excavations free of detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

7.3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose, disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

7.3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain the construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout the construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

7.3.2.4 Dewatering

Dewatering is subject to permitting by the State and shall be conducted according to an approved City of Pueblo dewatering plan through the Stormwater Utility Department.

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches are not permitted within 3′ of the foundation of any structure, except with written approval by the City Engineer. Control measures shall be established prior to the time that the excavation reaches the water level in order to maintain the integrity of the in-situ material. While the excavation is open, maintain the water level continuously, at least 2′ below the working level. Operate the dewatering system continuously until construction work below existing water levels is complete. In the event of minor ground water conditions being present, it is the contractor's responsibility to dewater prior to compaction.

7.3.2.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore the trench walls, cut them back to a stable slope, or provide an equivalent means of protection for employees who may be exposed to moving ground or a cave in, as determined by the Contractor's Safety Engineer or other competent person. Excavate trench walls that are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24″ plus pipe outside diameter (O.D.) for pipes of less than 24″ inside diameter, and do not exceed 36″ plus pipe outside diameter for sizes larger than 24″ inside diameter. Where recommended trench widths are exceeded, the Contractor will provide redesign, stronger pipe, or special installation procedures. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the City.

(a) Bottom Preparation. Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing.

(b) Removal of Unyielding Material. Where unyielding material is encountered in the bottom of the trench, remove such materials below the required grade and replace with suitable materials as provided in paragraph 7.3.12 FILLING, BACKFILLING AND COMPACTION.

(c) Removal of Unstable Material. Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph 7.3.12 FILLING, BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the City.

(d) Excavation for Appurtenances. Provide excavation for manholes, catch-basins, inlets, or similar structures sufficient to leave at least 12″ clear between the outer structure surfaces and the face of the excavation or support members. Clear rock or loose debris and cut to a firm surface either level, stepped, or serrated, as directed by the Engineer. Remove loose disintegrated rock and thin strata. When concrete or masonry is to be placed in the excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

(e) Jacking, Boring, and Tunneling. Unless otherwise indicated, provide excavation by open cut except the sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Engineer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections. The utility shall be at a cover depth of not less than 48″ unless approved by the City Engineer. Equipment to be used and method of installation shall be presented to the City Engineer for approval prior to any installation.

(f) Underground Utilities. The contractor is responsible for the movement of construction machinery and equipment over pipes and utilities during construction. Work performed adjacent to non-City utilities shall be in accordance with procedures outlined by the utility owner. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the excavation until approval for backfill is granted by the Engineer. Report damage to utility lines or subsurface construction to Engineer immediately.

(g) Asphalt Patch. If the distance from the lip line of the curb & gutter to the trench is less than 4′, all asphalt shall be removed from lip to the trench line. Asphalt shall have a sawcut edge 12″ on either side of the trench, and 2’ of CLSM directly beneath HMA.

7.3.2.6 Potholing Backfill Requirements

It is the responsibility of the contractor working within the public right-of-way to locate all utilities and telecommunication infrastructure prior to beginning any work. The locating of these utility infrastructures shall be performed by a licensed contractor and shall conform to the following requirements:

(a) Utility locate potholes shall not be placed in the wheel path of a travel lane or within 10-feet of a crosswalk. Potholes shall not be placed within the concrete accessible walking surfaces of curb ramps; if a pothole must be made in these surfaces, the contractor shall replace the entire concrete section or curb ramp.

(b) All utility locate potholes in the pavement section, sidewalk, or curb and gutter shall be cored with a circular coring saw with a maximum diameter of 12-inches. The plug shall

be carefully removed, without causing damage to the plug. The plug shall be marked and removed from the site until such time as it is returned in the core hole.

(c) Excavations for potholes shall be backfilled with CLSM in accordance with Article 4.2.3. Native material removed shall not be used to backfill the pothole.

(d) All plugs will be placed back in the corresponding hole in the original orientation at the time of restoration. The sides of the plugs shall be coated and the top sealed with permanent bonding agent.

(e) In the event the core plugs are damaged or cannot be used to fill the core hole, the asphalt shall be repaired using hot mix asphalt paving material from the City approved list. For concrete plugs, repairs shall be made using a 4,000-psi concrete mix.

(f) Core holes shall be cleaned and tacked prior to placing hot mix asphalt paving materials to the thickness of the existing asphalt.

(g) Initial locate potholes may be temporarily repaired, meeting all applicable safety requirements, for no more than 30 days unless additional time is authorized by the City in writing.

7.3.3 STRIPPING OF TOPSOIL

Where indicated or as directed, strip topsoil to a depth as prescribed in the construction plans or to a depth of 4″. Spread topsoil on areas already graded and prepared for topsoil, or transport and deposit it in stockpiles convenient to the areas that are to receive application of the topsoil later, or at locations indicated or specified by the Engineer. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2″ in diameter, and other materials that would interfere with planting and maintenance operations.

7.3.4 CLEARING AND GRUBBING

Always keep roads and walkways free of dirt and debris.

7.3.4.1 Clearing

Clearing consists of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing also includes the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Cut off flush with or below the original ground surface trees, stumps, roots, brush, and other vegetation in areas to be cleared, except such trees and vegetation that are indicated or directed to be left standing. Trim dead branches that are 1-1/2″ or more in diameter on trees designated to be left standing within the cleared areas and trim all branches to the heights indicated or directed. Neatly cut close to the bole of the tree or main branches, limbs and branches to be trimmed. Paint, with an approved tree-wound

paint, cuts more than 1-1/2″ in diameter.

(a) Tree Removal. Where indicated or directed, trees, and stumps that are designated as trees, shall be removed from areas outside those areas designated for clearing and grubbing. This works includes the felling of such trees and the removal of their stumps and roots. Dispose of trees as specified in this Section.

(b) Pruning. Prune/trim trees designated to be left standing within the cleared areas of dead branches 1-1/2″ or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1-1/4″ (should highlighted be different values) in diameter with an approved wound paint.

7.3.4.2 Grubbing

Grubbing consists of the removal and disposal of stumps, roots larger than 3″ in diameter, and matted roots from the designated grubbing areas. Remove material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, to a depth of no less than 18″ below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas, such as areas for buildings, and areas to be paved. Fill depressions from grubbing with suitable material and compact to make the surface conform with the original adjacent surface of the ground.

After clearing and grubbing is complete, the Contractor shall notify the Engineer for his approval of the clearing and grubbing prior to subsequent earthwork operations.

7.3.5 DISPOSAL OF MATERIALS

Dispose of excess materials in accordance with the approved solid waste management permit and all local and state requirements.

All wood or wood-like materials remaining from clearing, pruning or grubbing such as limbs, treetops, roots, stumps, logs, rotten wood, and other similar materials shall become the property of the Contractor and disposed of as specified. If stated on the drawings, the Contractor shall stockpile the stripped materials at a location designated by the Engineer for future use. When a site is not designated, the Contractor must dispose of the material off site.

7.3.6 BURNING

Burning to remove or dispose of materials will not be permitted.

7.3.7 REMOVAL OF STRUCTURES AND OBSTRUCTIONS

All existing physical features which conflict with the new construction shall be removed by the Contractor and disposed of properly at a site acceptable to the Engineer. These shall include but not be limited to; asphalt or concrete paving, base course, miscellaneous concrete flatwork, curb and gutter, sidewalk, foundations, culverts and headwalls, fences, abandoned utilities, and any other items not intended to remain. Where required to obtain a

straight line without jagged edges, the removal shall require sawcutting. Sawcuts shall be a minimum of one-fourth the thickness of material (or deeper) to obtain a clean straight face.

Unless specifically noted otherwise on the drawings or in the Special Provisions, sawcuts shall be considered subsidiary to the removal item and will not be paid for separately. If any items are removed or damaged by the Contractor beyond the limits of demolition shown on the drawings or as marked in the field, they shall be replaced by the Contractor at no expense to the City.

7.3.8 ROCK OR MAN-MADE OBSTRUCTION EXCAVATION

Rock will be defined as any naturally occurring or man-made material in such a form that it cannot be readily removed using the equivalent of a 165 hp/40,000 lb operating weight track-type tractor (bulldozer) with a ripper or a 188 hp/63,000 lb operating weight hydraulic excavator (crawler mounted backhoe) with “rock teeth” without a significant loss of production. It also includes boulders exceeding 1/2 CY in volume.

Whenever rock material is encountered in an excavation, the Contractor shall immediately notify the Engineer for field verification. The Engineer shall measure and document the limits of the rock prior to excavation. Any rock removed prior to notification will not be considered for payment.

Blasting for rock excavation will only be allowed with the written permission of the City Engineer and Fire Chief. The Contractor shall exercise the utmost care to protect the public from harm and to avoid property damage. Blasting shall be done by a State licensed blaster. The Contractor shall comply with all laws, ordinances, insurance, bonding, and applicable safety code requirements and regulations and shall be responsible for all damage caused by the blasting operations.

7.3.9 SHORING

Shoring shall be used for all excavations greater than 5′ in depth or where it is known that in-situ soils lack the stability to hold near vertical faces. Sloping back trench walls rather than shoring shall only be permitted when all the following conditions are met:

(a) The excavation is less than 20′ in depth,

(b) There are no adjacent structures, roads, or pavements that will affect the excavation,

(c) No equipment, stored material, or overlying material will affect the excavation,

(d) Vibration from equipment, traffic, or blasting will not affect the excavation,

(e) There will be no ground water problems,

(f) Surcharges will not affect the excavation, and

(g) Site conditions permit laying back the slopes of the excavation.

For excavations exceeding 20′ depth, submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting, to City Engineer 15 days prior to start of work. Finish shoring, including sheet piling, and install as necessary workers, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

7.3.10 GRADING AREAS

Divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when directed in writing by the Engineer. Place and grade stockpiles of satisfactory and unsatisfactory material as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. If the contractor fails to protect the stockpiles, and any material becomes unsatisfactory, the Contractor shall be required to remove and replace such material with satisfactory material from approved sources at no additional cost to the City.

7.3.11 SUBSURFACE PREPARATION

(a) General Requirements. Remove and replace unsatisfactory material with satisfactory materials, as directed by the Engineer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6″ before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1:4 vertical: horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6″, then pulverize and compact to the specified density. When the subgrade has been previously disturbed by construction activity, scarify the excavated or natural ground portion to a depth of 12″ and compact it as specified for the adjacent fill.

(b) Frozen Material. Do not place material on surfaces that are muddy, frozen, or contain frost.

(c) Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to 95% of optimum moisture.

7.3.12 FILLING, BACKFILLING AND COMPACTION

Place fill and backfill beneath and adjacent to any and all types of structures, in successive horizontal layers of loose material not more than 8″ in depth, or in loose layers not more than 5″ in depth when using hand-operated compaction equipment. Compact to at least 95% of a Standard Proctor laboratory maximum density, except as otherwise specified. Perform compaction in such a manner as to prevent wedging action or eccentric loading upon or against the structure. Moisture condition the fill and backfill material to within range of ±2% of optimum moisture content at the time of compaction. Prepare the ground surface on which backfill is to be placed and perform the compaction requirements for backfill

materials in conformance with the applicable portions of paragraphs *7.3.11 SUBSURFACE PREPARATION. The top 24" of utility trenching shall be filled with CLSM.* Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

If requested by the Contractor and/or Developer, and written permission is granted by the Director of Public Works, backfill for utility trenches may be consolidated using water induced settlement techniques (i.e., jetting/puddling/ponding). This method of trench backfill consolidation shall only be allowed in those special locations where a failure history exists for trenches using conventional engineered controlled fill. As a condition of permission to use jetting/puddling, the Contractor and/or Developer must agree in writing to provide a full and complete three (3) year warranty from the final acceptance date, that shall include repair of any surface amenities to the complete satisfaction of the City which may include a full width asphalt overlay if warranted.

Where backfill for utility trenches within the roadway section are consolidated using jetting/puddling, the moisture and density requirements within the trench compaction limits stated above shall not apply; however, the compaction limits for the finished roadway subgrade as outlined within this Article shall apply

Specific requirements and guidance for Sanitary Sewer and Storm Sewer can be found in ARTICLES 11 & 12.

7.3.13 EMBANKMENTS

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3″. Place the material in successive horizontal layers of loose material not more than 8″ in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise break up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 95% of the Standard Proctor laboratory maximum density. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph 7.3.15 SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

7.3.14 BORROW

When the quantity of suitable excavated material required for the embankment and subgrade preparation is greater than the quantity that can be obtained from the excavation in the project, the Contractor shall make-up the deficiency from borrow pits. The borrow material shall be obtained from sources selected by the Contractor subject to approval of the Engineer. All material shall be clean and free from any environmental hazards. The Contractor shall obtain the written permission from the owner to procure borrow material, shall pay all royalty and other charges involved and shall bear all the expenses of developing the sources, including right-of-way for hauling.

7.3.15 SUBGRADE PREPARATION

7.3.15.1 Proof Rolling

Unsuitable materials encountered in the subgrade, roadway, or embankment foundation that are determined to be detrimental to the roadway or embankment shall be removed to the depth and extents directed by the Engineer. The excavated area shall be backfilled to the finished graded section with approved material. Materials that contain organics, or those that cannot be dried or moisture conditioned, then compacted to the required density, shall be disposed of and shall not be reused as embankment fill. Materials that do not contain organics that can be dried, or moisture conditioned and compacted to the required density may be reused as embankment fill as approved by the Engineer.

Proof rolling with pneumatic tire equipment shall be performed using a minimum axle load of 18 kips per axle and at speeds between 2 to 6 mph. A weigh ticket from an approved scale shall be furnished by the Contractor to substantiate this weight.

The subgrade shall be proof rolled after the required compaction has been obtained and the subgrade has been shaped to the required cross section.

The proof roller shall be operated in a systematic manner so that a record may be readily kept of the area tested and the working time required for the testing. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Engineer, shall be ripped, scarified, dried or wetted as necessary, and recompacted to the requirements for density and moisture at the Contractor's expense. After re-compaction, these areas shall be proof rolled again and all failures again corrected at the Contractor's expense.

Upon approval of the proof rolling, the subbase, base course, or initial pavement course shall be placed within 48 hours. If the Contractor fails to place the subbase, base course, or initial pavement course within 48 hours or the condition of the subgrade changes due to weather or other conditions, proof rolling, and correction shall be performed again at the Contractor's expense.

7.3.15.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, discing, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace it with satisfactory excavated material or other approved material as directed. Excavate rock encountered in the cut section to a depth of 6″ below finished grade for the subgrade. Bring up low areas resulting from the removal of unsatisfactory material or excavation of rock to the required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1/2″ when tested with a 10′ straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05′ (3/5″) from the established grade and cross section.

7.3.15.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers,

vibratory compactors, or other approved equipment. Compact each layer of the embankment to at least 95% of a Standard Proctor laboratory maximum density.

7.3.16 EXCAVATION AND DIRECTIONAL BORING

No excavation or directional bore shall be made without prior notification of **ALL** utility companies and the City Public Works Department. All excavations shall be done by open cut from the surface by an approved method of trenchless technology.

In open cut excavations, all excavated material determined to be saturated shall be removed from the site daily.

The width of all trenches shall be kept to a minimum but provide adequate space for workers and safety devices. All Federal, State, and Local regulations pertaining to worker safety and health shall be followed.

In existing paved areas, all telecommunications and cablevision installations shall be done using directional boring unless otherwise approved by the City Engineer. See 7.3.2.5 (e) Trench Excavation Requirements for jacking, boring, and tunneling.

7.3.17 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1′ of the grades and elevations indicated except the degree of finish for subgrades specified in paragraph *7.3.15 SUBGRADE PREPARATION.* Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, top-soiled, or backfilled areas prior to acceptance of the work, and re-establish grades to the required elevations and slopes.

7.3.18 DUST PREVENTION

During construction and until final acceptance by the Engineer, the Contractor shall be responsible for controlling dust emissions in the construction area. No earthwork activities shall be performed when the wind speed exceeds 30 MPH. Whenever conditions exist that create airborne soil particles, at the Contractors expense, wet all disturbed areas as often as necessary to control the dust. All fill areas shall be compacted daily to the specified compaction. Any mud or dirt carried out onto paved surfaces shall be cleaned up daily and when directed by the Engineer. Failure by the Contractor to comply with the above may result in the Engineer issuing a stop-work order until the problems are corrected. Any dust control or clean-up done by City crews will be back charged to the Contractor.

When a building permit is issued for a structure and the site disturbance is greater than 1,000 square feet but less than or equal to 1 acre, a sign-off at Pueblo Regional Building Department is required. Areas of land disturbance greater than 1 acre but less than 25 acres require an **Emission Permit Application: Land Development/Construction**

Activity. The permits are available at the Pueblo City and County Health Department and are to be secured by the Contractor. Dust Prevention will not be paid for as a separate bid item.

7.3.19 EROSION AND SEDIMENT CONTROL

All construction activities disturbing more than 1 acre will require a *General Permit for Stormwater Discharges Associated With: Construction Activity* issued by the "Colorado Dept of Health, Water Quality Control Division, Permits and Enforcement Section". A Stormwater Management Plan (SWMP) is required as a condition of obtaining said permit. A copy of the Construction Activity Permit and the Stormwater Management Plan shall be submitted to the City of Pueblo Stormwater Management Department for review.

In addition to the SWMP, an erosion control plan stating the "Best Management Practices" (BMPS) to control erosion, sediment, and stormwater quality during and after the construction activity shall be submitted to the City of Pueblo for review. The erosion control plan shall be prepared in accordance with the provisions set forth in The City of Pueblo's *Storm Drainage Design Criteria and Drainage Policies Manual.*

Guidance for engineers, contractors, and developers in the selection, design, and maintenance of "Best Management Practices" to improve stormwater run-off quality can be found in Volume 3 of the *Urban Storm Drainage Criteria Manual* or most current edition.

7.3.20 QUALITY CONTROL

The contractor/developer shall provide the City Engineer with a soil classification, including a sieve analysis, plasticity index and a Proctor curve for each of the different soils to be encountered at the site. Copies of all field moisture/density testing performed by independent testing firms shall be submitted to the City. The cost for these tests shall be paid for by the Contractor for City projects.

Field testing for moisture content and dry density of the compacted soil will be done by a qualified geotechnical testing service. The frequency and location for the tests will be at the City's discretion. In general, a minimum of one test per foot of fill and/or along the bases of cuts and fills, will be taken for each 200′ of roadway being constructed.

Any areas where the field test indicates that the soil does not meet the moisture or density specification shall be wetted or dried as necessary and reworked until the requirements are satisfied.

7.4 METHOD OF MEASUREMENT

In general, excavation and embankment will not be measured or paid for as a separate bid item but will be considered subsidiary to a bid item such as hot bituminous pavement, sidewalk, driveway, curb & gutter, etc.

When paid for as a separate bid item, excavation and embankment will be measured by the volume of embankment in cubic yards as compacted in-place, based on the grading plans and cross sections. When paid for as a separate bid item, borrow shall be measured in cubic yards

in its original position using the method of end areas.

The measured volume for unsuitable material shall be the actual measurements of the excavation required to remove the objectionable material computed to cubic yards. When the unsuitable material is replaced by aggregate base course, the measurement shall be by the volume in cubic yards or by the ton and fraction thereof as evidenced by weight tickets for each truckload placed.

Rock excavation shall be measured as the actual volume in cubic yards of verified rock removed to the limits established by the Engineer.

7.5 BASIS OF PAYMENT

No payment will be made for excavation and/or embankment unless noted otherwise in the Special Provisions. When paid for, embankment will be paid for per cubic yard as compacted in place, with the material measured in accordance with *Section 7.4 METHOD OF MEASUREMENT.*

All costs associated with clearing and grubbing, removal of obstructions, excavation, embankment, compaction, grading and all related work shall be paid for as a separate bid item unless otherwise noted in the project's plans and/or special provisions.

Payment for excavation to remove unsuitable material beyond the compaction limits shall be full compensation for all costs associated with the complete removal and disposal including hauling and landfill fees if necessary, and the replacement with suitable material.

Rock excavation will include all costs associated with the removal and disposal of rock as defined in this Article. Payment for rock excavation will be for the actual costs of documented labor and equipment associated with rock removal plus a 15% mark-up. Rates for equipment shall not exceed the rental rates used by the Colorado Department of Transportation.

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ARTICLE 8

PAVEMENT

8.1 ASPHALT PAVEMENT

8.1.1 DESCRIPTION

Asphalt concrete pavement shall consist of asphalt cement uniformly mixed with well-graded aggregate and laid upon a prepared surface, along the lines and to the thickness as shown on the approved plans.

8.1.2 SUBMITTALS

Asphalt suppliers furnishing asphalt for placement within any City right-of-way shall provide to the City, once every two years, asphalt mix designs for asphalt intended for use within the City right-of-way.

8.1.3 MATERIALS

8.1.3.1 Asphalt Cement

Asphalt cement for the pavement mixture shall be SPG 58-28 (residential streets) or SPG 64-22 or SX PG 64-28 (arterial, collector, and industrial streets) unless otherwise specified in Article 2 - Special
Provisions and shall conform to the requirements of Table 2 of AASHTO M-226 (latest revision). The asphalt cement shall be homogeneous, free from water, and show no tendency to foam when heated to 347°F. The spot test shall be negative for all grades when conducted with a napthaxylene solvent containing not more than 10% xylene by volume.

Asphalt cement shall not be heated during the process of its manufacture, storage or during construction, to a temperature that will cause the formation of carbonized particles. After loading in a tank for transportation from the refinery to the purchaser at no time shall the temperature of the asphalt cement be raised above 375°F

Written Certification of Compliance with these specifications shall be provided to the City Engineer. The City Engineer may, in the absence of written certification, require that samples of the asphalt cement be delivered to an approved testing laboratory to ensure compliance with these specifications. Costs for testing shall be paid for by the Contractor/Developer.

8.1.3.2 Aggregate

The coarse and fine aggregates for hot bituminous pavement mixtures shall be graded and combined in such proportions that the resulting composite blend meets the grading requirements of the job mix formula. The job mix formula, with the aggregate tolerances, shall be within the master range set forth in the following table:

Table 8.1. Percent by weight passing square mesh sieves

Sieve Size	Grading SF	Grading ST	Grading SX	Grading S
1 1/2″				
1″				100
3/4″			100	90-100
1/2″		100	90-100	*
3/8″	100	90-100	*	*
No. 4	90-100	*	*	*
No. 8	*	28-58	28-58	23-49
No. 16	30-54			
No. 30	*	*	*	*
No. 200	2-12	2-10	2-10	2-8

The grading of the aggregate shall be Grading SX unless otherwise approved by the City Engineer.

Coarse aggregate (material retained on the No. 8 sieve) shall have a "Los Angeles Abrasion Test" (AASHTO T-96) percentage of wear not exceeding 45%. Fine aggregate (material passing the No. 8 sieve) shall have a maximum of 12% wear at five cycles in the sodium sulfate solution by the “Soundness Aggregate Test (AASHTO T-104). The aggregate shall be free from clay balls, organic matter, or other deleterious substances. At least 60% of the aggregate retained on the No. 4 sieve, and larger, shall have at least two fractured faces.

8.1.3.3 Asphalt-Aggregate Mixture (Job Mix Formula)

The Contractor/Developer shall furnish to the City Engineer a mix design, from an approved independent testing laboratory, of the hot bituminous pavement proposed for use. This job mix formula shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate, and a single temperature for the mixture at the discharge point at the plant. The job mix formula shall also give recommended temperatures for delivery and compaction. The job mix formula shall be determined a minimum of once per year, or when the asphalt supplier or aggregate characteristics change. **After the job mix formula has been established, all mixtures furnished for respective projects shall conform to within the following range of tolerances:**

Table 8.2. Percent by weight passing square mesh sieves

Maximum Size	± 0%
Passing No. 8 and larger sieves	± 8%
No. 8 to No. 200	± 6%
Passing No. 200	± 2%

Asphalt Content	± 0.5%
Discharge Mix Temperature	± 20°F

The job-mix formula may be changed by the City Engineer for either of the following reasons:

(a) Change in the job-mix formula will produce material of equal or better quality and will provide for more efficient pit operations.

(b) Change in the job-mix formula will produce material of equal or better quality and will result in a cost savings to the City through an adjustment in unit price.

Asphalt mix designs containing reclaimed asphalt pavement (RAP) materials greater than 20% will only be allowed with written approval from the City Engineer.

8.1.3.4 Quality Control

All samples and tests described herein shall be made in accordance with approved ASTM/AASHTO procedures. The Contractor/Developer shall provide for all testing laboratory services in connection with tests verifying conformance of proposed materials with project requirements. The City may also provide for testing laboratory services in connection with tests on materials after incorporation into the project.

Additional tests may be required at the direction of the Engineer. If additional tests are required, the financial burden will be borne by the Contractor/Developer if the testing results fail to meet minimum city specifications. If the testing results meet or exceed the city specifications the additional testing costs will be paid for by the requesting entity.

Table 8.3. Minimum Project Testing

Gradation	1/1,000 Tons or 1/project site
Asphalt Content	1/1,000 Tons or 1/project site
In-Place Density (including cores & comparative lab densities)	1/1,000 Tons or min. 1/500 L.F. of paving

8.1.4 MIXING PLANT

The requirements of this section shall be the same as Section 401.08 “Asphalt Mixing Plant” of the Standard Specifications for the Road and Bridge Construction, by the Colorado Department of Transportation, 1991 edition, or as amended. For plant inspection, the Engineer or approved laboratory shall have full right to enter at any time and conduct necessary tests to ensure compliance with these specifications.

8.1.5 CONSTRUCTION METHODS

8.1.5.1 Hauling Equipment

Trucks used for hauling the asphalt concrete mixture shall be equipped with tight, clean, smooth metal beds. When directed by the Engineer, the beds shall be coated with an oil or other approved material to prevent the mixture from adhering to the beds. Each load shall be covered

with canvas or other suitable material of sufficient size to protect it from inclement weather conditions.

8.1.5.2 Paving Machines

Unless otherwise permitted by the Engineer, the mixture shall be spread by means of a self-propelled laydown machine equipped with a screed or strike-off assembly and capable of spreading and finishing the asphalt concrete mixture to the line, grade, and crown as shown on the plans.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed. The mixture shall be dumped in the center of the hoppers, and care exercised to avoid overloading and spilling over of the mixture onto the base.

The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

When laying mixtures, the paver shall be capable of being operated at the necessary forward speeds for satisfactory placement. The operation of the paver shall be as such to attain continuous paving.

8.1.5.3 Rollers

Rollers shall be steel wheeled and/or pneumatic tire type and be in good condition, capable of reversing without backlash. They shall weigh not less than 8 tons. All rollers shall have a water system capable of keeping the wheels properly moistened to prevent adhesion of the mixture to the wheels.

8.1.5.4 Paving Surface

After the pavement base has been prepared, it shall be made ready for paving by clearing any loose material off as directed by the Engineer. Edges of all contact surfaces such as curb and gutter, manholes, cross pans and other structures shall be coated with the tack coat material as described herein before paving. When more than one lift is required, a tack coat shall be used between courses of pavement in accordance with Section 8.2 of these specifications as directed by the Engineer.

Asphalt pavement shall be a minimum of 2″ compacted thickness and shall be laid in one lift. If a thickness greater than 3″ is specified, separate courses shall be laid; each course shall be not less than 1-1/2″ compacted thickness, nor greater than 3″ compacted thickness or three times the nominal aggregate size.

For overlays the material shall be placed in a maximum compacted thickness of 3” and a minimum compacted thickness of twice the diameter of the aggregate unless otherwise directed by the Engineer.

8.1.5.5 Spreading, Finishing, and Compaction

The mixture shall be laid upon the approved base surface, spread, and struck off to the grade and elevation required. Pavers shall be used to distribute the mixture over the entire surface except where hand placing is necessary.

The longitudinal and transverse joints shall be made in a careful manner, well bonded and sealed. If directed, the joints shall be coated with tack coat material.

On the areas where the use of mechanical pavers cannot be used, the mixture shall be spread, raked and luted by hand tools. When material is shoveled, it shall be deposited by turning the shovel over above the desired area. No "slinging" of the shovel will be permitted. The hand placed material shall be smoothed and left higher than the machine laid material by about 1/4″ per inch of depth prior to rolling. If the machine laid mixture has been rolled, then the hand laid mixture shall be smoothed and left higher than the rolled pavement by about 1/4″ per inch depth. The majority of the raker's work shall be done with a lute rather than a tined rake.

Segregation of materials shall not be permitted. If segregation occurs, the spreading operation shall be immediately suspended until the cause is determined and corrected.

Placement of the mixture shall be as continuous as possible. All surface irregularities shall be adjusted by the addition or removal of mixture prior to rolling. After the mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling.

The surface shall be rolled at a specified breakdown temperature which shall be determined by the Contractor's foreman and the Engineer at the beginning of the job. The breakdown temperature shall be such that the required density is obtained without displacement, cracking, or shoving of the mixture. The rollers shall operate at a speed slow enough to avoid displacements or "crawl" of the mixture. Any displacement shall be immediately corrected by means suitable to the Engineer.

The number, weight, and type of rollers furnished shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The minimum number of rollers shall be two. Heavy equipment or rollers shall not be allowed to stand on freshly placed pavement.

Unless otherwise directed, rolling shall begin at the sides and proceed longitudinally parallel to the street centerline, each pass overlapping one-half the roller width, gradually progressing to the crown of the street. When paving adjacent to a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure.

Rolling shall be continued until all roller marks are eliminated and no further compression is possible. The minimum density of the compacted mixture shall be 95% of the maximum density required to provide laboratory compacted specimen made in the same proportions as the job mix formula (AASHTO T-209). However, if in the opinion of the Engineer a 95% density would prove to be detrimental to the asphalt cement pavement, then a density of 93% will be allowed. Along forms, curbs, manholes, and other places not accessible to rollers, the mixture shall be thoroughly compacted with hand tampers or with mechanical tampers. The joints between these structures shall be effectively sealed.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area.

8.1.5.6 Asphalt Temperature

The minimum and maximum delivery and discharge temperatures of the asphalt to the jobsite shall comply with CDOT Section 401.15 “Mixing”.

8.1.5.7 Joints

Transverse joints shall be formed by cutting through the previously laid course to expose the full depth of the course. A coat of tack coat material shall be used on contact surfaces of all joints just before additional mixture is placed.

8.1.5.8 Weather Limitations

Hot mix asphalt shall be placed only on properly prepared unfrozen surfaces that are free of water, snow, and ice. The hot mix shall be placed only when both the air and surface temperatures equal or exceed the temperatures specified in Table 8.4 and the City Engineer determines that the weather conditions permit the pavement to be properly placed and compacted. If the temperature falls below the minimum air or surface temperature, paving shall stop. The temperature of the hot mix asphalt delivered to the jobsite shall not be less than 235°F.

Table 8.4. Minimum Surface and Air Temperature

Compacted Layer Thickness	Minimum Surface and Air Temperature	
	Top Layer	Layers Below Top Layer
1-1/2″	60°F	50°F
2″ - <3″	50°F	40°F
Note: Air temperature is taken in the shade. Surface is defined as the existing base on that the new pavement is to be placed.		

8.1.5.9 Surface and Thickness Tolerances

The surface of the finished pavement shall be free from depressions exceeding 3/16″ in 10′, when tested with a straight-edge. All depressions exceeding the specified tolerances shall be corrected by removing defective work and replacing it with new material as directed. The surface shall be smooth and true to the established crown and grade. The required compacted thickness shall be as specified on the construction drawings.

8.1.6 RESTRICTION OF TRAFFIC

The Contractor shall arrange the work in such a manner as to cause a minimum of inconvenience to the traveling public and the abutting property owners. The Contractor shall submit to the Engineer a plan of this operation. In general, the Contractor shall be allowed to proceed as they propose. However, the Engineer retains the authority to order the Contractor to schedule the proposed operation in another manner if such a change in schedule is to the

benefit of the City and is beneficial to the interests of a good project. The Contractor shall arrange to have the haul vehicles operate over roads which will not be damaged by such vehicles. The Contractor shall provide all necessary Traffic Control in conformity with these provisions and specifications and with the ordinances and regulations of the *City of Pueblo, MUTCD and ARTICLE 9 –Traffic Control*; shall be paid for as specified in the contract documents.

8.1.7 PATCHING

For warranty work or patching repairs, the requirement is for the patching to be equal to the existing pavement thickness or Table 3-1 from the design criteria, whichever is greater.

Remove the backfill material to the depth and extent required in accordance with the drawings. Prepare the subsurface with the required base course, Flowfill, and/or Portland Cement concrete subsurface in accordance with the drawings. Depths and/or thickness of base course, Portland Cement concrete and/or asphalt pavement shall be as indicated on the drawings. The asphalt pavement shall conform to the *Pavement Design Criteria for the City of Pueblo* or equal to the existing pavement thickness, whichever is greater. The backfill and base coarse material shall be thoroughly compacted to the densities specified in *ARTICLE 6 – Aggregate Base Course* with a roller for large areas and smaller hand operated compactor for small patches.

Existing pavement may be rough cut initially in conjunction with trenching; however, a square, even, vertical saw cut shall be made in the existing asphalt pavement after placement of backfill and prior to pavement replacement. The square, vertical saw cut shall be made at a minimum of 1′ back from the trench line into good pavement (not required if using CLSM). Before placement of the new pavement, the cut edges shall be thoroughly cleaned, and a tack coat shall be uniformly and evenly applied to any vertical faces in accordance with Section 8.2. The patch shall be made with the placement of a hot asphalt cement and aggregate mixture as described in this Article. If asphalt cut is within 2′ of the lip of curb & gutter, a new asphalt patch shall extend to the lip of the curb & gutter in a continuous patch.

In large patches or whenever possible, a self-propelled paving machine shall be used to place the mixture. In small patches, the material shall be hand placed or placed with a spreader box without separation of the mixture. The material shall be placed to the grade and thickness required to allow for compaction after rolling. The hot mix material shall be compacted using the number, weight and type of rollers required to provide 95% of the maximum density of a laboratory compacted specimen made in the same proportions as the job mix formula (AASHTO T-209). Rolling shall continue until all roller marks are eliminated and no further compression is possible in the pavement. After rolling the surface, a straight-edge or a stringline shall be used to check the grade and riding quality of the patch.

8.1.8 RECYCLED PLANT MIX BITUMINOUS PAVEMENTS

Plant mixed bituminous pavements shall not contain more than 20% reclaimed asphalt pavement. The reclaimed asphalt pavement shall meet all the requirements for hot bituminous pavement, as contained herein.

8.1.8.1 Reclaimed Asphalt Pavement (RAP) Material

The Engineer may require the Contractor to maintain separate stockpiles for each type of RAP material. All processed material shall be free of foreign materials and segregation shall be minimized. The RAP material shall be processed, if needed, so that at least 95% passes through a 5/8″ sieve. Any RAP material that cannot be readily broken down in the mixing process and/or affects the paving operation, shall be processed prior to mixing with the virgin material.

8.1.8.2 Composition of Mixtures

Tests for cleanliness, abrasion loss, and the percentage of fractured faces will be made on representative samples of aggregate taken during production or from the stockpiles. Proportions of the reclaimed and virgin material shall be determined and proposed by the Contractor/Developer to meet the mix composition requirements of CDOT Standard Specifications for Road and Bridge Construction - Section 400. The maximum aggregate size contained in the combination of reclaimed asphalt pavement and new aggregate shall not exceed the maximum specified in the gradations presented in these specifications.

(a) **Job-Mix Formula.** See Section 8.1 of these specifications for approval of mix design. The cost for this testing shall be the responsibility of the Contractor/Developer.

(b) **Uniformity.** After the job-mix formula has been approved, the owner shall implement an acceptable quality control plan as detailed in Section 8.1.3.4 of these specifications. Deviations from the final approved design for bitumen content and gradation of aggregates shall not be greater than the tolerances listed in Section 8.1.3.3 of these specifications and shall be based on the extraction test.

(c) **Bituminous Mixing Plant**

(1) **Batch Plant.** The batch plant shall be modified to allow weighing the reclaimed asphalt pavement (RAP) material prior to incorporation into the pugmill. The cold feed bin, conveyor system and the special bin adjacent to the weigh box, if used, shall be designed to avoid segregation and stocking of the RAP material. The virgin aggregates shall be dried and heated to a suitable temperature so that on combining with the RAP material at ambient temperature the resulting mix temperature of successive loads may not be a cause for a rejection of the mix by the Engineer. The virgin aggregates shall be free of unburned fuel oil when delivered to the pugmill.

(2) **Drum Mixer Plant.** The drum mixer plant shall be modified to prevent direct contact of the RAP material with the burner flame and/or overheating of the RAP material in the process.

8.1.9 MEASUREMENT AND PAYMENT

Asphalt concrete pavement courses measured by the square yard will be paid for at the contract unit price per square . This payment shall be full compensation for all materials, tools, equipment, and labor necessary to complete the work under this section in accordance with the plans and these specifications. The payment shall be full compensation for all coats applied in accordance with these specifications.

If there is no pay item for asphalt concrete pavement of the type specified, it will not be measured and paid for separately but shall be included in the pay item most closely associated with the work. Payment will be made under:

Table 8.5. Payment Units

Pay Item	Pay Unit
Asphalt Pavement (Asphalt)	Ton
Asphalt Pavement (RAP) (Asphalt)	Ton
Asphalt Pavement (Patching) (Asphalt)	S.F.

8.2 ASPHALTIC TACK COAT

8.2.1 TACK COAT

8.2.1.1 Description

Existing asphalt surfaces receiving an asphalt overlay, existing vertical concrete surfaces (such as curb and gutter, crosspans and manholes) or between layers of multi-course asphaltic pavement structure, shall receive a tack coat consisting of an emulsified asphalt in accordance with these specifications at the locations shown on the plans, or as directed by the Engineer. Tack coat may be eliminated between successive lifts if the Contractor protects the surface from contamination.

8.2.1.2 Surface Preparation

Before applying the tack coat, surfaces shall be thoroughly cleaned of all dirt and other debris to ensure an adequate bond between the tack surface and asphaltic mat. The surface of the existing asphalt must be completely dry before placing tack coat.

8.2.1.3 Liquid Asphalt

The liquid asphalt used for the tack coat shall be an emulsified asphalt whose grade conforms to *CDOT Specifications Section 407* and shall satisfy the requirements of AASHTO M-140 or M-208. Other emulsified asphalts may be used with written permission of the Engineer.

8.2.1.4 Placing

The rate of application shall be 0.1 to 0.3 gallons per square yard and shall provide a uniform and even coating of the surface. The surface shall be allowed to cure to permit drying and setting of the tack coat prior to the paving operation.

8.2.2 MEASUREMENT AND PAYMENT

Payment for the tack coat shall be included in the unit price bid for asphalt pavement, and shall include all materials, tools, equipment, and labor necessary to complete the work in accordance with the plans and specifications, and as directed by the Engineer.

8.3 CONCRETE PAVEMENT

8.3.1 DESCRIPTION

The work performed under this section shall consist of the construction of a pavement composed of Portland cement concrete, with or without reinforcement as specified, on a prepared subgrade or base course in accordance with these specifications. The work performed will be in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or as established.

8.3.2 MATERIAL

8.3.2.1 General

The specifications presented in this section are performance oriented. The City's objective in setting forth these specifications is to achieve an acceptable quality of streets. All sources for the mined or manufactured materials must be annually approved by the City as having met the appropriate materials performance specifications. This approval is a condition of using those material sources for public improvement construction.

8.3.2.2 Procedure for Material Source Approval

On or before April 1st of each year, a material supplier for any City improvement shall supply written documentation and material test results from a qualified, independent materials testing laboratory that describes:

(a) Material(s) being tested to meet City specifications.

(b) The test procedures employed.

(c) The supplier(s) manufacturing, mining, or treating process by which the tested materials were created.

(d) The material test results.

(e) A signed statement by the material supplier that the materials produced and tested for this certification are truly representative of the materials to be provided for public improvements in the City during the coming 365-day period.

8.3.2.3 Portland Cement Concrete

This material shall consist of a mixture of fine and coarse aggregates, Portland cement, water and other materials or admixtures as required. Comply with ARTICLE 4 – Concrete and ARTICLE 5 – Structural Concrete.

8.3.3 CONSTRUCTION REQUIREMENTS

Materials shall be proportioned, handled, measured, batched, placed, finished and cured in accordance with Section 412 of the CDOT and ASTM C-94 (whichever is more stringent).

8.3.4 QUALITY CONTROL

All samples and tests described herein shall be made in accordance with approved ASTM/AASHTO procedures. The Contractor/Developer shall provide for all testing laboratory services in connection with tests verifying conformance of the proposed materials with the project requirements. The Contractor/Developer shall also provide for testing laboratory services in connection with tests on materials after incorporation into the project, on a first-time basis only. Additional tests may be required at the direction of the Engineer. If additional tests are required, the financial burden will be borne by the Contractor/Developer if the testing results fail to meet minimum city specifications. If the testing results meet or exceed the city specifications the additional testing costs will be paid for by the requesting entity.

During the placement of Portland cement concrete pavement, observation and testing shall be on a full-time basis. For each day of production, aggregate samples shall be obtained for gradation of both the coarse and fine aggregates.

Testing shall be done per ARTICLE 4 – Concrete.

Thickness of fresh concrete must be checked a minimum of every 300 linear feet each traffic lane according to the CDOT Section 412.24. Any noted deficient areas shall be corrected at that time. Surface smoothness shall be tested and corrected as necessary according to CDOT Section 412.16. The Engineer will decide when the pavement shall be opened to traffic; otherwise, the pavement shall not be opened to traffic until 14 days after the concrete was placed, or until the compressive strength of the laboratory cured 6 x 12 cylinders (ASTM C-39) averages 3000 psi. Prior to opening to traffic, the pavement shall also be cleaned, and all joints sealed.

8.3.5 FINAL ACCEPTANCE

All test results shall be submitted to and reviewed by the City. Provided all tests are acceptable, the pavement will be accepted. Should testing indicate unsatisfactory work, the removal, replacement, or grinding of the pavement or reduced payment will be required.

8.3.6 MEASUREMENT AND PAYMENT

The accepted quantities of concrete pavement will be paid for at the contract unit price per square yard. Price and payment shall be full compensation for furnishing and placing all materials, including any dowels, tie bars and joint material.

No additional payment over the unit contract bid price will be made for any pavement which has an average thickness in excess of that shown on the plans. Reinforcing steel, other than as mentioned above, will be measured and paid for in accordance with *ARTICLE 5 – Structural Concrete.*

8.4 PAVEMENT MARKING

See Article 9.3.5

8.5 CRACK SEALING

8.5.1 DESCRIPTION

This item shall consist of furnishing all materials, equipment, labor, cleaning and clean up, traffic control and incidental items necessary for the sealing or filling of cracks in asphalt pavements. The purpose of crack sealing and crack filling is to prevent the intrusion of water and other materials. Crack sealing shall be applicable for cracks 1/4” to 3/4” wide or as recommended by the manufacturer. Crack filler is recommended for cracks that are 1” or wider and/or exhibit edge deterioration.

Crack **Sealer** is used for working cracks, those cracks that have more than 1/4” seasonal movement. Both hot and cold materials are currently available for crack sealing. However, this specification is meant to only apply to hot applied materials.

Crack **Filler** should be used for non-working cracks. Non-working cracks are cracks that have annual movement less than 1/4”. Non-working crack types may include wide transverse cracks. If a crack exhibits edge deterioration it should be filled not sealed.

8.5.2 MATERIALS

Materials used for crack sealing shall meet or exceed the requirements of ASTM D 6690 for Type II Material as specified. Crack sealers are typically viscous at high temperatures and applied with a wand and any excess material is spread with a squeegee. The Contractor/Developer shall provide material certifications and manufacturer’s instructions for heating and application.

Materials used for crack filling shall be a premixed blend of polymer modified asphalt binder and wear resistant aggregates heated and mixed in a specialized melter. They are usually applied using a specialized device and smoothed with a heated float. The Contractor/Developer shall provide material certifications and manufacturer’s instructions for heating and application. Material shall be approved by the Engineer prior to application.

8.5.3 EQUIPMENT

Equipment shall be as specified by the sealant manufacturer and approved by the Engineer. All equipment and machinery shall be kept in good working order, free of leaks and properly muffled. All taxes, licenses and fees shall have been paid and proper licenses and permits shall be posted as required by law.

An oil jacketed type melting unit equipped with both agitation and recirculation systems shall be used to heat the sealant. Direct Fire Melters will not be allowed. The unit shall be equipped with separate thermometers for both the oil bath and the crack sealing material. Thermometers shall be calibrated on a weekly basis to ensure the proper heating of the material.

Materials shall be heated according to the manufacturer’s specifications. Fresh material shall not be added to material that was overheated to make it acceptable. Material that has been overheated shall be removed and discarded.

8.5.4 CONSTRUCTION REQUIREMENTS

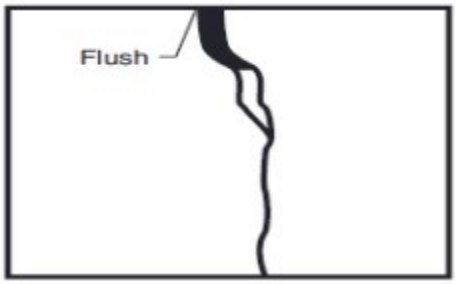
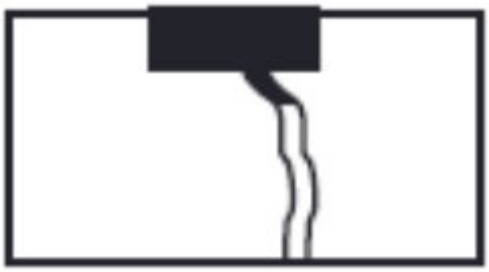
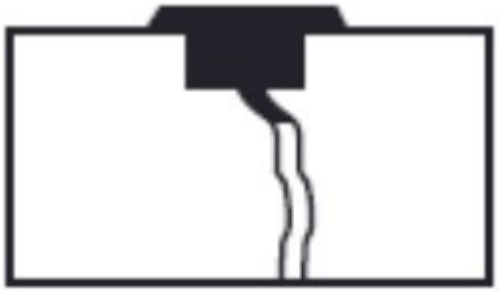
Prior to sealing, all loose material shall be blown out of cracks using a heat lance. Care shall be taken not to burn or scorch the pavement. Torches shall not be used. The Contractor/Developer shall ensure that blown debris shall not strike pedestrians, workers, or cause damage to vehicles and/or private property during cleaning and sealing operations. The Contractor/Developer shall clean debris from the streets and sidewalks as soon as the sealant has hardened sufficiently.

Cracks shall be free of moisture, residue from deicing chemicals, vegetation and loose matter prior to sealing. If sealant boils when applied, additional drying is required before sealing resumes.

Cracks shall be sealed to a minimum depth equal to two times the crack width or the full thickness of the pavement. Overband, if used, shall not exceed 3” in width and 1/8” in height above the pavement surface. Overband width is critical when sealing longitudinal cracks or in stopping zones to avoid creating hazards for cyclists or reducing tire friction.

When the Engineer specifies routing of cracks, routing shall precede blowing out cracks.

Engineer shall specify if routing is required prior to placement of Crack Seal and the type of sealant or filler application to be installed:

Flush Fill	**Routed and Flush Filled**
	
Overband (also referred to as “Band Aid”)	**Routed and Overband**
	

The finished level of Crack Seal or Crack Filler shall be flush to an 1/8” above the asphalt surface. Excess material shall be removed by the Contractor/Developer at the Contractor’s/Developer’s expense.

The Contractor/Developer shall apply the sealant material according to manufacturer’s recommendations with approval by the Engineer. The Contractor/Developer shall be solely

responsible for safety during all operations and making sure that the material is placed only in cracks with or without overband as shown above. Costs of damage, cleanup and/or material placed incorrectly shall be borne by the Contractor/Developer.

Traffic shall be kept off the sealant until it is sufficiently hard to not be picked up by traffic. Cooling of sealant can be accelerated using a commercial solution or water. Blotting with sand or paper is not acceptable.

QUALITY CONTROL REQUIREMENT CHECKLIST

Climatic Conditions:

- Surface temperature is at least 45°F and rising or per manufacturer's recommendations.
- No moisture, fog or dew is present.
- Early morning operations should be performed in direct sunlight.

Routing

- Cutting tips are sufficiently sharp to minimize spalling and cracking.
- Proper safety garments are worn (hard hat, reflective vest, long-sleeved shirt, pants, steel toed boots, safety goggles, and hearing protection).
- Guards and safety mechanisms on equipment work properly.
- Router follows cracks without difficulty.
- Routed cracks do not exhibit spalling.

Material Preparation

- Proper safety garments are worn (hard hat, reflective vest, long-sleeved shirt, pants, steel toed boots, safety goggles, and hearing protection).
- Heating oil in melter jacket is not fuming and level is adequate.
- Temperature gauge on the melter has been calibrated to the satisfaction of the AGENCY.
- If the temperature gauge has not been calibrated:
    - Measure sealant temperature with a thermometer.
    - Ensure that the reading on the thermometer is the same as the reading on the melter temperature gauge.
- Sealant is never heated above the manufacturer's recommended pouring temperature.
- Material safety data sheet (MSDS) is available on-site.

Cleaning of Cracks and Routs

- Proper safety garments are worn (hard hat, reflective vest, long-sleeved shirt, pants, steel toed boots, safety goggles, and hearing protection).
- A power sweeper or vacuum cleaner is being used to remove dirt and debris from the pavement surface.
- Compressor for high-pressure air provides at least 100 psi.
- Oil and moisture filters on compressor work properly.
- Temperature of the hot-air lance is below 930°F and the tip is 2 to 4 inches from the crack or rout.
- The cleanliness of the crack or rut is being checked every 30 minutes.
- The crack or rout is dry.
- No deicing chemical residue is present.

Sealant Application

- Hot-pour sealant is poured at the manufacturer's recommended temperature.
- The material is applied to the inside of the cracks.
- Ensure that sealant is placed up to the asphalt surface.
- There is sufficient sealant to allow for overband (if applicable). There are no bubbles due to moisture present.

Overbanding of Sealant (if applicable)

- Over band is not more than 3 inches wide.
- Over band is not more than 1/8 inch above the pavement surface.
- Over band is formed during, or immediately after, sealant application. Excess sealant is removed before hardening.

Sealant Protection

- Traffic is rerouted until sealant is set.

8.5.5 MEASUREMENT

Crack sealant shall be measured and paid by the ton completed in place and accepted. If routing is specified it will not be measured and paid separately but shall be included in the cost of material.

The Contractor/Developer shall measure and the inspector verify the following:

Before work starts each day:

- Amount of material in melter
- Number and weight of containers of material on site
- All containers are clearly marked with manufacturer's information.

At the end of work each day:

- Amount of material in melter.
- Number of containers of material not used.

The Contractor/Developer shall certify that material in the melter is per the specifications and has not been overheated.

Measurement will not begin before the Inspector arrives.

The inspector shall be given adequate notice if material is to be delivered during the workday and have the opportunity to verify quantity.

Counting or delivering boxes or lids shall not be an acceptable method of verifying quantity of material.

8.5.6 TESTING AND INSPECTION - GUIDANCE

When pulled vertically using a flattened sharp tipped ¼” rod bent at 90° the bond between the sealant and asphalt should be stronger than the sealant or the asphalt. Sealant or existing asphalt pavement should fail before the bond is broken.

ARTICLE 9

TRAFFIC CONTROL

9.1 GENERAL

9.1.1 DESCRIPTION

Traffic control shall conform to the ordinances and regulations of the City of Pueblo. Construction signing and marking shall conform to the Manual of Uniform Traffic Control Devices for Streets and Highways, U.S. Department of Transportation, latest edition and revisions thereto, City of Pueblo Supplement to MUTCD for Traffic Control for Street Construction Utility Work and Maintenance Operations and the State of Colorado Department of Highways Standard Specifications for Road and Bridge Construction (latest edition), Section 614, "Traffic Control Devices", and Section 713, "Traffic Control Materials".

9.2 SCOPE

This work shall consist of furnishing and maintaining in place all barricades, warning signs, lights, and other safety devices required to protect the work, divert traffic, and warn pedestrians of open excavations, unfilled trenches, and other areas or conditions which might be hazardous or dangerous during daylight or darkness.

Detours shall be maintained throughout the period of construction in such a manner as to provide the least amount of disruption to normal traffic flow.

The Contractor shall strictly adhere to all time limits and other restrictions as specified by the City Traffic Engineering Division in the approval of the Traffic Control Plan.

9.3 CONSTRUCTION STAGING

The contractor shall coordinate with the City Traffic Engineering Division to determine the site-specific staging and/or phasing requirements. The Contractor shall schedule the work in such a manner as to comply with the staging and/or phasing requirements contained in the contract documents.

9.4 CONSTRUCTION REQUIREMENTS

9.4.1 General

The Contractor shall maintain a 24 hour, 7 days a week (including weekends and holidays) emergency service to remove, install, relocate, and maintain warning devices. The Contractor shall furnish to the City the name and telephone number of the Traffic Control Supervisor responsible for emergency service.

In the event the Traffic Control Supervisor does not respond within 2 hours, or the City deems it necessary to call out other forces to accomplish emergency services, the Contractor will be held responsible for the cost of such emergency services, without reimbursement.

9.4.2 Existing Traffic Control Devices

Prior to commencing work in the vicinity of any existing Traffic Control Devices, the Contractor shall coordinate with the City Traffic Engineering Division in the removal of devices which need to be removed or relocated to accommodate the work. The Contractor shall store all devices in a safe and secure manner throughout the period of work and assume responsibility for temporary devices if necessary.

Upon completion of the work in the vicinity of the previously removed Traffic Control Devices, the Contractor shall reinstall the devices as directed by the City Traffic Engineering Division. Any Traffic Control Devices damaged during removal, relocation storage, or reinstallation shall be repaired or replaced by the Contractor, to City Standard, at their expense.

The removal relocations, storage, and reinstallation of existing devices shall not be paid for separately but shall be considered as incidental to the project.

9.4.3 Traffic Control Plans

9.4.3.1 Submittal

The Contractor shall submit Traffic Control Plans in drawing form for the review and approval by the City Traffic Engineering Division or project engineer. The Traffic Control Supervisor shall provide a night telephone number to assure 24-hour availability.

Traffic Control Plans for street closure and major detours of local and/or through traffic shall be submitted to the City Traffic Engineering Division or project engineer at least ten calendar days in advance of the closure or detouring.

Traffic Control Plans not involving closures or major detours shall be submitted a minimum of 72 hours (three City business days) prior to implementation.

No phase of construction shall commence until the Traffic Control Plan has been approved. Approved Traffic Control Plans shall not be revised without prior approval of the City Traffic Engineering Division or project engineer. Revisions shall be submitted in accordance with the above requirements.

9.4.3.2 Format

Traffic Control Plans shall include detailed signing, barricading, and traffic detouring information for each phase or stage of construction including as a minimum: type and number of devices, working hours, date(s), number and location of flaggers, and time restrictions, if any.

9.4.3.3 Copies of Approved Plan

Copies of the approved Traffic Control Plans shall be available on-site at all times; the Contractor shall provide copies to the Project Engineer, Traffic Engineer, and Project Inspector.

9.4.4 Traffic Control Supervisor

9.4.4.1 Qualifications

The Contractor shall designate a Traffic Control Supervisor who shall perform the Traffic Control Management and shall be responsible for maintaining all Traffic Control Devices in compliance with the approved Traffic Control Plan.

The Traffic Control Supervisor shall be either an employee of the Contractor, other than the Superintendent, or an employee of a firm which has a subcontract for the overall Traffic Control Management for the project. The Traffic Control Supervisor shall be currently certified by the American Traffic Safety Services Association or Colorado Contractors Association as a Worksite Traffic Control Supervisor.

The name and qualifications, including a current copy of the American Traffic Safety Services Association certification, of the Traffic Control Supervisor shall be submitted to the Engineer and the Engineer's approval shall be obtained prior to commencing construction. The Traffic Control Supervisor shall have an up-to-date copy of part VI of the Manual of Uniform Traffic Control Devices (and revisions thereof) and City of Pueblo Supplement to MUTCD for Traffic Control for Construction, Utility Work and Maintenance Operations available on-site at all times.

9.4.4.2 Duties

The Traffic Control Supervisor duties shall include, but not be limited to:

(a) Preparing, revising, and submitting the Traffic Control Plan as required.

(b) Direct supervision of project flaggers.

(c) Coordinating all Traffic Control operations, including those of subcontractors and suppliers.

(d) Coordinating project activities with appropriate police and fire control agencies.

(e) Maintaining a project Traffic Control diary which shall become a part of the project records.

(f) Inspecting Traffic Control Devices on every calendar day that Traffic Control Devices are in use. (By the Traffic Control Supervisor or his approved representative).

(g) Ensuring that Traffic Control Devices are functioning as required.

(h) Overseeing all requirements covered by the plans and specifications which contribute to the convenience, safety and orderly movement of traffic.

9.4.4.3 Working Hours

The Traffic Control Supervisor shall be available on a 24 hour per day basis. The Contractor shall make arrangements so that the Traffic Control Supervisor, or his representative as approved by the City, will be available on every working day and upon the request of the Engineer.

9.4.5 Flaggers/Off-Duty Police Officers

The City Traffic Engineering Division may require flaggers or off-duty police officers for traffic direction.

9.4.5.1 Qualifications

(a) All flagging personnel shall have completed the Colorado Department of Transportation minimum training requirements for flaggers within 2 years prior to beginning the project. Flaggers will be required to have a current American Traffic Safety Services Association certification card upon their person when engaged in any flagging operation.

(b) Off-duty police officers shall be active members of the City of Pueblo Police Department. The Contractor shall be responsible for contacting the Police Department and making all arrangements for off-duty officers.

9.4.6 Pedestrian Traffic Control

Throughout construction, the Contractor shall maintain pedestrian walkways along all public streets unless otherwise approved by the City Traffic Engineering Division. Said pedestrian walkways shall be a minimum of 4′ wide and shall be safely delineated. Pedestrian walkways shall be surfaced in a manner approved by the Engineer and shall be safely maintained and kept clear of all debris and obstructions (including tools, equipment, and materials). Unless otherwise specified in the contract documents, pedestrian walkways shall be supplied and maintained by the Contractor at his expense.

9.4.7 Access to Adjacent Properties

The Contractor shall notify all affected residents and/or property owners a minimum of 48-hours prior to restricting normal access from public streets to adjacent properties. The Contractor shall inform each resident and/or property owner of the nature of the access restriction, the approximate duration of the restriction, and the best alternate access route for that particular property. Any closure of access to or from adjacent property shall be submitted to the Engineer and approved prior to implementation.

9.4.8 Re-Opening to Traffic

Before reopening any portion of the public streets to vehicular traffic, the Contractor shall restore the pavement as required by the Plans and Specifications and in accordance with Section 19-5-2 of the City Code, "Excavations", shall reset all signs, and shall restore all pavement markings. If necessary, a temporary asphalt concrete surface and temporary pavement markings shall be installed by the Contractor at his expense.

Any signs damaged as a result of the Contractor's work shall be repaired or replaced to the requirements of the City Traffic Engineering Division; said repair or replacement shall be at the Contractor's expense.

9.5 MEASUREMENT AND PAYMENT

Work performed under this section shall be paid for by one of the following methods as specified in the contract documents:

9.5.1 Lump Sum Bid Item

When Traffic Control is shown as a Lump Sum item in the bid schedule, it shall be the responsibility of the Contractor to determine the Traffic Control needs for the project, including all devices and personnel, and to develop the bid amount accordingly. Payment shall be made as a percentage of the Traffic Control Lump Sum amount equal to the percent-complete-to-date of the balance of the total contract amount less any previous payments for Traffic Control. In no case shall the total amount paid for Traffic Control exceed the Lump Sum shown in the bid schedule.

9.5.2 Incidental to Project

When Traffic Control is not shown in the bid schedule as a separate item, the work shall not be paid for separately, but will be considered as incidental to the project.

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ARTICLE 10

LANDSCAPING

10.1 DESCRIPTION

This work shall consist of furnishing and spreading fertilizers; soil preparation; furnishing and drilling or sowing seed; mulching the seeded areas; and placing blue grass sod in accordance with these specifications, accepted horticultural practice, and in reasonably close conformity with the locations and details shown on the plans or as designated.

For seeding in areas that don't have sprinklers or aren't irrigated , spring seeding is allowed from the **spring thaw to June 15th** and fall seeding is allowed from **September 1st until consistent ground freeze**. Seeding will be allowed between June 15th and September 1st only with irrigation or sprinkler systems being utilized.

Seeding accomplished outside the time periods listed above will be allowed only when ordered by the Landscape Architect or City Engineer or when the Contractor's request is approved in writing. When requested by the Contractor, the Contractor must agree to perform the following work at no cost to the City: (1) apply the specified seed and mulch at a rate of not less than 25 percent greater per unit area than the rates specified for use within the time periods listed above, (2) re-seed, re-mulch, and repair areas which fail to produce vegetation.

When seeding is ordered by the Landscape Architect or City Engineer outside the time periods listed above, the cost of additional material will be paid for by the City. The Contractor will not be responsible for failure of the seeded area to produce vegetation due to reasons beyond the control of the Contractor.

Sod shall be placed between **September 15 to October 15 and March 1 to April 15** of the calendar year or as otherwise approved by the Engineer.

Mulching may be accomplished by the crimping method using straw or hay, by the hydraulic method using wood cellulose fiber mulch or by other acceptable mulching methods approved by the Landscape Architect or City Engineer.

10.2 MATERIALS

10.2.1 SEED

(1) All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net weight, origin, the percent of weed seed content, the guaranteed percentage of purity and germination, pounds of pure live seed (PLS) of each seed species and the total pounds of pure live seed in the container. All brands furnished shall be free from such noxious seeds as Russian or Canadian Thistle, European Bindweed, Johnson Grass and Leafy Spurge. The Contractor shall furnish to the Engineer a signed statement certifying that the seed furnished is from a lot that has been tested by a recognized laboratory for seed testing within six months prior to the date of delivery. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable.

(2) The mixture shall consist of the following species and rates. Planting rates are expressed in terms of pure live seed (PLS).

(3) Turf Mix:

Species	Variety	LBS. PLS per 1,000 SF Drilled	LBS. PLS per 1,000 SF Broadcast
Turf Type Tall Fescue (*Festuca spp*.)		9.0	18.0
Kentucky Bluegrass (*P. pratensis*)		1.0	2.0
		10# PLS	20# PLS

*NOTE: This is a sample seed mix, refer to project specifications.

(4) Native Mix:

Species	Variety	LBS. PLS per Acre Drilled	LBS. PLS per Acre Broadcast
Blue grama (B. gracilis)	Lovington	0.4	0.8
Little bluestem (*S. scoparium*)	Pastura	1.2	2.4
Sideoats grama (B. *curtipendula*)	Butte or Vaughn		
Prairie sandreed (*C. longifolia*)	Goshen	1.1	2.2
Sand dropseed (*S. cryptandrus*)		0.1	0.1
Green needlegrass (N. *viridula*)		1.7	3.4
Streambank wheatgrass (*E. lanceolatus)*	Sodar	2.0	4.0
		8.1# PLS	16.1# PLS

*NOTE: This is a sample seed mix, refer to project specifications.

(5) Seed and seed labels shall conform to all current State and Federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis. Computations for quantity of seed required are based on the percentage of purity and percent of germination.

(6) If seed available on the market does not meet the minimum purity and germination percentages specified, the Contractor must compensate for a lesser percentage of purity of germination by furnishing sufficient additional seed to equal the specified product. Product comparison shall be made on the basis of pure live seed in pounds based on the information received from each seed bag. The formula used for determining the quantity of pure live seed (PLS) shall be: Pounds of Seed x (Purity x Germination) = Pounds of Pure Live Seed (PLS).

(7) Areas that are not irrigated or not provided with sprinkling or watering systems shall be seeded prior to May 15th in the Spring **or** following September 30th in the Fall.

(8) Seeding shall follow closely behind tilling the fertilizer or as directed by the Landscape Architect or City Engineer, to make special seed bed preparation unnecessary. The Landscape Architect or City Engineer may establish test sections for adjusting the seeding equipment to assure the specified rate. The Engineer may order equipment readjustment at any time.

(9) All slopes 2:1 and flatter shall be seeded by mechanical power drawn drills followed by packer wheels or drag chains. Mechanical power drawn drills shall have depth bands set to maintain a planting depth of at least one-quarter inch and shall be set to space the rows not more than seven inches (7”) apart. Seed that is extremely small shall be sown from a separate hopper adjusted to the proper rate of application.

(10) Seed shall not be drilled or sown during windy weather or when the ground is frozen or otherwise untillable.

(11) If inspections indicate that strips wider than the specified space between the rows planted have been left or other areas skipped, the Landscape Architect of City Engineer may require immediate resowing of the seed in such areas at the Contractor's expense.

(12) Unless otherwise noted on the plans, the Contractor shall be responsible for maintaining and watering areas seeded for a period of seven weeks after the time of seeding.

(13) Areas in which there is not a satisfactory stand (no bare areas larger than six (6) square inches) at the expiration of this seven-week period shall be reseeded. Watering of the seeded areas shall be carefully done in such a manner to avoid standing water, surface wash, or scour. Areas seeded and so maintained shall be protected against damage by vehicle and pedestrian traffic by the use of barriers and appropriate warning signs.

10.2.2 SOD

(1) Superior sod grown from certified, high quality seed of known origin or from plantings of certified grass seeds or stolons. Contractor shall submit to the Landscape Architect or City Engineer the name of the turf farm(s).

(2) Sod shall be true to type, quality cultured turf grass grown from seed approved by the US Department of Agriculture, free of diseases, clover, stones, pests and debris, and containing maximum of 2% of other grass species than variety specified; no more than two (2) broadleaf weeds or ten (10) annual weeds of weedy grasses per 50 square yards. Thickness of sod soil portion 1" maximum.

(3) Inspect sod to –

a. Assure satisfactory genetic identity and purity.
b. Assure over-all high quality and freedom from noxious weeds or an excessive amount of other crop and weedy plants at time of harvest.

(4) Sod shall be composed of the following approved seed mixtures:

Sod Blend		Supplier
KBG/Texas Mix		Southwest Farms
VorTEX		Korby Sod LLC
Graff's Texas Blue Grass Blend		Graff's Turf Farms
G & S Select		Bigfoot Turf

*NOTE: Sample seed mixture, refer to project specifications.

10.2.3 FERTILIZERS

(1) Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis and shall be furnished to the Landscape Architect or City Engineer. Store fertilizer in a weatherproof place and in such a manner that it shall be kept dry and its effectiveness shall not be impaired.

(2) Superphosphate: Soluble mixture of treated minerals, 16% to 20% available phosphoric acid.

(3) Commercial Fertilizer: Complete fertilizer containing the following percentages of available plant nutrients:

a. Tablets: For trees and shrubs, provide tightly compressed long lasting, slow release tablets weighing 21 grams with an analysis of 20-10-5, and a potential acidity of not more than 5% by weight.
b. Granular: For lawns, vines, flowers and groundcovers, provide a granular, slow release, commercial fertilizer with NPK proportion of 3:1:2 with 120 days controlled release such as 24-4-10 50% duration and 3% iron.
c. Trees over 2" in caliber shall also receive: Install one 3 oz. packet of Mycor Tree Saver per one-inch diameter of tree trunk (i.e. 3 (3 oz.) packets per 3" B&B tree). Provide City Representative with 20 extra packets.

10.2.4 MULCH

(1) Hay mulch shall consist of clean field hay and shall not contain seeds of noxious weeds. Hay in such an advanced state of decomposition as to smother or retard the growth of grass will not be accepted. Hay which breaks in the crimping process rather than bending will not be accepted. The hay mulch shall have a minimum of 60% of the hay stubble 10" or longer upon completion of the crimping operation.

(2) After seeding has been completed, hay shall be uniformly applied at the rate of two tons per acre or as directed. It shall then be crimped in with a crimper or other approved equipment. After application, 60% of the crimped hay shall be 10" or longer. The Landscape Architect or City Engineer may order the employment of hand-crimping operations on such areas where excessive ground slopes or confined areas would

cause unsatisfactory crimping to result by mechanical methods. Crimping shall be performed on the contour. Crimping against the contour shall not be accepted.

(3) The seeded area shall be mulched and crimped within 24 hours after seeding. Areas not mulched and crimped within 24 hours after seeding must be reseeded with the specified seed mix at the Contractor's expense.

(4) Wood Cellulose Fiber for hydraulic mulching shall not contain any substance or factor which might inhibit germination or growth of grass seed. It shall be dyed an appropriate color to allow visual metering of its application. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fiber shall form a blotter-like ground cover which readily absorbs water and allows infiltration to the underlying soil. Weight specifications from suppliers, and for all applications, shall refer only to air dry weight of the fiber, a standard equivalent to 10 percent moisture. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and shall be marked by the manufacturer to show the air-dry weight content. Suppliers shall certify that laboratory and field testing of their product has been accomplished, and that it meets all the foregoing requirements pertaining to wood cellulose fiber mulch.

(5) Cellulose wood fiber mulch shall be added after the proportionate quantities of water and other approved materials have been placed in the slurry tank. All ingredients shall be mixed to form a homogeneous slurry. Using the color of the mulch as a metering agent, the operator shall spray apply the slurry mixture uniformly over the designated seeded areas. Areas not properly mulched or areas damaged due to the Contractor's negligence, shall be repaired and remulched in an acceptable manner at the Contractor's expense. Mulch removed by circumstances beyond the Contractor's control shall be repaired and remulched as ordered. Payment for this corrective work, when ordered, shall be at the contract prices.

10.2.5 IMPORTED BACKFILL

(1) Fertile, loose, friable sandy loam or natural agriculture topsoil typical of locality and capable of sustaining vigorous plant growth; it shall be clean and free from toxic minerals, noxious weeds, rocks larger than two inch (2”) in any dimension, and other objectionable materials.

(2) Borrow Topsoil shall be tested by an approved laboratory for both a “Soil Sample Test” and a ” Paste Test” and provide the results to the Owner. If necessary, to bring the soil into a satisfactory condition for growing the plant material, the Contractor shall provide proposed recommendations on how the Contractor will amend the soil, at the Contractor’s expense.

(3) Acidity/alkalinity range - pH 6.0 to 8.0.

10.2.6 TOP SOIL

(1) Contractor is to provide topsoil mix that conforms to the following tolerances.

(2) Topsoil for all tree, shrub, and ground cover planting beds shall consist of the following:

a. 60% to 70% sand
b. 10% max. silt.
c. 10% max. clay.
d. minimum 12% organic matter
e. pH value of 5.0 to 6.0.
f. Drainage minimum of 3/4 inch/hr.

(3) Acceptable amendments include:

a. Composted organic wood and manure-based product with a carbon to nitrogen ratio between 15:1 and 30:1, with a pH of 5 to 6, salt content below 6 mmhos/cm. Other materials such as mushroom compost, etc. may be considered for approval.
b. Amendments shall be free of objectionable odor, and free from all viable weed seeds, finely shredded to pass 70% through a 1/4 inch mesh screen.

(4) Topsoil for all lawn and meadow areas shall consist of the following:

a. 60% to 80% round sand.
b. 10% max. silt.
c. 10% max. clay.
d. minimum 5% organic matter
e. pH value of 5.0 to 6.0.
f. Drainage minimum of 3/4 inch/hr.

(5) Sand:

a. River pump or screened quarry sand with a particle size breakdown as follows. Provide sieve analysis for approval.

Coarse Sand	15%
Medium Sand	65%
Fine Sand	20%

(6) Compost:

a. Well-decomposed, 2-year-old, organic wood and manure based product with a carbon to nitrogen ratio between 15:1 and 30:1, with a pH of 5 to 6, and a salt content below 6 mmhos/cm. Other materials such as a decomposed mushroom or vegetable matter of natural occurrence may be considered for approval. Sheep and peat is acceptable.
b. Shredded particle minimum size: 1/4 – 1/2 inch.

(7) Fertilizer:

a. Analysis and application rates in accordance with soil analysis results - Slow release type sulphur coated urea complete with micronutrients.

(8) Peat Moss: (Mountain peat moss is not acceptable for use on the project)

a. Derived from partially decomposed fibrous or cellular stems and leaves of species of Sphagnum Mosses.
b. Elastic and homogenous, brown in color.
c. Free of wood and deleterious material that could prohibit growth.
d. Shredded particle minimum size: 1/4".

(9) Drain gravel: 3/4" diameter clean round drain rock, free of fines.

10.2.7 ORGANIC SOIL AMENDMENT

(1) Organic soil amendment shall be a composted organic wood and manure-based product with a carbon to nitrogen ratio between 15:1 and 30:1, with a pH of 5.0 to 6.0, and a salt content below 6 mmhos/cm. Other materials such as a decomposed mushroom or vegetable matter of natural occurrence may be considered for approval.

(2) The organic soil amendment shall be free of objectionable odor, and free from all viable weed seeds, finely shredded to pass 70% through a 1/8-inch mesh.

(3) Compost steer manure or peat moss, “Nutril Mulch”, “Soil Pep”, nitrogen stablilized organic amendment (not sawdust), or other material approved by Owner.

10.2.8 NATURAL ROCK MATERIALS

(1) Boulders shall be selected and approved by the Landscape Architect or City Engineer. Type, size, and color shall be as directed by the City. Boulders shall be approved prior to delivery to the site.

(2) Boulders shall be clean, uniform in type, and free of abrasions, marks, drill holes, and all other deleterious marks.

10.2.9 BRICK PAVERS

(1) Brick pavers shall conform to ASTM C-902, SW grade, Class SX, Type 1. Water absorption shall not exceed 4%.

(2) Size: Wire-cut pavers to the dimensions shown on the drawings.

(3) Color shall be as specified on the drawings or by the Landscape Architect or City Engineer.

(4) Friction Factor: Permanent wet leather/wet paver factor of 0.5 minimum.

10.2.10 IRRIGATION

(1) General Piping

a. Pressure Supply Lines (downstream of backflow prevention units) – Sch. 40 PVC.
b. Non-pressure Lines - Class 200 PVC
c. PVC Sleeving – Sch. 40 PVC.
d. Drip Tubing – Toro Dura-Pol EHD 1645 3/4" with .050 inch wall thickness.
e. Emitter Tubing - As recommended by emitter manufacturer.

(2) Plastic Pipe and Fittings:

a. Identification Markings. Identify all pipe with following indelible markings.

i. Manufacturer's name. ii. Nominal pipe size. iii. Schedule of class. iv. Pressure rating.
v. NSF (National Sanitation Foundation) seal of approval.
vi. Date of extrusion.

(3) Solvent Weld Pipe. Manufactured from virgin polyvinyl chloride (PVC) compound in accordance with ASTM D2241 and ASTM D1784; cell classification 12454-B, Type 1, Grade 1.

a. Fittings - Standard Schedule 40, injection molded PVC; complying with ASTM D1784 and D2466, cell classification 12454-B.

i. Threads. Injection molded type (where required).
ii. Tees and ells
1. Threaded Nipples - ASTM D2464, Schedule 80 with molded threads.
2. Joint Cement and Primer - Type as recommended by the manufacturer of the pipe and fittings.

(4) Drip Irrigation Systems

a. Drip Tubing - Manufactured of flexible vinyl chloride compound conforming to ASTM D1248, Type 1, Class C, Category 4, P14 and ASTM D3350 for PE 122111C.
b. Fittings - Type and make recommended by the tubing manufacturer.
c. Drip Valve Assembly – type and size to be shown on the design submittal.

i. PR Filter - Plastic construction with 200 mesh (75 micron) nylon screen and 1/2 inch blow-out assembly. Pressure reduction is included in the filter.
ii. Control Valve - 2 way, solenoid pilot operated type made of synthetic, non-corrosive material; diaphragm activated and slow closing. Include freely pivoted seat seal; retained (mounted) without attachment to diaphragm.
d. Emitters –Single port, pressure compensating, press on type by Rainbird.

i. Use 2 emitters per shrub, 4 per tree, and 1 per flower or groundcover. See plant list for specific emitter size.
ii. Gallons per hour (GPH) as indicated on plans.

e. Landscape Dripline Tubing – Dual outlet ports, pressure compensating in-line emitter tubing, Rainbird LD-09-12.

(5) Gate Valves - Gate Valves for 3/4 inch through 2-1/2 Inch Pipe - Brass construction; solid wedge, IPS threads, and non-rising stem with wheel operating handle.

(6) Quick Coupling Valves - Brass two-piece body designed for working pressure of 150 PSI; operable with quick coupler. Equip the quick coupler with a locking rubber cover. Key size and type will be as shown on Drawing.

(7) Valve Boxes:

a. Gate Valves, Quick Coupling Valves, Drain Valves, Drip Line Blow-out Stubs, and Wire Stub Box - Carson Brooks #910-10, box as detailed.
b. 3/4 inch through 2 inch Control Valves - Carson Brooks #1419-12 box.
c. Drip Valve Assemblies - Carson Brooks #1220-12 box.

(8) Electrical Control Wiring:

a. Two Wire System
b. Low Voltage
c. Electrical Control Wire - American Wire Gauge (AWG) No. 14 solid copper, Type UF cable, which is UL approved for direct underground burial, if required to operate system as designed.

d. If multiple controllers are utilized, and wire paths of different controllers cross each other, both common and control wires from each controller shall be different colors approved by Landscape Architect or City Engineer.
e. Control Wire connections and splices shall be made with 3M direct bury splice, Rain Bird Pentite connectors, or a similar dry splice method.
f. Low Voltage – (2-Wire Decoder Cable)
    i. Electrical Control Wire - UFUL approved, Paige Wire P7072D 12/2 (or as per manufactures requirements, direct burial copper wire to operate the system as designed.
    ii. If multiple controllers are utilized, refer to the wire routing plan for individual wire runs. Each controller shall have a wire path of a different color.
    Refer to plan for any additional cable color requirements.
    iii. If multiple controllers are utilized, each controller shall have its own 2-wire decoder cable run, controllers cannot be connected with the same 2-wire run.
    iv. Loop five (5) feet minimum of 2-wire cable into all valve boxes.
    v. Control Wire connections and splices shall be made with 3M DBY or King 600 DBY/R, or similar, direct bury splice, or as required by the controller manufacturer.

g. High Voltage – Type required by local codes and ordinances, of proper size to accommodate the needs of the equipment serviced.

(9) Automatic Controller – Size and type as shown on drawings and details. Unless otherwise specified use Weathertrak brand.

(10) Hydrometer Master Control Valve/Flowmeter - Size and type shown on drawings per each system design.

(11) Electric Control Valves - Size and type shown on drawings, having manual flow adjustment (except drip valves) and manual bleed nut.

(12) Sprinkler Heads - As indicated on drawings; Fabricated riser units in accordance with details on drawings – with riser nipples of the same size as riser openings in the sprinkler body.

(13) Backflow Preventer - Size and type indicated on drawings; Brass construction with 150 psi working pressure.

10.2.11 EROSION MATTING

(1) The erosion matting shall be installed as shown on the drawings and as directed by the Landscape Architect or City Engineer. An additional row of blanket (approximately four feet wide) may also be required in areas of steep slopes, drainage paths or south exposures. The area to be covered shall be properly prepared, fertilized, and seeded before the blanket is applied.

(2) The product data for the erosion matting must be submitted to and approved by the Landscape Architect or City Engineer prior to installation.

(3) When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. In ditches, the blankets shall be applied in the direction of the flow of the water, butted snugly at ends and sides and stapled. On slopes, the blankets shall be applied either horizontally or vertically to the slope. Ends and sides shall be butted snugly and stapled.

(4) When two or more lengths of fabric are required to be installed side-by-side or end to end to cover an area, a common row of staples will be used on adjoining blankets.

Minimum Blanket Dimensions	
Width	4 feet min.
Length	180 feet min.
Roll Sizes	80 square yards
Approx. Weight	78 pounds per roll
Staples	11 gauge wire, “U” shaped with 2-inch crown and legs 8-inches in length, min.

(5) The erosion matting will be applied uniformly and completely over the designated area. Use four staples across at the start of each roll. When blankets are placed along side of each other, outer staples shall be placed so as to catch the edge of each roll. Staple in row, in two-foot intervals along the entire length of the roll, and place two staples centered on the blanket, halfway between each row.

(6) As a waterway liner, staple at two-foot intervals throughout the length of the roll. When using two or more blankets side-by-side in a water course, do not put the seam (edges of adjoining blanket) at the center of the water flow. Offset approximately six (6) inches to one (1) foot.

(7) The Contractor shall also be responsible for maintaining and caring for the blankets for a seven-week period. All blankets that are disturbed during this period will be replaced and/or restapled by the Contractor.

10.2.12 GEOTEXTILE FABRIC

Geotextile Fabric (Filter Fabric): Shall be Warren's Terrabond, Mirascape, DuPont Typar 3301 or an approved substitution.

10.2.13 PLANT INSTALLATION ACCESSORIES AND MATERIALS

(1) Ground Anchors at Tree Pits: Duckbill-type galvanized steel ground anchor/rootball system and cable assembly 68 RBK kit (for trees up to 3'' caliper) or 88 RBK kit (for trees up to 6'' caliper), by Foresight Products, Inc., (800) 325-5360, or accepted equal. Install per manufacturer's recommendations. Do not install on dry, cracked, crumbling or broken rootballs.

(2) Guying and Staking Material:

a. Guying Wire: 12-gauge galvanized steel wire. Cotton/Nylon Webbing Straps with Grommets as provided by Jeffco Enterprises, Inc., 6340 W. 56th Avenue, Arvada, CO 80002, (303)422-2722, or accepted substitute.

i. Size for Trees Up to 3-1/2" Caliper: 16" x 3".
ii. Straps: Tensile strength of 1,000 lbs. and heat sealed on ends. iii. Strap Color: Brown or Tan. iv. Grommets: Securely attached and minimum 1/4 inch from end of strap.

b. Tree Wrapping: Tree wrapping material shall be of first quality, 4-inch wide, bituminous impregnated tape, corrugated or crepe paper; brown in color, specifically manufactured for tree wrapping. The Contractor shall submit a sample for the City's approval a minimum of 3 weeks prior to delivery on site.

10.2.14 PRE-EMERGENT HERBICIDE

At Contractor's option, pre-emergent herbicide: Shall be "Pendulam Aqua Cap" as manufactured by BASF or approved substitution. Apply per the manufacturer's recommendations for weed control.

10.2.15 EMERGENT HERBICIDE

For all turf planting beds, provide Roundup (Glyphosate) as manufactured by Monsanto Company or an approved equal.

10.2.16 INSECTICIDE AND FUNGICIDE

(1) For all tree plantings, provide systemic insecticide, Merit 75 WP or an approved equal.

a. Systemic insecticide such as Merit 75 WP Brand or an approved equal shall be applied per the manufacturer's recommendation at the time of planting of trees and approved by the Landscape Architect. .
b. Trees: Install 1.0 to 1.4 level teaspoons per one-inch of trunk diameter (D.B.H., At Breast Height) Minimum (1) teaspoon per 2" caliper tree.
c. Shrubs: Install .7 to 1.4 level teaspoons per one-foot of height of shrub.
d. Method of application shall be soil injection or soil drench as per manufacturer's recommendation. Apply treatment with water and keep moist for 7 to 10 days. Insecticide and fungicide shall be approved by the Landscape Architect.

10.2.17 LANDSCAPE EDGER

Landscape edger shall be "Permaloc Cleanline" or equal, 3/16" x 5 ½" aluminum edger with aluminum stakes or pins for supports, factory painted dark green

10.2.18 INTEGRAL COLORED CONCRETE

(1) Refer to *Article 4 - Non-Structural Concrete* for the concrete mix requirements.

(2) Integrally colored concrete used on the project shall be Davis Color, as noted on plans, and installed per the manufacturer's specifications.

(3) Coloring pigment added must be determined by weight. Visual bag splitting will not be permitted.

(4) All aggregate materials must be supplied from the same source and must be nonreactive.

(5) Cement for the entire project must be supplied from the same source and must be the same type and brand.

(6) For each specified color, maintain the same weight ratio pigment to cement for all colored concrete that is placed.

(7) The curing and sealing compound for colored concrete shall be of the same manufacturer as the colored admixture, for use with integrally colored concrete, and shall conform to
ASTMC309.

10.2.19 PLANT MATERIALS

(1) Plant Quality:

a. Plants: First class representatives of specified species or variety or cultivar, in healthy condition with normal well developed branch and root systems, free of

all objectionable features, and in conformance with the requirements of AJCH, American Standard for Nursery Stock and Colorado State Nursery Act. Where standards may conflict, use the standard that requires the highest quality of performance.

i. Trees: Fully branched in proportion to width and height. Minimum acceptable sizes of plants measured before pruning with branches in normal position, shall conform to the measurements as specified in the plant list furnished. ii. Larger plants than specified may be used, if accepted, at no additional cost to the Landscape Architect.
iii. All plants must be a minimum of 2 years old.

b. Source: Plants grown in Hardiness Zones 2, 3, 4 and 5 only will be accepted. Plants shall be nursery grown. The term "nursery grown" includes native plants and imported plants that have been growing in a nursery for a minimum of one growing season. Trees and shrubs shall have been root-pruned during their growing period in the nursery in accordance with standard nursery practice.

i. Hardiness Zones: Defined in U.S. Department of Agriculture publications. ii. Grower's Certificates: Required when doubt exists as to origin of plant material.

c. Insects, Pests and Plant Diseases:

i. Trees and Shrubs: Healthy, free of diseases, insects, eggs, larvae, or parasites of objectionable or damaging nature. ii. Coniferous Trees: Spray at time of installation and periodically as required to exclude infestation until final acceptance.

d. Inspection: Subject to inspection and acceptance. Landscape Architect reserves right to reject at any time or place prior to final project acceptance, any and all materials and plants which in the Landscape Architect's opinion fail to meet these specification requirements. Inspection is primarily for quality; however, other requirements are not waived when visual inspection results in acceptance. Plants may be inspected where growing, but inspection at the growth site shall not preclude the right of rejection at the site.
e. Promptly remove rejected plants and other materials from the site.

(2) Plants Required: Species (botanical name), size, manner in which to be furnished and quantity required to complete the planting, are listed and indicated by symbol on the drawings.

a. In the event discrepancies occur between the quantities of plants indicated in the schedule and indicated by symbol on the drawings, plant quantities indicated by symbol on the drawing shall govern.

(3) Procurement: The entering of a proposal and execution of a contract will be construed as evidence that the Contractor has made successful procurement arrangements for the plant materials as specified.

(4) Substitutions: Substitutions will not be accepted, except with written permission of the Landscape Architect.

10.2.20 ROOT BARRIER

Root Barrier shall be Century Root Barrier, CR2420, as supplied by:

Century Products USA 1144
North Grove St.
Anaheim, CA 92806
Ph. 714-632-7083
Fax: 714-632-5470 www.centuryrootbarrier.com

10.3 EXECUTION

10.3.1 FINISH GRADING AND SITE PREPARATION

Preparation:

(1) Protection

a. Trees, shrubs, and other plants

i. Protect the trunks and roots of existing trees on site, which are intended to remain. Do not use heavy equipment within branch spread or within the dripline of the tree. Interfering branches may be removed only at the direction of the Landscape Architect or City Engineer. Protect other plants and features which are to remain. Do not expose or damage existing shrub or tree roots.

(2) During preliminary grading, dig out weeds from planting areas by their roots and remove from the site.

(3) Remove from the site rocks larger than 2 inches in size and foreign matter such as building rubble, wire, cans, sticks, concrete, etc., before placing topsoil.

Performance:

(1) Add necessary amendments and redistribute existing topsoil stored on site and provide additional borrow backfill material to bring the surface to within 1” below the finish walk or curb grades.

(2) Direct surface drainage in the manner indicated on drawings by molding the surface to facilitate the natural run-off of water. Fill low spots and pockets with topsoil and grade to drain properly.

10.3.2 ROCKWORK

General:

(1) Construct rockwork with natural rock, at locations shown on the drawings or as directed by the Landscape Architect or City Engineer.

(2) During installation, rockwork that does not meet the quality of the submittals or samples as determined by the Landscape Architect or City Engineer shall be removed by the Contractor and replaced at no additional cost to the City. Field modifications recommended by the Contractor and approved by the Landscape Architect or City Engineer shall be made without additional cost to the City.

Preparation, Layout, and Installation:

(1) Field verify the location for boulder placement prior to installation of boulders.

(2) Handle, hoist, anchor and otherwise place boulders in the location approved by the Landscape Architect.

(3) Boulders shall be installed with no more than 2/3 of the boulder height above grade.

(4) Boulders shall be placed so that the top of the boulder is no higher than 24” above the adjacent street elevation.

(5) Contractor shall assume responsibility for the proper alignment of completed work.

Defective Materials and Rockwork:

(1) Rockwork shall be considered defective if not constructed or placed in accordance with the requirements of the drawings and specifications as determined by the Architect. Natural boulders must be held securely in a permanent position.

(2) Defective rockwork shall be removed and replaced with new rockwork acceptable to the Landscape Architect or City Engineer, unless suitable correction of defects may be otherwise accomplished as authorized by the Landscape Architect or City Engineer, and without additional cost to the City.

10.3.3 BRICK PAVING

Examination:

(1) Verification of Conditions:

a. Notify Landscape Architect or City Engineer of any discovered conflicts and discrepancies on the drawings with the conditions on the site which would prevent the proper installation of brick work.
b. Review the site and verify that other trades have completed their work and that the site is acceptable to receive the brick work.

Preparation:

(1) Controls: Lay brick work plumb and true to line and grade as indicated on the drawings and in accordance with approved standards for brick paving construction. Plan for proper drainage on brick paving surfaces.

(2) Brick on Sand Base: For subgrade preparation, see *Section 02310 - Finish Grading and Section 02315 - Excavating, Backfilling and Compacting.*

(3) Cleaning: Clean brick before setting by thoroughly scrubbing with fiber brushes and follow with a thorough drenching with clean water. Use only mild cleaning compounds containing no caustic or harsh fillers or abrasives.

(4) Setting Bed/Surface: Thoroughly clean up, sweep, brush down and scrub as required to generate an optimum substrate for accepting the brick work.

Installation of Brick on Sand Base:

(1) Soil Sterilant: Apply solution over the entire area to be paved in accordance with the manufacturer's latest printed instructions.

(2) Sand Base: Place the sand base to the thickness indicated on the drawings and thoroughly compact.

(3) Setting: Set pavers in the patterns indicated on the drawings.

(4) Joints: Set pavers snugly together with tight joints; tamp in place maintaining true line and grade.

(5) Sand Topping: Sweep the joints full of sand. Sweep excess sand from the bricks and remove.

Tolerances:

(1) Do not permit finished paving surfaces to vary more than 1/4 in. measured with a 10 ft. metal straightedge, except at grade changes.

(2) No "birdbaths" or other surface irregularities will be permitted. Correct irregularities to the satisfaction of the Landscape Architect.

10.3.4 IRRIGATION

(1) Coordination with City Parks Department - The contractor shall meet and coordinate with the appropriate City Parks Department supervisor for the new, replaced or repaired irrigation system as associated with this project and the plans and specifications.

(2) Landscape Plan Review and Coordination - Contractor will be held responsible for coordination between landscape and the irrigation system installation. Landscape

material locations shown on the Landscape Plan shall take precedence over the irrigation system equipment locations. If the irrigation equipment is installed in conflict with the landscape material locations shown on the Landscape Plan, the Contractor will be required to relocate the irrigation equipment, as necessary, at Contractor's expense.

(3) Static Pressure Verification - Contractor shall field verify the static pressure at the project site, prior to commencing work or ordering irrigation materials, and submit findings, in writing, to the Landscape Architect. If Contractor fails to verify static water pressure prior to commencing work or ordering irrigation materials, Contractor shall assume responsibility for all costs required to make the system operational and the costs required to replace any damaged landscape material. Damage shall include all required material costs, design costs and plant replacement costs.

(4) Inspection – Examine areas and conditions under which the Work of this Section is to be performed. Do not proceed with Work until unsatisfactory conditions have been corrected. Grading operations, with the exception of final grading, shall be completed and approved by the Landscape Architect or City Engineer before staking or installation of any irrigation system begins.

(5) Preparation

a. Staking shall Occur as Follows:

Mark, with powdered lime, the routing of the pressure supply line and flag heads for first few zones. Contact the Landscape Architect 48 hours in advance and request a review of the staking. Landscape Architect will advise installer as to the amount of staking to be prepared. Landscape Architect will review staking and direct changes if required. Review does not relieve the installer from coverage problems due to the improper placement of heads after staking.
ii. If the Project has significant topography, freeform planting beds, or other amenities that could require alteration of irrigation equipment layout as deemed necessary by the Landscape Architect, do not install irrigation equipment in these areas until the Landscape Architect has approved equipment staking.

b. Install sleeving under asphalt paving and concrete walks, prior to concreting and paving operations, to accommodate piping and wiring. Compact backfill around the sleeves to 95% Modified Proctor Density within 2% of optimum moisture content in accordance with ASTM D1557.

c. Trenching – Trench excavation shall follow, as much as possible, the layout shown on the drawing. Dig trenches straight and support the pipe continuously on the bottom of trench. The trench bottom shall be clean and smooth with all rock and organic debris removed.

d. Clearances

i. Piping 3 Inches and Larger - Make trenches of sufficient width (14 inches minimum) to properly assemble and position pipe in the

trench. The minimum clearance of piping 3 inches or larger shall be 5 inches horizontally on both sides of the trench. ii. Piping Smaller than 3 Inches - Trenches shall have a minimum width of 7 inches.
ii. Line Clearance - Provide not less than 6 inches of clearance between each line, and not less than 12 inches of clearance between the lines of other trades.

e. Pipe and Wire Depth:

iii. Pressure Supply Piping – 24 inches from top of pipe.
iv. PVC Sleeving – 18 inches from top of pipe. iii. Non-pressure Piping (rotor) - 18 inches from top of pipe. iv. Non-pressure Piping (pop-up) - 18 inches from top of pipe.
v. Control Wiring – Located below pressure main.
vi. Drip Tubing - 2 inches from top of pipe.
vii. Emitter Tubing (Micro-tubing) – Surface installation under fabric.

f. Boring will be permitted only where the pipe must pass under obstruction(s) which cannot be removed. In backfilling bore, the final density of backfill shall match that of the surrounding soil. It is acceptable to use sleeves of suitable diameter installed first by jacking or boring, and pipe laid through the sleeves. Observe the same precautions as though pipe were installed in an open trench.

g. Vibratory Plow - Non-pressure piping may be installed through the use of the vibratory plow method if the Landscape Architect determines soil conditions are satisfactory for this method of installation. Vibratory plowing does not relieve the installer of observing minimum pipe depths.

(6) Installation - Locate other equipment as near as possible to the locations designated. Deviations shall be reviewed by the Landscape Architect prior to installation.

a. PVC Piping

i. Snake the pipe in the trench as much as possible to allow for expansion and contraction.
ii. Do not install pipe when the air temperature is below 40° F.
iii. Place manual drain valves at low points and dead ends of pressure supply piping to ensure complete drainage of the system.
iv. When pipe laying is not in progress, or at end of each day, close pipe ends with a tight plug or cap.
v. Perform Work in accordance with good practices prevailing in piping trades.
1. Solvent Weld PVC Pipe - Lay pipe and make all plastic-to-plastic joints in accordance with the manufacturer's recommendations.

b. Drip Tubing

i. Make all fitting connections as per manufacturers recommendations.
ii. Use only a manufacturer provided or recommended hole punch when making penetrations in drip tubing for insert fittings. Use of any other

hole punch shall be cause for immediate removal and replacement of all installed drip tubing.

iii. Install drip line blow-out stubs at all dead ends of drip tubing.

c. Control Wiring

i. Low Voltage Wiring– 2-Wire:

1. Bury control wiring between the controller and electric valves in pressure supply line trenches, strung as close as possible to the main pipe lines with such wires to be consistently located below and to one side of the pipe, or in separate trenches.
2. Provide an expansion loop at every pressure pipe angle fitting, every electric control valve location (in valve box), and every 500 feet. Include a minimum of 5 feet in every valve box, 2 feet at every angle fitting and 10 feet at every future phase line.
3. Make all splices and E.C.V. connections using 3M DBY-6, King 600 DBR/Y connectors, or a similar dry splice method.
4. Install all control wire splices not occurring at the control valve in a separate splice valve box.
5. Install one decoder for each control valve or as indicated on the plans.
6. The wire paths shall be sized per distance requirements or as shown on the plan. The two-wire decoder cable shall be of the type indicated on the plans or per manufacturer recommendation.
7. The two-wire paths may be spliced, or “teed”, permitting extensions of the path in multiple directions. In general, the distance from the controller to the end of any one end of a “tee” or wire run shall not exceed the maximum for the gauge of any wire, even if the total of all wires exceeds that number. All wire splices must be made in a valve box with DBR-6 or equal direct-burial waterproof connectors.
8. Grounding of decoders and decoder wire shall occur every 500' of wire or every 8TH decoder and at all ends of 2-wire decoder cable run.
9. Grounding shall occur at right angles to the wire path and shall have an impedance of 10 Ohms or less, or shall meet the standards of the Earth Grounding Guidelines by ASIC.
10. Where the limits of work consist of narrow areas that make grounding rods installed at right angles a hardship, contractor shall utilize grounding plates installed at a minimum distance of 4’ offset and parallel to the wire path. Avoid installing grounding near other electrical equipment.

ii. High Voltage Wiring for Automatic Controller:

1. Provide 120 volt power connection to an automatic controller.
2. All electric work shall conform to local codes, ordinances, and authorities having jurisdiction. All high voltage electrical work shall be performed by a licensed electrician.

d. Automatic Controller

i. Install the controller in accordance with the manufacturer's instructions as detailed and where shown on the drawings. ii. Connect remote control valves to the controller in numerical sequence as shown on drawings.

ii. Final location of the controller shall be approved by the Landscape Architect prior to installation.

iii. Each controller shall have a dedicated, separate, ground wire and grounding rod as detailed.

iv. All above ground conduit shall be rigid galvanized with appropriate fittings. vi. All below ground conduit shall be schedule 40 PVC.

e. Hydrometer Master Control Valve/Flowmeter

i. Install the cross-handle 3 inches below finished grade as shown on drawings as detailed.

ii. When grouped together, allow at least 12 inches between valve box sides.

iii. Install each remote-control valve in a separate valve box.

iv. Install each individual valve box flush with the grade.

f. Isolation Control Valve

i. All control valves shall be a threaded union.

ii. A PVC ball valve shall be installed upstream of the control valve.

g. Electric Control Valves

i. All control valves shall be a threaded union.

ii. Install the cross-handle 3 inches below the finished grade where shown on the drawings as detailed.

iii. When grouped together, allow at least 12 inches between valve box sides.

iv. Install each remote-control valve in a separate valve box.

v. Install each individual valve box flush with grade.

h. Quick Coupling Valves

i. Install quick couplers on double swing-joint assemblies of Schedule 80 PVC pipe; plumb and flush to grade.

ii. Angled nipple relative to pressure supply line shall be no more than 45 degrees and no less than 10 degrees.

iii. Install quick coupling valves as detailed.

i. Drip Valve Assemblies

i. Install drip valve assembly as detailed.

j. Drip Emitters

i. Stake all surface emitters as detailed and with acceptable tubing stakes.

k. Drain Valves

i. Install manual drain valves at all low points in the pressure supply line as detailed.
ii. Provide a three cubic foot drainage sump for each drain valve installed.

l. Valve Boxes

i. Install one valve box for each type of valve installed as detailed.
ii. Valve box extensions are not acceptable except for master valves. Install gravel sump after compaction of all trenches.
iii. Place the final portion of gravel inside the valve box after the valve box is backfilled and compacted.
iv. Brand the controller letter and station number on the lid of each valve box. Letter and number size shall be no smaller than 1 inch and no greater in size than 1 1/2 inches. Depth of the branding shall be no more than 1/8 inch into the valve box lid.

m. Gate Valves

i. Install where shown on the drawings as detailed.

n. Sprinkler Heads

i. Install sprinkler heads where designated on the drawings or where staked. Set to finish grade as detailed.
ii. Spacing of heads shall not exceed the maximum length indicated on the drawing unless re-staked as directed by the Landscape Architect. In no case shall the spacing exceed the maximum recommended length by the manufacturer.
iii. Install heads on double swing-joint risers of schedule 40 PVC pipe. An angled nipple relative to a non-pressure line shall be no more than 45 degrees or less than 10 degrees.
iv. Adjust partial circle heads for proper coverage.
v. Adjust heads to the correct height after sod is installed.
vi. Plant placement shall not interfere with intended sprinkler head coverage, piping, or other equipment.
vii. The Landscape Architect may request nozzle changes or adjustments without additional cost to the Owner.

o. Backflow Preventer

i. Install where shown on the drawings as detailed.

p. Backfilling

i. Do not begin backfilling operations until the required system tests have been completed. Backfilling shall not be done in freezing weather except with the approval of the Landscape Architect. ii. Leave trenches slightly mounded to allow for settlement after backfilling is completed. Trenches shall be finish graded prior to walk-through of system by the Landscape Architect.

iii. Materials

1. Excavated material is generally considered satisfactory for backfill purposes.
2. Backfill material shall be free of rubbish, vegetable matter, frozen materials, and stones larger than 1 inch in any dimension.
3. Do not mix subsoil with topsoil.
4. Material not suitable for backfill shall be hauled away. Contractor shall be responsible for providing suitable backfill if the excavated material is unacceptable or not sufficient to meet the backfill, compaction, and final grade requirements.

iv. Do not leave trenches open for a period of more than 48 hours. Open excavations shall be protected in accordance with OSHA regulations.

v. Compact backfill to 90% maximum density, determined in accordance with ASTM D1557 utilizing the following methods:

1. Mechanical tamping.
2. Puddling or ponding. Puddling or ponding and/or jetting is prohibited within 20'-0" of building or foundation walls.

q. Piping Under Paving

i. Provide for a minimum cover of 18 inches between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete or concrete paving. ii. Piping located under areas where asphalt or concrete paving will be installed shall be bedded with sand (a layer 6" below pipe and 6" above pipe).

iii. Compact backfill material in 6" lifts at 90% maximum density determined in accordance with ASTM D1557 using manual or mechanical tamping devices.

iv. Set in place, cap, and pressure test all piping under paving, in presence of the Landscape Architect prior to backfilling and paving operations.

v. Piping under existing walks or concrete pavement shall be done by jacking, boring, or hydraulic driving, but where cutting or breaking of walks and/or concrete is necessary, it shall be done and replaced at no cost to the City. Obtain permission to cut or break walks and/or concrete from the Landscape Architect.

r. Water Supply and Point of Connection

i. Water supply shall be extended as shown from the water main.

(7) Field Quality Control

a. Flushing - After piping, risers, and valves are in place and connected, but prior to installation of sprinkler heads, quick coupler assemblies, and hose valves,

thoroughly flush the piping system under a full head of water pressure from dead end fittings. Maintain flushing for 5 minutes through the furthermost valves. Cap all risers after flushing.

b. Testing - Conduct tests in the presence of the Landscape Architect. Arrange for presence of the Landscape Architect 48 hours in advance of testing. Supply a hydrostatic pump and all other test equipment.

i. Prior to backfilling, and after the installation of all control valves, fill the pressure supply line with water, and pressurize to 40 PSI over the designated static pressure or 120 PSI, whichever is greater, for a period of 24 hours (24 hour test). ii. Leakage, Pressure Loss - Test is acceptable if no loss of pressure is evident during the test period.
ii. Leaks - Detect and repair leaks.
iii. Retest system until test pressure can be maintained for the duration of the test.
iv. Before final acceptance, pressure supply line shall remain under pressure for a period of 48 hours.

(8) Adjusting - Upon completion of installation, "fine-tune" the entire system by regulating valves, adjusting patterns and break-up arms, and setting pressure reducing valves at pro-per and similar pressure to provide optimum and efficient coverage. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings as much as possible. Heads of same type shall be operating at the same pressure +/- 7%.

a. If it is determined that irrigation adjustments will provide proper coverage, and improved water distribution as determined by the Landscape Architect, contractor shall make such adjustments prior to Final Acceptance, as directed, at no additional cost to the City. Adjustments may also include changes in nozzle sizes, degrees of arc, and control valve throttling.
b. All sprinkler heads shall be set perpendicular to the finish grade unless otherwise designated.
c. Areas which do not conform to designated operation requirements due to unauthorized changes or poor installation practices shall be immediately corrected at no additional cost to the City.

(9) Cleaning – Maintain a continuous cleaning operation throughout the duration of work. Dispose of, off-site at no additional cost to the City, all trash or debris generated by the installation of the irrigation system.

(10) Maintenance

a. Furnish the following maintenance items to the City prior to final Acceptance:

i. 2 Sets of special tools required for removing, disassembling, and adjusting each type of sprinkler head and valve supplied on this Project.
ii. 2 six foot valve keys for the operation of gate valves or stop and waste valves (if applicable).

iii. 2 keys for each automatic controller, if applicable. iv. 2 quick coupler keys and 2 matching hose swivels for each type of quick coupling valve installed, if applicable.

v. Aluminum drain valve keys of sufficient length for the operation of drain valves, if applicable.

10.3.5 PLANTING AND LANDSCAPING

(1) Layout and Identification

a. The Contractor shall locate and stake all tree and shrub locations and sod limits according to the locations shown on the plans. All planting locations shall be observed and approved by the Landscape Architect, prior to planting operations. The Contractor shall make minor modifications in planting locations as directed by the Landscape Architect.

(2) Plant Protection and Delivery

a. All plant material shall be protected from the time of digging, to the time of final acceptance from injury, excessive drying winds, improper ventilation, overwatering, freezing, high temperatures, or any other condition damaging to the plant. Any plants showing evidence of poor care, or which are molded, mildewed, wilted or dried out shall be rejected.

b. Plant material shall be planted on the day of delivery or shall be placed in a temporary nursery, kept moist, shaded and protected from sun and wind. If balled and burlapped plants are not planted on the day of delivery, they shall be heeled in immediately in the temporary nursery, kept moist and protected with damp soil, moss, or other acceptable material to the full height of the root ball.

c. Plants shall not be bound with wire or rope that may damage the bark or break branches. Plants shall be lifted and handled from bottom of ball or container. Plants with balls loose, cracked or broken, man-made, or completely dry or plants with trunks loose in the ball before or during planting operations shall not be accepted and shall be removed from the site at the Contractor’s expense within 24 hours.

(3) Excavation of Planting Pit

a. All plant pits shall be centered on the location stake, and shall be excavated in a saucer shape with sloped/tapered sides and a flat bottom. The depth of the plant pit shall be measured from the finish grade of the soil, not mulch, and as detailed in the contract drawings. The base of all soil balls shall be placed on compacted backfill fill.

b. Trees: The diameter of all tree pits shall be a minimum of 3X larger than the diameter of the ball or spread of the roots or as specified in the details drawings. Remove wire baskets, bundling cords, and the top 2/3 of burlap from the trees. Except for trees planted on slopes, the top surface of all root balls shall be slightly above the adjacent finished grade. It is important not to place tree balls too low.

c. Shrubs: The diameter of all shrub pits shall be a minimum of twice the diameter of the ball or spread of roots. The base of all soil balls shall be placed on compacted backfill fill.
d. Vines and Ground Covers and Perennials: The diameter of all vine and ground cover pits shall be 6 inches greater than the spread of roots.

(4) Plant Installation Procedures

a. Planting and Staking

i. Plants shall be set in the center of the pit on compacted backfill mix. Immediately after setting the plant in the pit, all non-biodegradable materials shall be completely removed from the ball and trunk, including but not limited to plastic, metal, wire, wood, cardboard, paper, fiber, treated burlap and twine. The only exception shall be the bottoms (not sides) of fiber pots. Plant handling shall be done in such a manner as not to injure the plant root system, disturb the soil ball or in any way cause harm or stress to the plant. If the root system of a container-grown plant has become container-bound, the roots shall be gently vertically cut on four sides of the root ball prior to planting.

ii. All plants shall be placed and kept plumb and straight as the pit is filled with backfill mix. Contractor shall adjust any plant which is not perfectly upright to a plumb position prior to acceptance. . Trees and shrubs in non-irrigated areas are to have saucers built around them at the drip lines.

iii. Plant trees and shrubs with the root flare of the plant at grade level. After placing the tree in the pit, the hole around the plant root system shall be halfway backfilled with specified mix and any large air pockets removed by hand with the blunt, handle end of a shovel or other such hand tool. If the Landscape Archirect determines that the ball is excessively dry, the Contractor shall then inset a deep watering device into the ball at a 45degree angle every 8 inches for one minute. The pit shall then be completely filled with backfill mix and tamped again with the shovel. No mechanical compaction shall be allowed. The pit shall then be watered by thoroughly saturating the backfill with water to a minimum of 3 feet surface dimension. No watering shall be done prior to this time. Watering shall be repeated once when all free water has disappeared. The second watering shall not be completed if the sub grade around the pit is already moist. After the second watering, the Contractor shall add the specified mulch. All surplus soil and debris shall be removed by the Contractor. The Contractor shall stake and guy trees immediately after planting according to standard detail.

iv. For trees in grass and planting beds, the Contractor shall drive stakes 3 feet vertically into firm soil outside the plant pit. The Contractor shall run wire up to the tree trunk and through the nylon webbing wrapped around the tree at approximately ½ the height of the tree. Webbing and wire attachment between stake and tree shall be

adjusted so the straps are under just enough tension to avoid visible sag in the lines. Rigid guying shall be accepted.

v. Contractor shall place stakes according to the construction detail. The Contractor shall return to the site and remove stakes one year from planting.

b. Wrapping, Pruning, and Mulching

i. Wrapping - Trees shall be wrapped with two layers of crinkled paper cemented together with bituminous material, four-inches (4") wide minimum, with a stretch factor of thirty-three percent (33%).
ii. Pruning – Prune only damaged or dead branches as directed by the Project Manager.
iii. Mulch –
1. Trees: Create a forty-eight-inch (48") diameter by four inch (4") high formed soil berm around the tree and fill with four-inch (4") deep specified wood mulch. Mulch shall be kept four to six inches (4"-6") away from tree trunk.
2. Shrubs: Mulch backfilled surfaces of pits, planting beds areas, and other areas indicated or as directed by the Project Manager. Apply four-inch (4") thick layer of mulch and finish level with adjacent finish grades. Do not place mulch against the stems of plants.

c. Backfill for Trees and Shrubs

i. Organic Soil Amendment: 33% volume of backfill.
ii. Planting Pit excavated material: 67% volume of backfill.
iii. Fertilizer Tablets: One 21 gram fertilizer tablet for each ½" of tree trunk caliper and one tablet per 12 inches height, or spread (whichever is greater) for each shrub.
iv. Insecticide: Trees: Install 1.0 to 1.4 level teaspoons per one-inch of trunk diameter (D.B.H., At Breast Height); Minimum (1) teaspoon per 2" caliper tree. Shrubs: Install 0.7 to 1.4 level teaspoons per one-foot of height of shrub.

(5) Soil Preparation

a. Soil preparation and mulching for all landscape areas, including seed and sod:

i. Finish grading shall be performed to fill in erosion gullies on slopes identified on the drawings. Where the use of large machinery is difficult, finished grade shall be worked with smaller equipment or by hand.
ii. Remove all rubble, stone and extraneous material over two (2) inches in diameter from the site.
iii. For planting areas, apply "Roundup" or equal short-term herbicide to inhibit unwanted plant growth prior to seeding. Apply in accordance with the manufacturer's recommendation for this purpose and sufficiently in advance of planting to avoid damage to new plants and grass.

iv. Spread approved topsoil and the following amendments to the areas specified on the drawings. Do not rototill or disk topsoil dressing. Seeding to follow within 7 days of topsoil application.
    1. Organic Soil Amendment: Apply 3 cubic yards per 1,000 square feet.
    2. Commercial Fertilizer (18-46-0): Apply 15 lbs of available Nitrogen per 1,000 square feet.
    3. Substantiate quantities with delivery tickets and empty manufacturer bags on a daily basis to the City.
v. Refine grade to restore smooth even finish grades and to ensure positive surface drainage. No planting shall take place until the Landscape Architect accepts the final grade.
vi. Moisten prepared sod/seed areas before planting if the soil is dry. Water thoroughly and allow the surface moisture to dry before planting lawns. Do not create a muddy soil condition.
vii. Apply mulch a minimum of 4-inches thick to completely cover the root ball.

(6) Installation of Landscape Edger

a. Contractor shall install edging per the manufacturer's recommendation. Edging shall be installed between all plant beds and sod/seeded area, or as shown on the plans.

(7) Schedule

a. No planting work shall take place during freezing or excessively windy or wet weather or when the ground conditions are, in the opinion of the Landscape Architect, not in a condition to be properly worked. Contractor shall include time in their schedule for work stoppage due to inclement weather or ground conditions. Inclement weather or ground conditions shall not be a cause for an extension of the project completion date unless written approval has been obtained from the City for extension of the project completion date.
b. No planting work shall commence until the adjacent site improvements, pavements, utility installation and finish grading are completed. The Contractor shall limit their use of heavy equipment on pavement and planted areas. In all cases, the Contractor shall be responsible for all damage to existing conditions.

(8) Maintenance, Acceptance, and Guarantee

a. Maintenance period shall begin immediately after each area is planted based on the following requirements:
    i. All plants shall be protected and maintained until final acceptance of all work. Maintenance shall include mowing, watering, weeding, cultivating, mulching, tightening and repairing of guys, adjusting metal edging, the removal of dead branches, resetting plants to proper grade or upright position, barricading the site and any other necessary operations. The Contractor shall provide all water and equipment necessary for maintenance throughout the duration of the contract.

Water is available at the planting site. After final acceptance, maintenance becomes the responsibility of the City.

ii. If during the duration of the contract period, but prior to final acceptance, any of the plants die or if they are, in the opinion of the Landscape Architect , in an unhealthy or unsightly condition or if they have lost their natural shape due to dead branches or excessive pruning of branches, then the Contractor shall replace the material at the Contractor's expense. This replacement shall be completed prior to final acceptance of the project and shall not void the two-year guarantee.

b. Prior to final acceptance, the Contractor shall furnish four (4) copies of written maintenance instructions to the City for the maintenance and care of all new planted areas for the initial three (3) years after installation. These instructions shall include but not be limited to staking, pruning, insect and disease control and fertilizing.

c. Guarantee:

i. For a period of two (2) years after final acceptance of all work and at no additional cost to the City, the Contractor shall replace any plants that have died, or are partially dead, if they are in the opinion of the Landscape Architect, in an unhealthy or unsightly condition, or they have lost their natural shape due to dead branches or excessive pruning of dead branches. Inadequate or improper maintenance by the City shall not be cause for replacement by the Contractor provided the Contractor shall have submitted throughout the guarantee period a bi-weekly letter of report to the City on improper or inadequate maintenance practices and recommended remedial actions. The Contractor shall apply a "new" two-year guarantee period to each replacement plant that is installed.

ii. The Contractor shall guarantee all plants to be true to name and to meet all conditions of these specifications. Any plant which is not true to name as indicated by leaf, flower form, or fruiting characteristics revealed within the guaranteed period shall be replaced by the Contractor at the Contractor's expense.

iii. All replacement planting under the guarantee provision shall be executed within one month of notice to replace such plants. Upon the Landscape Architect's written approval, the Contractor shall replace rejected plants at a later date, mutually agreed upon, provided that the Contractor removes all rejected plants within seven (7) days of the notice to replace such plants. If the rejected plants are not removed in seven (7) days, the City may at their option remove these plants and the cost of the removal shall be charged to the Contractor.

iv. Replacement planting is to be in accordance with the original specifications and its cost considered to be included in the bid price. All areas damaged by tree or shrub planting or replacement operations are to be fully restored to their original conditions as specified.

10.3.6 TOPSOIL

(1) Preparation of Subgrade

a. Grade soil, eliminating uneven areas and low spots, ensuring positive drainage towards the storm drains. Remove soil that is contaminated with toxic materials or has materials detrimental to growth such as asphalt, concrete and debris which has contaminated the subgrade soil. Dispose of removed materials legally off site. If hazardous materials are discovered notify the City immediately.

b. Cultivate the area subsoil that is to receive topsoil to a depth of 12" in all areas, especially in those areas where equipment used for hauling and spreading has compacted the soil. A no-till drill will execute the seeding of the site; A minimum disturbance is required. Additional cultivation of disturbed or compacted areas shall be at the cost of the contractor.

c. Remove surface debris, roots, vegetation, branches and stones in excess of 3” diameter.

(2) Spreading of Soil Mixture

a. Coordinate efforts with other trades. Under no circumstances is the soil mixture to be spread if other trades have not completed their work; this could contaminate or compact the installed soil mixture.

b. Spread soil after the Landscape Architect has inspected and provided written approval of the subgrade preparation in terms of slope, scarification and depths. Do not spread soil in a frozen or saturated condition.

c. Spread soil mixture with adequate moisture in uniform layers over the approved subgrade, where planting is indicated.

d. For soil application around trees see the appropriate section of this Article.

e. Manually spread soil mixture around trees, shrubs and obstacles.

(3) Finish Grading of Soil Mixture

a. Grade soil, eliminating uneven areas and low spots, ensuring positive drainage away from buildings and towards storm drainage systems. Remove soil contaminated with toxic materials. Remove surface debris, roots, vegetation, branches, stones in excess of 3" diameter, and all extraneous material. Dispose of the removed materials. Prepare loose, friable beds by means of hand cultivation and subsequent raking. Following planting, mulch planted shrub beds with a depth of 5" gravel mulch and rake smooth.

10.3.7 SODDING

(1) Delivery, Storage, & Handling:

a. Cut and lift sod by approved methods. Cut sod in pieces approximately ¾ to one inch thick and a **minimum 30” width**. Roll or fold sod so it may be lifted and handled without breaking or tearing and without the loss of soil.

b. Schedule deliveries to coincide with soil preparation and finish grading. Keep storage at the job site to a minimum without causing delays.

    i. Deliver, unload and store sod on pallets within 24 hours of being lifted.
    ii. Do not deliver small, irregular or broken pieces of sod.

c. Storage

    i. During Wet Weather - Allow sod to dry sufficiently to prevent tearing during lifting and handling. ii. During Dry Weather - Protect sod from drying, water as necessary to ensure its vitality and prevent excess loss of soil in handling. Sod that dries out will be rejected.

(2) Timing of Installation:

a. Placement of Sod:

    i. Irrigated & Non-Irrigated Areas: Within seven (7) calendar days after the completion and acceptance of finish grading in any area.
    ii. There shall be no installation of sod between October 1 and April 1.

(3) Installation:

a. Lay sod during the growing season. Sodding during the dry summer period, at freezing temperatures, or over frozen soil is not acceptable.
b. Lay sod within 36 hours of it being lifted.
c. Lay sod in rows with the joints staggered. Butt sections closely without overlapping or leaving gaps between the sections. Cut out irregular or thin sections with a sharp knife.
d. Lay sod flush with the adjoining, existing sodded surfaces. Top of sod dirt shall be 2 inches below the top of concrete walks or curbs.
e. After sodding has been completed, roll horizontal surface areas in two directions perpendicular to each other.
f. Repair and re-roll areas with depressions, lumps, or other irregularities.
g. Heavy rolling to correct irregularities in the grade will not be permitted.
h. Water the sodded areas immediately after laying to obtain moisture penetration through the sod into the top 4 inches of topsoil.
i. Replace damaged areas at no additional cost to the City.

(4) Field Quality Control:

a. Final Acceptance -

    i. Sodded areas will be accepted at final inspection if –
        1. Sodded areas are properly rolled and turf is established (including that the roots have begun to develop).
        2. Sod is free of bare and dead spots and without weeds.
        3. No surface soil is visible when the grass has been cut to a height of 2 inches.
        4. Sodded areas have been mowed a minimum of two times.

(5) Protection:

a. Protecting sodded areas against traffic or other use immediately after sodding is completed by placing adequate warning signs and barricades.
b. Provide adequate protection of the sodded areas against trespassing, erosion, and damage of any kind. Remove this protection after the Landscape Architect has accepted the sodded areas.

(6) Maintenance:

a. Contractor shall maintain sodded area (including mowing, watering, removing weeds and resodding) until the Landscape Architect has accepted the sodded areas.
b. The Contractor shall maintain the sodded area until the Landscape Architect has accepted the project.
c. The maintenance includes:

i. Managing the irrigation schedule and repairs to the irrigation system as necessary.
ii. Maintaining acceptable coverage on all newly sodded areas to guarantee growth of the plant materials.

iii. Mowing, if applicable, to control weed growth and recommended growing height per supplier. If weed population is high, then clippings shall be collected. Frequency of mowing shall be done per the supplier's recommendations to guarantee a healthy and flourishing turf condition. If mowing is not possible, then the Contractor may use herbicides as necessary once the vegetation is at a mature stand and can handle the chemicals. If herbicide does damage the vegetation stand, then the Contractor will be responsible for reestablishing the vegetation stand at the Contractor's expense.

iv. Trimming shall be done where mowers are unable to reach.

v. Clippings shall be removed from all hard surfaces.

vi. Provide suitable signage notifying the public to keep off the seeded areas, providing barricades as needed.

vii. Apply fertilizer as necessary, typically four (4) times per year.

10.3.8 Root Barrier

(1) Installation:

a. Cut the desired length of molded roll material and install directly alongside hardscapes where shown on the plan.
b. Connecting: Connect the ends by overlapping two 6" sections with the leading rib cut directly down the middle. Glue the surface using Century sealant or equal.

c. When necessary, use an umbrella Cement nail to tack up the barrier. This must be used above the grade or water line.
d. Vertically integrated and flared, molded 90 degree root deflecting ribs are always facing the root ball.
e. Always install the root barriers 2” above the grade to prevent root penetration above the barrier.
f. Backfill with existing native soil. If necessary for drainage, use gravel or crushed rock. Avoid backfill less than ¾” or greater than 1-1/2” in diameter. Finish to grade. Do not distort the barrier during installation.

10.3.9 Seeding

(1) Timing of Installation:

a. No-Till Drill Seeding:
    i. Irrigated Areas: Within fourteen (14) calendar days after the completion and acceptance of finish grading in any area.
    ii. There shall be no seeding between September 20 and April 15.

(2) Preparation:

a. Excessive Soil Moisture: Do not commence with the work of this section when soil moisture content is so great that excessive compaction will occur.
b. Inadequate Soil Moisture: Apply water, as necessary, to bring the soil to optimum moisture content for planting. Do not work soil when it is so dry that dust will form in the air or that clods will not break readily.
c. After Site Preparation is completed, Contractor shall receive approval from the Landscape Architect prior to seeding.

(3) Mulching:

a. Application:

i. All areas to be seeded shall be mulched.

ii. Mulch should be applied immediately prior to seeding. The period between mulching and seeding shall not exceed 2 weeks.

iii. Rate of mulching shall be 1.5 tons per acre.

iv. Mulch shall be uniformly applied over the designated area.

v. Mulch shall be anchored in place immediately following application (the same day as applied).

vi. A mulch crimper, with flat serrated disk shall be used to anchor the mulch into the soil. The disk shall be not less than ¼ inch in thickness, shall have dull edges, and shall be spaced not more than nine inches apart. The disk shall be of sufficient diameter to prevent the frame of the equipment from dragging the mulch over the mulched area with anchoring equipment. The depth of cut shall be 3 to 4 inches.

Care must be exercised so that a minimum amount of soil will be disturbed.

(4) Field Quality Control:

a. Tests: Samples of materials may be taken and tested for conformity to the Specifications at any time.
b. Rejected Materials: Remove rejected materials immediately from the site at the Contractor's expense. Contractor shall pay the costs of testing materials that are not meeting specifications.

(5) Acceptance:

a. Contractor shall reseed areas that are thin or weak 14 days after the initial seeding. Contractor shall reseed (and keep reseeding) until there are no bare, thin or weak spots greater than a 12 square inch area.
b. Maintenance – Contractor shall maintain the turf area (i.e. mowing, watering and reseeding) until the Landscape Architect has accepted the lawn. The maintenance period includes the time period from initial seeding to final acceptance of the turf area, which may be a different date than the acceptance of the other facilities in the project. It will be the responsibility of the Contractor to establish a stand of grass that has no bare, weak or thin spots greater than a 12 square inch area and to maintain the lawn until the stand of grass has been achieved. From that date, a one – year warranty will begin on the lawn area.

10.3.10 TREES AND PLANTS

(1) Quality Assurance

a. Regulatory Requirements:

i. Plants: In conformance with the requirements of AJCH (plant names shall meet standards of AJCH), American Standard for Nursery Stock and Colorado State Nursery Act.
ii. Comply with federal, state and local laws requiring inspection for plant disease and infestations. Inspection certificates required by state law shall accompany each shipment of plants and the certificates will be delivered to the City. Inspections are to be performed in the state of origin.

b. Transport plant materials in enclosed or tarped vehicles to minimize damage from the wind and sun. Contractor is to carefully schedule and monitor shipments to minimize shipping time and to ensure the careful handling of plants.
c. Shipments of plants will be carefully inspected by the Engineer and/or Landscape Architect at the site at the time of off-loading from trucks to verify compliance with the above shipping requirements.
d. Substitutions of plant materials will not be permitted unless authorized in writing by the Landscape Architect. If proof is submitted that the plant specified is not

obtainable, a proposal will be considered for using the nearest equivalent size or variety with corresponding adjustments of Contract Price.

e. Landscape Contractors shall provide two previous project examples of similar size and scope with their bids.
f. Personnel: Employ only qualified personnel familiar with the required work.

(2) Delivery, Storage, and Handling

a. Preparation:

i. Plants: Containerized or balled and burlapped (B & B) with limbs bound, properly pruned and prepared for shipping in accordance with accepted industry standards and in a manner that will not damage roots, branches, shape, short and long term health, and future development. Size of root ball shall be as defined in the American Standard for Nursery Stock (American Association of Nurserymen; latest edition). Keep root systems moist and protect plants from adverse conditions due to climate and transportation between the time they are dug and actual planting. Spray broad-leafed trees planted in full leaf with Protec 400W Anti-transpirant or accepted substitute prior to delivery to the site. Apply according to the manufacturer's directions.
ii. Identification: Grower's label affixed to the plant which contains data necessary to indicate conformance to the Specifications. Use durable waterproof labels with water resistant ink that will remain legible for at least 60 days.
iii. Notify the Landscape Architect a minimum of two weeks prior to the delivery of plant materials to site so that a pre-delivery inspection may be made. Alternatively, indicate a delivery schedule in advance so that plant material may be inspected upon arrival at the job site, whichever is more appropriate.

b. Delivery:

i. Deliver packaged material in sealed containers showing weight, analysis and the name of the manufacturer. Protect materials from deterioration during delivery and while stored at the site.
ii. ii. Deliver only plant materials that can be planted in one day unless adequate storage and watering facilities are available on the project site.
iii. Protect B & B root balls during shipping with proper handling techniques; cracked or crumbling root balls will be rejected. Protect root balls at the site by maintaining a thorough moisture; heel in with sawdust (or comparable material) if not planted within 24 hours of delivery. Maintain the root ball in a moist condition and do not allow it to dry out.
iv. Tree trunks are to be wrapped in burlap during transportation and installation to avoid trunk damage. Trees with trunk damage will be rejected.
v. Notify the Landscape Architect or City Engineer of the delivery schedule a minimum of 48 hours in advance so that plant material can be inspected prior to unloading from trucks.
vi. Remove rejected material immediately from site.

vii. Do not lift, move, adjust to plumb, or otherwise manipulate plants by the trunk or stems.

c. Handling:

i. Do not drop plants. Do not lift plants by the trunk, stems or foliage.
1. Ball of Plant: Natural, not made. Handle plant by the root ball at all times. Plants will not be accepted if the root ball is broken or the trunk is loose in the ball.

ii. Protect plants from drying out or other injury.
1. Prune minor, broken and damaged roots before planting. Treat minor wounds immediately to prevent disease and insect infestation.
2. Major damage will be cause for rejection as determined by the Landscape Architect.

(3) Maintenance

a. General: Maintain trees, shrubs and ground cover in a healthy vigorous state until final acceptance of the entire project. Provide all supervision, labor, material, equipment and transportation required to maintain plants under the requirements of this section.
b. Materials: Conform to the Specifications or otherwise be acceptable to the Landscape Architect.
c. Replacement: Replace and replant plants damaged by the Contractor's operations and negligence, and according to *WARRANTY* of this section.
d. Watering: Water deeply (8-10") when soil moisture is below optimum level for the best plant growth. Water woody plants in any winter month that snow or rain does not provide at least 1" of precipitation.
e. Wrapping: After all trees have been inspected and accepted by the Landscape Architect, wrap deciduous tree trunks with standard nursery crepe wrap material from the ground level to the first limb after pruning. Tape securely at the top and bottom. Remove wrapping for spring and summer and replace it in the fall.
f. Staking and Guying: Inspect at least two (2) times per year (spring and fall) and assure conformance with the following:

i. Webbing strap in good condition.
ii. Trunks and branches are not girdled by the webbing strap.
iii. iii. Guy wires secure but not taut.
iv. iv. Stakes secure.
v. Trees plumb.

g. Pruning: Prune only damaged or dead branches in accordance with the Specifications in this section.
h. Mulching: Supplement mulch around trees in accordance with the Specifications in this section.
i. Weed Control: As required, use selective herbicides approved by the Landscape Architect.
j. Insect and Disease Control: As required, use insecticides and fungicides approved by the Landscape Architect.

(4) Plant Protection and Delivery

a. All plant material shall be protected, from the time of digging to the time of final acceptance, from injury, excessive drying or winds, improper ventilation, overwatering, freezing, high temperatures, or any other condition damaging to the plant. Any plants showing evidence of poor care, or which are molded, mildewed, wilted or dried out shall be rejected.
b. Plant materials shall be planted on the day of delivery or shall be placed in a temporary nursery, kept moist, shaded and protected from the sun and wind. If balled and burlapped plants are not planted on the day of delivery, they shall be heeled in immediately in the temporary nursery, kept moist and protected with damp soil, moss, or other acceptable material.
c. Plants shall not be bound with wire or rope that may damage the bark or break branches. Plants shall be lifted and handled from the bottom of the root ball or container. Plants with root balls that are loose, cracked, broken, man-made, or completely dry, or plants with trunks loose in the ball before or during planting operations shall not be accepted and shall be removed from the site at the Contractor's expense within 24 hours.

(5) Preparation

a. Plants: Do not begin planting until deficiencies are corrected or plants replaced.
b. Protection:
    i. Be responsible for the proper repair of underground pipe, electric wiring, or other subsurface improvements damaged by operations under this Section.
    ii. Be responsible for proper repair to walls, pavements and any other structural surfaces damaged by the operations under this Section.
    iii. Pay for repairs made by contractors designated by the City.
    iv. Be responsible for replacement of vandalized materials not yet installed. Report all cases of vandalism promptly to the City .

(6) Excavation of Planting Pit

a. All plant pits shall be centered on the location stake and shall be excavated in a saucer shape with vertical sides and a flat bottom. The depth of the plant pit shall be measured from the finished grade of the soil, not mulch. The base of all soil balls shall be placed on compacted backfill fill.
b. Trees: The diameter of all tree pits shall be a minimum of 3X larger than the diameter of the ball or spread of the roots. There shall be a minimum 3" clearance between the bottom of the root ball and the plant pit for balled and burlapped stock. Trees are to have wire baskets, bundling cords, and the top 2/3 of the burlap removed. Except for trees planted on slopes, the top surface of all root balls shall be flush with the adjacent planting beds or with the subgrade below the sod. It is important not to place tree balls too low.
c. Shrubs: The diameter of all shrub pits shall be twice the diameter of the ball or spread of the roots. There shall be a minimum 6” clearance between the bottom of the root ball and the plant pit. The base of all root balls shall be placed on compacted backfill fill.

d. Vines and Ground Covers and Perennials: The diameter of all vine and ground cover pits shall be 6 inches greater than the spread of the roots.

(7) Planting

a. General:

i. Center trees in the trench as dimensioned on drawings.
ii. Face for best effect.
iii. Set the plant plumb and hold rigidly in position until the soil has been lightly tamped around the ball or container roots.

b. Balled and Burlapped Plants (B & B):

i. Plants shall be set in the center of the pit on compacted backfill mix. Immediately after setting in the pit, all non-biodegradable materials shall be completely removed from the ball and trunk, including but not limited to plastic, metal, wire, wood, cardboard, paper, fiber, treated burlap and twine. The only exception shall be that the bottom (not sides) of fiber pots and plant handling shall be done in such a manner so as not to injure the plant root system, disturb the soil ball or in any way cause harm or stress to the plant. If the root system of a container-grown plant has become container-bound, the roots shall be gently, vertically cut on four sides of the root ball prior to planting.
ii. ii. Plant trees and shrubs with the root flare of the plant at grade level. All plants shall be placed and kept plumb and straight as the pit is filled with backfill mix. Any plant which is not perfectly upright and plumb prior to final acceptance shall be adjusted by the Contractor to a plumb position. Trees and shrubs in non-irrigated areas are to have saucers built around them at the drip line.
iii. After placing the plant in the pit, the hole around the plant root system shall be halfway backfilled with the specified mix and any large air pockets removed by hand with the blunt, handle end of a shovel or other such hand tool. If the Landscape Architect determines that the ball is excessively dry, the Contractor shall then inset a deep watering device into the ball at a 45 degree angle every 8 inches for one minute. The pit shall then be completely filled with backfill mix and tamped again with the shovel. No mechanical compaction shall be allowed. The pit shall then be watered by thoroughly saturating the backfill with water to a minimum of 3 feet. No watering shall be done prior to this time. Watering shall be repeated once, when all free water has disappeared. This second watering shall not be completed if the subgrade around the pit is already moist. After watering, the Contractor shall add the necessary soil to establish the finish grade level before adding specified mulch. All surplus soil and debris shall be removed by the Contractor. The Contractor shall stake and guy trees immediately after planting according to the standard detail.

c. Container-Grown Plants at Planter Pots:
i. Can Removal:

1. Knockout Cans: Do not cut the sides. Tap the can and gently remove the plant.
2. Straight-Side Cans: Cut the cans on 2 sides with an acceptable can cutter. Do not cut with a spade or axe.

ii. Carefully remove plants without injury or damage to the root ball. After removing the plant, vertically score the root ball using a sharp knife, about 1/4" deep and every 2" to 3" in circumference.
iii. Biodegradable container installations must be accepted prior to planting.
iv. Dig planting holes as specified.
v. Hand place plants on firmly compacted soil. Hand backfill and hand tamp leaving slight depression around outer circumference of planting area.

(8) Anchoring and Guying of Trees

a. Root ball Anchoring:

i. Anchor the root balls of trees as standard method per the details and notes on the plans.
ii. Trees shall remain plumb and straight from installation through the warranty period.
iii. Trees shall be supported immediately after planting. All trees shall be root ball anchored and wrapped (depending on date of installation) as detailed and anchored as detailed and/or per manufacturer's recommendations. Wrap smooth barked trees as part of maintenance work in the fall. Refer to planting and tree grate details.
iv. Mock-Up: Install mock-up of manufactured project at the job site per the manufacturer's instructions for review and acceptance by the Landscape Architect.

Tree Caliper @ 12-in Above Grade	Root ball Anchor Kit
Up to 3 inch	Duckbill 68 RBK Kit
Up to 6 inch	Duckbill 88 RBK Kit

b. Guying and Wrapping:

i. Stake and guy all trees not receiving root anchoring.

Tree Caliper @ 12-in Above Grade	No. of Guys	Size	Turn-Buckle	Deadmen/Anchor
2-6 inch	3	1/8"x7x7	3/8"x10-5/8	4x4x24, 18" deep
6-8 inch	3	3/16"x7x7	3/8"x10-5/8	6x6x30, 30" deep

ii. Root ball anchor or stake all trees immediately after planting, as shown on the planting details. Do not plant trees that cannot be anchored, or staked and guyed properly before the workday ends.

iii. Wrap all deciduous tree trunks per planting details no later than November 15. Before wrapping, the Landscape Architect should inspect tree trunks for injury, improper pruning, and insect infestation. Contractor shall remove all wrappings by May 21.
iv. Trees shall remain plumb and straight from installation through the warranty period.
v. Tree support shall be done as outlined on the following tables.
vi. Trees shall be supported immediately after planting. All trees shall be guyed and wrapped as detailed, or anchored as detailed and/or per the manufacturer's recommendations. Wrap smooth barked trees as part of maintenance work in the fall. Refer to planting and tree grate details.
vii. Wire and Positioning: Wire shall be passed through grommets in nylon straps to prevent direct contact with the bark of the tree and placed around the trunk in a single loop above the lowest branch. Wire shall be tightened and kept taut by twisting the strands together. Guy trees above the first point of branching, with guys spaced equally around and outside the perimeter of the ball. Cover guys with a specified tree collar at points of contact with the bark. Position guys at crotches and fasten to a deadman. All exposed wire is to be covered by white PVC pipe per the planting details.
viii. Turnbuckle: Provide one (1) turnbuckle for each guy. Use 2 cable clamps at each cable connection. Place white plastic guy covers on all guys.
ix. Mock-Up: Install a mock-up of the manufactured project at the job site per the manufacturer's instructions for review and acceptance by the Landscape Architect.
x. Contractor shall return to the site after one year and remove stakes.

(9) Schedule

a. No planting work shall take place during freezing, excessively windy or wet weather or when the ground conditions are, in the opinion of the Landscape Architect, not in a condition to be properly worked. Contractor shall include time in his schedule for work stoppage due to inclement weather or ground conditions. Inclement weather or ground conditions shall not be cause for an extension of the project completion date unless written approval has been obtained from the Landscape Architect for an extension of the project completion date.
b. No planting work shall commence until the adjacent site improvements, pavements, utility installation and finish grading are completed. The Contractor shall limit his use of heavy equipment on pavements and planted areas. In all cases, he shall be responsible for all damage to existing conditions.

(10) Plant Installation in Winter

a. When minimum night temperatures drop below 40º F, the following operations will be adhered to:

i. Preparation for field installation of plant materials shall be such that newly-delivered plants can be installed immediately and not maintained in temporary storage.
ii. Broadleaf evergreens and coniferous plants installed after December 1st should be treated with an approved anti-desiccant according to the manufacturer's recommendations.
iii. Where specified, backfill should be placed around plants immediately following planting. Leaving the tops of root balls exposed for more than 24 hours is unacceptable.
iv. Installation contractors should closely monitor the soil moisture levels of plant root balls. Inspect moisture levels weekly and adjust irrigation controllers accordingly. Soils should be moist but not saturated. Do not irrigate soils that contain adequate moisture.

(11) Watering

a. Plants shall be watered immediately after planting. After the first watering, water shall be applied to plants as conditions require to keep the plants in a healthy and vigorous growing condition until completion of the Contract.

(12) Pruning

a. Trees: A licensed tree surgeon shall prune trees as necessary under direction of the Landscape Architect immediately following installation.
b. New Plant Material: Prune the minimum necessary to remove injured twigs and branches, deadwood, and suckers and as required to insure a healthy plant representative of the species and in keeping with accepted horticulture practices.

i. Prune any damaged or dead roots or branches back to and slightly above, the nearest healthy side bud, but at angle from the remaining portion not exceeding 45 degrees.
ii. Evergreen: Trim only damaged or dead foliage and/or branches.
iii. Do not prune leaders. On cuts over 1" diameter, trace the injury back to living tissue, smooth and treat with an accepted tree wound dressing.

(13) Mulching - Where used, mulch shall be placed within 2 days of planting and a minimum of 4-inches deep to a radius of 3-feet. Mulch shall not be placed within 6 inches of the trunk.

(14) Maintenance, Acceptance, and Guarantee

a. Maintenance period shall begin immediately after each area is planted based on the following requirements:

i. All planting shall be protected and maintained until final acceptance of all work. Maintenance shall include watering, weeding, cultivating, mulching, tightening and repairing of guys, removal of dead branches, resetting plants to proper grade or upright position, barricading the site and other necessary operations. The Contractor shall provide all water

and equipment necessary for maintenance during the duration of the contract. Water is available at the planting site. After final acceptance, maintenance becomes the responsibility of the City.

ii. If during the duration of the contract prior to final acceptance, any of the plants die, or if they are, in the opinion of the Landscape Architect, in unhealthy or unsightly condition or if they have lost their natural shape due to dead branches or excessive pruning of branches, then the Contractor shall replace the material at his expense. This replacement shall be completed prior to final acceptance of the project and shall not void the one-year guarantee.

iii. Minor vandalism, theft, or other damage to the plants or related work shall be the responsibility of the Contractor until all work receives final acceptance.

b. Prior to final acceptance, the Contractor shall furnish four (4) copies of written maintenance instructions to the City for maintenance and care of all new planted areas for the first 3 years after installation. These instructions shall include but not be limited to staking, pruning, insect and disease control and fertilizing.

c. Guarantee

i. For a period of two years after final acceptance of all work and at no additional cost to the City, the Contractor shall replace any plants that have died or are partially dead due to unhealthy or unsightly conditions, or have lost their natural shape due to dead branches or excessive pruning of dead branches. Adverse site conditions are natural causes for the purposes of this contract. Inadequate or improper maintenance by the City shall not be cause for replacement by the Contractor, provided the Contractor has submitted throughout the guarantee period a bi-monthly letter of report to the City on improper or inadequate maintenance practices and recommended remedial actions. The Contractor shall apply a “new” one year guaranty period to each replacement plant that is installed.

ii. The Contractor shall guaranty all plants to be true to name and to meet all conditions of these specifications. Any plant which is not true to name as indicated by leaf, flower form, or fruiting characteristics revealed within the guarantee period shall be replaced by the Contractor, at the Contractor's expense.

iii. All replacement planting under the guarantee provision shall be executed within one month of notice to replace such plants. Upon the Landscape Architect’s written approval, the Contractor shall replace rejected plants at a later date, mutually agreed upon, provided that the Contractor removes all rejected plants within seven days of the notice to replace such plants. If the rejected plants are not removed in 7 days, the Landscape Architect may at their option remove these plants and the cost of such removal shall be charged to the Contractor.

iv. Replacement planting is to be in accordance with the original specifications and its cost considered to be included in the bid price. All areas damaged by tree or shrub planting or replacement operations are to be fully restored to their original condition as specified.

10.3.11 INTEGRAL CONCRETE COLORING

(1) Placing Colored Flatwork Concrete

a. The concrete consistency as denoted by the slump test should remain at the same slump + ½" for all colored concrete placed. The concrete slump shall be 3" maximum + ½" at the point of delivery. Once a portion of the batch has been placed, no water should be added to the remaining batch.
b. Concrete should always be placed in forms as near the final location as possible. Avoid using a concrete vibrator to move the concrete laterally.

(2) Finishing Colored Flatwork Concrete

a. Finishing must be done uniformly. Over troweling often results in dark spots in the colored concrete and will not be permitted. Finishing must not begin until bleed water has left the surface. No sprinkling or fogging will be permitted.

(3) Curing Colored Flatwork Concrete

a. The finished slab should be sealed with Davis seal in a matching color. Plastic sheeting or membrane paper will not be permitted.

(4) Patching Colored Concrete

a. All repair work must be done within three days of form removal so the repair and surrounding concrete age together.
b. White cement must be added to the patching mix to overcome the fact that a patch area will normally dry darker. The color added to the patch mix should be the same ratio as the original color/cement ratio.

10.6 METHOD OF MEASUREMENT

The quantities of native seeding will not be measured but shall be the quantities shown on the plans, completed and accepted; except that measurements will be made for revisions requested by the Engineer, or for discrepancies of plus or minus five percent of the total quantity shown on the plans.

The quantity of native seeding shall include fertilizer and matting (if applicable), mulch and seed, completed and accepted. The quantity of sod to be measured will be the actual number of square feet including sod preparation, fertilizer, and sod, completed and accepted.

Measurement for acres will be by slope distances.

10.7 BASIS OF PAYMENT

The accepted quantities of native seeding and sod will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule. Payment will be made under:

Pay Item	Pay Unit
Seeding (Native)	Acre
Sod	Square Foot

Soil preparation, seed, fertilizer, mulching and erosion matting will not be paid for separately but shall be included in the work.

Cost for adjusting or re-adjusting the seeding or fertilizing equipment will not be paid for separately but shall be included in the work.

Costs for adjusting or re-adjusting the mulching equipment will not be paid for separately but shall be included in the work.

Water for seeding, mulching, hydraulic mulching, and sodding will not be paid for separately but shall be included in the work.

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ARTICLE 11

SANITARY SEWERS

11.1 GENERAL

11.1.1 DESCRIPTION

The work covered by this section of the specifications consists of the furnishing of all labor, supplies, equipment and materials and performing all operations in connection with the construction of sanitary sewers and appurtenances, as shown on the plans, as herein specified and directed by the City Engineer.

11.1.2 PLANS AND DATA

Profiles of the ground are shown on the plans for the work. The Contractor must satisfy themself regarding the character of the material to be excavated and the work to be done.

11.1.3 SOURCE OF SUPPLY

Materials complying with these specifications will be accepted from any source of supply. The Engineer reserves the right to reject the entire output of any source from which it is impossible to secure a continuous supply of satisfactory material or a source where conditions are such that the use of unfit material can be prevented only by extraordinary methods.

The Engineer may require the taking and testing of preliminary samples of material from any source before that source is approved for delivery.

The Contractor shall be held responsible for the care and storage of materials delivered on the work site or purchased for use thereon. Any material that has been delivered on the work site and has become damaged before actual incorporation in the work may be rejected by the Engineer even though it may have been accepted previously. Stored material will be so located as to facilitate thorough inspection.

Materials which do not meet the requirements of these specifications will be rejected and will be promptly removed from the work site.

11.2 MATERIALS

11.2.1 PIPE MATERIALS

All sanitary sewer mains shall be a minimum of eight inches (8”) in diameter. Any sanitary sewer mains less than eight inches (8”) will not be approved or accepted.

(a) POLYVINYL CHLORIDE (PVC) PIPE. Polyvinyl chloride pipe shall be unplasticized polyvinyl chloride manufactured specifically for sanitary sewage and with an integral bell. All PVC pipe with diameters not exceeding fifteen inches (15") will conform to ASTM D3034 Standard Specifications. A minimum wall dimension ratio (ratio of the average specified outside diameter to the minimum specified wall thickness) shall be SDR 35. All PVC pipe with diameters eighteen inches (18") and greater shall conform to ASTM F679 Standard Specifications.

The bell end of all pipes shall contain a confined elastomeric gasket conforming to ASTM F477 and will be tested in accordance with ASTM D3212 Standard Specifications. PVC pipe shall not be exposed to ultraviolet light longer than six (6)

months. Any discoloration of the pipe material will be evidence of ultraviolet damage and may be reason for rejection and removal from the project.

All PVC sewer pipe, eight inches (8") in diameter or larger, shall be an integral green tint in color. Lightly tinted pipe will not be acceptable. Contractors shall install all **PVC pipe in a manner where there are no sags or interruptions in the flow**. All pipe shall have a home mark on the spigot to indicate proper penetration when the joint is made.

Connections to an existing PVC pipe, for extensions or repairs, shall be made with a double bell coupling when a bell end does not exist, (i.e. plain end to plain end connection). After it has been laid and backfilled, and prior to the placing of surface improvements, all PVC pipe shall be tested by the Contractor by means of a certified mandrel (go-nogo device).

(b) CAST IRON PIPE (CIP). Cast Iron Pipe will not be allowed.

(c) DUCTILE IRON PIPE (DIP). Ductile Iron Pipe shall be centrifugally cast, grade 60-42-10 iron conforming to ASTM A746 and ANSI A21.51 Standard Specifications. Thickness class for buried pipe shall be as determined by ANSI A21.51, Tables 51.1 and 51.2. Ductile Iron Pipe shall have rubber gasket push-on joints and shall have a polyethylene lining.

Polyethylene lining material shall conform to ASTM D1248 Standard Specifications, compounded without an inert filler except 3% carbon black to resist ultraviolet rays. The polyethylene shall be chemically bonded to the interior of the pipe. The lining shall have a nominal thickness of 40 mils and a minimum thickness of 35 mils.

Each piece of pipe shall be checked for holidays by the manufacturer. Holiday testing shall conform to ASTM G62 standard specifications.

Field cutting and coating of the cut pipe shall be made in accordance with the manufacturer's recommendations. In no case shall polyethylene-lined pipe be cut with a torch.

An approved pipe bonding and cathodic protection system will be required on all buried ductile iron pipe.

(d) VITRIFIED CLAY PIPE (VCP) - EXTRA STRENGTH. Vitrified clay pipe will be allowed only when prior written approval is obtained from the City Engineer.

11.2.5 CONCRETE MANHOLES

Unless otherwise specified on the plans, or approved by the City Engineer, manholes shall be constructed of precast concrete barrels and cones with cast-in-place concrete bases. Bases may be precast if placed on six inches (6") of compacted gravel bedding extending a minimum of twelve inches (12") around the base or the width of the excavation-whichever is greater. In the event severe groundwater conditions are encountered, the thickness of the gravel bedding below the manhole base shall be increased to twelve inches (12"). Alternate construction methods may be required as approved by the Engineer on a case-by-case basis. The concrete channel and bench within precast bases shall be poured on site after the sewer pipe is set to grade. Where possible, the manhole channel shall be sewer pipe with the upper portion removed. Precast concrete barrels and cones shall conform to ASTM C478 Standard

Specifications except that the wall thickness may be either wall A or wall B as described in ASTM C76 Standard Specifications. Provide eccentric cones for all manholes greater than six feet (6') deep, and flat lids for manholes six feet (6') deep or less as shown on the drawings. Manholes shall conform to the Standard Details shown on the plans. Concrete used in the construction of all sanitary sewer structures shall conform to those portions of *ARTICLE 4 – CONCRETE and ARTICLE 5 – STRUCTURAL CONCRETE*, which are applicable.

All joints in the manhole barrel, cone, grade adjustment rings, and flat top sections shall be sealed with a preformed flexible plastic sealing compound conforming to Federal Specification SS-S-00210 (GSA-FS6). All joint surfaces shall be cleaned prior to applying the sealant. The outside of the manhole joints shall be wrapped with a butyl adhesive tape sealant that conforms to Federal Specification SS-S-00210 (GSA-FS6). The eccentric cone section shall be situated so that the slope of the cone section is pointing toward the downstream direction.

All pipe penetrations in cast-in-place concrete bases shall utilize two strips of the above mentioned preformed flexible plastic sealing compound, placed around the pipe, as a water stop. All pipe penetrations in precast concrete bases shall be provided with a resilient rubber connector in conformance with ASTM C923, when connection to an existing manhole is allowed a water stop and non-shrink grout shall be used at all pipe penetrations.

11.2.6 TRENCHLESS MANHOLE REPAIR

Unless specified on plans, materials used shall conform to the following, or be otherwise approved by the engineer:

(a) CEMENTIOUS MATERIAL

DESCRIPTION	METHOD	RESULTS
Compressive Strength, 28-day	ASTM C109	9,000 psi
Flexural Strength, 28-day	ASTM C293	1,000 psi
Bond Strength	ASTM C882	2,000 psi
Freeze-Thaw Durability	ASTM C666	No visible damage after 300 cycles
Shrinkage at 95” Humidity, 28-day	ASTM C596	0%
Sulfide Resistance	ASTM C267	No attack

(b) EPOXY COATING

DESCRIPTION	METHOD	RESULTS
Flexural Strength	ASTM D790	13,000 psi
Compressive Strength	ASTM D695	18,000 psi
Tensile Strength	ASTM D638	7,600 psi
Tensile Ultimate Elongation	ASTM D638	1.5 %
Hardness, Shore D	ASTM D2240	85-89
Taber Abrasion, CS17 Wheel	ASTM D4060, 1,000g load/1,000 cycles	<112mg loss
Adhesion	ASTM D4541, Concrete	Substrate Failure and >250 psi*

*Adhesion Mode of Failure shall be by Substrate Failure mode only with an adhesion value 250psi and greater. Mode of failure categorized as

"Glue Failure or Adhesive Failure Y/Z" below the minimum PSI specified shall be cause for retesting. Mode of failure as noted in ASTM D4541Section 8.3.1 thru 8.3.3/ASTM D7234 Section 9.3.1 thru 9.3.4 categorized as Adhesive A/B, B/C, C/D etc. or Cohesive B, C, D etc. shall be cause for rejection.

11.2.7 MANHOLE RING AND COVER ADJUSTMENT

(a) CONCRETE GRADE RINGS. Reinforced concrete grade rings may be used in the adjustment of manhole rings. Grade rings shall have a minimum thickness of two inches (2") and maximum thickness of six inches (6"). Total adjustment height shall not exceed the tolerances as shown on the Standard Details.

(b) HIGH DENSITY POLYETHYLENE (HDPE) GRADE RINGS. High Density Polyethylene grade rings may be used in the adjustment of manhole rings. Grade rings shall be rated for HS-20 loading. Total adjustment height shall not exceed the tolerances as shown on the Standard Details.

11.2.8 MANHOLE RING AND COVERS

Iron castings shall conform to the requirements of AASHTO M306. Gray iron used in the casting shall conform to AASHTO M105, Class 35B, unless otherwise specified.

Castings shall be boldly filleted at angles and the risers shall be sharp and perfect. Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes or other defects in positions affecting their strength for services intended. The ring and covers for manholes and all sanitary sewer appurtenances shall be straight and shall fit properly together so that traffic will not cause them to rattle. Rough spots, which prevent a suitable fitting, shall be removed by grinding. Manhole castings shall be Neenah R-1706, Deeter 1258, East Jordan Ironworks 2430 or approved an equal. Manhole covers shall be lettered "SANITARY". See City Standard Details for additional information.

11.2.9 REINFORCING STEEL

Reinforcing steel shall meet the requirements of *ARTICLE 5 – STRUCTURAL CONCRETE, SECTION 5.3 - REINFORCEMENT.*

11.2.10 BEDDING FOR PIPE

(a) CLASS “A” BEDDING - Class "A" bedding shall be defined as the method of bedding by which additional supporting strength of the pipe is attained by supporting the pipe with a continuous concrete cradle. The lower part of the pipe shall be bedded in a continuous cradle constructed of concrete conforming to those portions of *ARTICLE 4 – CONCRETE* for Caisson Concrete Mix, which are applicable.

(b) CLASS “B” BEDDING - Class "B" bedding shall be a well-graded crushed stone or slag. When tested by means of laboratory sieves it shall conform to the following requirements: (AASHTO M43, NO. 67 gradation)

SIEVE SIZE	PERCENT PASSING
1 in.	100
¾ in.	90
3/8 in.	20 – 55
No. 4	0 – 10
No. 8	0 – 5

When crushed gravel or stone is used, at least 50 percent, by weight, of the particles retained on the No. 4 sieve and above shall have at least two (2) fractured faces.

(c) REINFORCED CONCRETE ARCH AND ENCASEMENT – Concrete and reinforcement for an arch or encasement shall conform to those portions of *ARTICLE 4 – CONCRETE for 6-Sack Concrete Mix and ARTICLE 5 – STRUCTURAL CONCRETE*, which are applicable.

11.2.11 TRENCH STABILIZATION MATERIAL

Backfill for unstable subgrade conditions shall be select material as approved by the Engineer. Contractor shall submit a sample and sieve analysis for City Engineer's review and approval prior to the delivery of the materials to the site.

11.2.12 BACKFILL MATERIALS

Subject to the provisions specified herein, the material removed from the project excavations may be used as backfill. All organic material, rubbish, debris, and other objectionable materials shall be removed from the site and shall not be considered acceptable for backfill.

(a) INITIAL BACKFILL. The specified selected material for the initial backfill (from the spring line of the pipe to a plane one foot (1') above the top of the pipe) in the "pipe zone" shall be Class "B" bedding material, unless stated otherwise on the plans. The initial backfill shall be carefully and simultaneously placed on each side of the pipe for the full width of the trench.

(b) BACKFILL ABOVE THE PIPE ZONE. The material for backfill above the pipe zone (from the top of the bedding to a plane two feet (2') above the top of the bedding) shall be free from rocks, stones, concrete, or asphalt greater than three inches (3") in any dimension. If the Contractor cannot prevent rocks from accumulating at the top of the bedding during the backfill operation, then the City Engineer may require an additional twelve inches (12") of Class "B" bedding or select material be provided at no cost to the City. Material for the backfill from a plane two feet (2') above the bedding to the top of ground shall be free from rocks, stones, concrete or asphalt greater than eight inches (8") in any dimension. All Material shall be well graded and consolidated with a minimum of voids.

(c) IMPORTED BACKFILL MATERIAL. When a shortage of satisfactory backfill material occurs from a cause which is not the fault of the Contractor, as verified by the City Engineer, the Contractor shall furnish all necessary suitable material. The imported backfill material shall be inspected and approved by the City Engineer prior to import.

11.2.13 SEWER SERVICE LINES

Sewer service lines shall be four inches (4") in diameter unless otherwise specified on the plans, or by the Engineer. Material for sewer service lines shall be PVC having a minimum wall dimension ratio with an SDR rating of 35, meeting the requirements of ASTM D3033 or D3034 or better. Sewer services shall be connected to the main, not the manhole, and shall be a wye fitting or a tee fitting when the diameter of the service line exceeds one-half (½) the diameter of the sanitary sewer main. An approved multi-fitting saddle or wye with a lip may be used when the diameter of the service line is less than or equal to one-half (½) the diameter of the sanitary sewer main.

11.2.14 TRACER WIRE

All tracer wire and tracer wire products shall be domestically manufactured in the U.S.A. All tracer wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.

(a) OPEN TRENCH. Tracer wire for open trenches shall be #12 AWG copper clad steel, high strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.

(b) DIRECTIONAL DRILLING/BORING. Tracer wire for directional drilling or boring shall be #12 AWG copper clad steel, extra high strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.

(c) PIPE BURSTING/SLIP LINING. Tracer wire for pipe bursting or slip lining shall be 7 x 7 stranded copper clad steel, extreme strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness.

(d) CONNECTORS. All mainline tracer wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector (SnakeBiteTM or approved equal). At crosses, the four wires shall be joined using a 4-way connector. Use of two (2) 3-way connectors with a short jumper wire between them is an acceptable alternative.

Direct bury wire connectors. Shall include SnakeBiteTM 3-way lockable connectors (or approved equal) and mainline to lateral lug connectors specifically manufactured for use in underground tracer wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion and shall be installed in a manner to prevent any uninsulated wire exposure.

Non-locking friction fit, twist on or taped connectors are prohibited.

(e) TERMINATION/ACCESS. All tracer wire termination points must utilize an approved tracer wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.

All grade level/in-ground access boxes shall include a dual terminal, switchable lid (SnakePit LD14G2T-SW or approved equal), be appropriately identified with “sewer” cast into the cap, and color coded per APWA standard for the specific utility being marked.

A minimum of two feet (2’) of excess/slack wire is required in all tracer wire access boxes after meeting final elevation.

All tracer wire access boxes must include a manually interruptible, conductive/connective link between the terminal(s) for the tracer wire connection and the terminal for the ground rod wire connection.

Ground wire shall be connected to the identified (or bottom) terminal on all access boxes.

(f) Service Laterals on public property. Tracer wire must terminate with a coil of six feet (6’) of tracer wire for future extension to the building, located at the edge of the road right-of-way, and out of the roadway. Termination/Access boxes must be installed at the first south or east sanitary sewer service stub located from the downstream manhole for each block in new subdivisions.

(g) Service Laterals on private property. Tracer wire must terminate at an approved above-ground tracer wire access box, affixed to the building exterior directly above where the utility enters the building, at an elevation not greater than five (5) vertical feet above finished grade, or terminate at an approved grade level/in-ground tracer wire access box, located within two (2) linear feet of the building being served by the utility.

(h) Long-runs, in excess of 2,500 linear feet. Tracer wire access must be provided utilizing an approved grade level/in-ground tracer wire access box, located at the edge of the road right-of-way and out of the roadway. The grade level/in-ground tracer wire access box shall be delineated using a minimum 48" polyethylene marker post, color coded per APWA standard for the specific utility being marked or another approved marker by the City of Pueblo.

(i) GROUNDING. Tracer wire must be properly grounded at all dead ends/stubs.

Grounding of tracer wire shall be achieved by use of a drive-in magnesium ground rod with a minimum of 20 feet of #12 red HDPE insulated copper clad steel wire connected to a node (minimum 1.5 lb.) specifically manufactured for this purpose and buried at the same elevation as the utility.

When grounding the tracer wire at dead ends/stubs, the ground rod shall be installed in a direction 180 degrees opposite of the tracer wire, at the maximum possible distance.

When grounding the tracer wire in areas where the tracer wire is continuous and neither the mainline tracer wire or the ground rod wire will be terminated at/above grade, install the ground rod wire directly beneath and in-line with the tracer wire. Do not coil excess wire from the ground rod wire. In this installation method, the ground rod wire shall be trimmed to an appropriate length before connecting to the tracer wire with a mainline to the lateral lug connector.

Where the ground rod wire will be connected to a tracer wire access box, a minimum of two feet (2') of excess/slack wire is required after meeting final elevation.

(j) Prohibited Products and Methods. The following products shall not be allowed or acceptable:

(1) Uninsulated tracer wire
(2) Tracer wire insulations other than HDPE
(3) Tracer wires not domestically manufactured
(4) Non-locking, friction fit, twist on or taped connectors
(5) Brass or copper ground rods
(6) Wire connections utilizing taping or spray-on waterproofing
(7) Brass fittings with tracer wire connection lugs

(k) Approved Products and Methods. The following products have been deemed acceptable and appropriate. These products are a guide only to help you choose the correct applications for your tracer wire project.

(1) Copper-Clad Steel (CCS) Tracer Wire or approved equal.
(2) Open Trench. Copperhead #12 High Strength part # 1230G-HS or approved equal.
(3) Directional Drilling/Boring. Copperhead Extra High Strength part # 1245G-EHS or approved equal.

(4) Pipe Bursting/Slip Lining. Copperhead SoloShot Extreme Strength 7 x 7 Stranded part # GPBX- 50 or approved equal.
(5) Connectors Copperhead. 3-way locking connector part # LSC1230C or approved equal.
(6) DryConn 3-way Direct Bury Lug: Copperhead Part # 3WB-01 or approved equal.
(7) Termination/Access
(8) Non-Roadway access boxes applications: Tracer wire access boxes grade level Copperhead 3-way Direct Bury Lug adjustable lite duty Part # LD14G2T-SW or approved equal.
(9) Concrete / Driveway access box applications: Tracer wire access boxes grade level Copperhead Part # CD14G2T-SW or approved equal.
(10) Grounding. Drive in Magnesium Ground Rod: Copperhead Part # ANO-12 (1.5 lb.) or approved equal.
(11) Manufacturer Product Options: Copperhead products or approved equal.

11.3 CONSTRUCTION REQUIREMENTS

11.3.1 WATER LINE AND STORM SEWER CROSSINGS

Where sanitary sewer mains cross water mains, storm sewers or other non-potable lines, the sanitary sewer pipe shall be a minimum of eighteen inches (18") clear distance vertically below the water main or storm sewer. If this clear distance is not feasible, the pipe section must be designed and constructed so as to protect the water main or storm sewer. Minimum protection shall consist of the installation of an impervious and structural sewer. For example:

(a) REINFORCED CONCRETE ENCASEMENT. The sanitary sewer pipe shall be reinforced with a reinforced concrete encasement. The encasement shall be at least six inches (6") thick and extend a distance of ten feet (10') on either side of the water main or storm sewer. See *Section 11.3.11 - PIPE BEDDING LIMITS, REINFORCED CONCRETE ENCASEMENT*.

(b) JOINT CENTERING. The sewer shall be constructed such that one length of pipe, at least eighteen feet (18') long, shall be centered over the water main or storm sewer. Joints between the sewer pipe and special length pipe (18' section of pipe) shall be encased in a concrete collar at least six inches (6") thick and extending at least six inches (6") on either side of the joint.

In all cases, proper soil compaction, suitable backfill or other structural protection shall be provided to preclude settling and/or failure of either pipe.

11.3.2 RAILROAD AND HIGHWAY CROSSINGS

At all railroad and highway crossings, extreme care shall be exercised to safeguard life and property. All sewer work under and adjacent to railroads and highways shall be accomplished to the satisfaction of a representative of the railroad company and/or the Colorado Department of Transportation (CDOT) and the Engineer. The Contractor shall obtain at his own expense all permits, bonds, and insurances necessary for the execution of this work, and/or required by the appropriate railroad or CDOT. Contractor shall submit a plan for approval for crossing railroads or highways unless otherwise shown on drawings.

11.3.3 EXCAVATION - GENERAL

All excavation for sewer and/or manhole construction will be considered as unclassified excavation. The contractor shall make his own estimate of the type and extent of the various

materials which will be encountered in the excavation.

All excavation shall be done by open cut from the surface except when boring is expressly herein permitted or directed in writing by the Engineer. Trenches shall be excavated along the lines and to the grades established by the Engineer. In no case, without previous written consent from the Engineer, shall more than five hundred feet (500') or one (1) block whichever is less, of trench be opened in one place in advance of the completed and backfilled sewer. All open cuts shall be backfilled and barricaded at the end of each day except the unfinished end of the conduit, which may be left unbackfilled to permit continuation the next working day.

Width of the trenches shall be kept to a minimum, but provide safe and adequate space for workers . Contractor shall be responsible for protecting the existing utilities and property. Contractor shall comply with all Local, State and Federal Health and Safety requirements including but not limited to the deposition of cut, sloping, and/or bracing. The cost to meet these safety requirements shall be included in the respective bid items.

The Contractor shall barricade all excavations and ditch lines as specified in the *Manual on Uniform Traffic Control Devices (MUTCD).* The Engineer may require additional barricades at their discretion. At the end of each day the Contractor shall remove all excess excavated material from travel ways, and thoroughly clean all streets, alleys, driveways, and sidewalks affected by the excavation. If it becomes necessary to accomplish this, all streets, driveways, alleys (if asphalt), and sidewalks shall be swept or washed as needed.

Excavation shall conform to *ARTICLE 7 – EARTHWORK, Section 7.3.2 General Excavation.*

11.3.4 TRENCH EXCAVATION - WIDTH AND DEPTH

The width of the trench shall provide adequate space for workers to place, joint, and bed the pipe properly.

The minimum width of the trench from a plane six inches (6") below the pipe to a plane twelve inches (12") above the pipe shall be a minimum of nine inches (9") clear on each side from the undisturbed edge of the trench wall to the outside diameter of the pipe. This minimum trench width shall also be used for the measurement of trenches in rock.

To protect the pipe from external loads in excess of those used in the design of the pipe, it is necessary to limit the width of the lower portion of the trench below an elevation 12 inches above the top of the installed pipe to 6” below the invert of the pipe. The trench from a plane six inches (6") below the pipe to a plane twelve inches (12") above the pipe shall be excavated so the trench walls are as close to vertical as possible. The maximum trench width within this zone will not be limited but shall be kept as narrow as possible.

When using a movable trench support, care shall be exercised not to disturb the pipe location, jointing or bedding material. Any voids left in the bedding material by support removal shall be carefully filled with additional bedding material and properly tamped. The width and slope of the trench from a plane twelve inches (12") above the pipe to the top of the ground shall be determined by the Contractor. Considering factors shall include, but not be limited to; all safety requirements; type of material being excavated; equipment used; widths of dedicated right-of-ways; and adjacent structures, properties, and utilities.

The trench bottom shall be constructed to provide a firm, stable and uniform support for the full length of the pipe. Except in ledge rock, water bearing earth, or where a special pipe bedding is called for in the contract documents, the rough excavation of trenches shall extend no less than four inches (4") nor more than six inches (6") below the bottom of the pipe.

Correction of a trench grade that is too low shall be done by compacting select material of the

types designated by the Engineer, over the entire width of the trench to 95% of AASHTO T99. Such work required due to over excavation will not be included for payment.

Trench excavation shall meet the requirements of *ARTICLE 7 – EARTHWORK, SECTION 7.3.2(5) TRENCH EXCAVATION.*

11.3.5 HANDLING EXCAVATED MATERIAL

The material excavated from trenches, which is suitable for backfill, shall be kept so as not to significantly alter drainage flow patterns, endanger the work and to be of as little inconvenience as possible to the traveling public and the occupants of the abutting properties. Free access must be maintained at all times to driveways, fire hydrants, water valves, gas valves, existing manholes, etc., in the vicinity of the work.

Where lines are located in alleys or in any other case where the Contractor proposes to deposit material on private property, written permission shall be obtained from the owner of the property prior to placing any material on the property. The Contractor shall be held responsible for any damage to private property.

Materials encountered during clearing of the right-of-way and excavation of the trench such as rubbish, organic material, abandoned foundations and any other material which are not satisfactory for use as backfill in the opinion of the Engineer, shall be removed from the site and disposed of by the Contractor at his own expense.

11.3.6 UNSTABLE SUBGRADE

Where unstable subgrade conditions are encountered, as determined by the Engineer, the Contractor may be required to excavate below subgrade elevation and backfill the unstable area with material as per *Section 11.2.12 - TRENCH STABILIZATION MATERIAL.* The material approved by the Engineer shall be used to an elevation six inches (6") below the bottom of the pipe. Any extra depth of excavation and backfill shall be as ordered by the Engineer, and only when ordered by the Engineer.

If the unstable condition is a result of the Contractor not properly protecting his work from surface water infiltration, or from sewer or water lines damaged or broken by the Contractor, the cost shall be borne by the Contractor. If the unstable soil condition is the result of ground water infiltration and other causes beyond the control of the Contractor, the extra foundation material ordered by the Engineer will be paid for.

Unstable subgrade shall meet the requirements of *ARTICLE 7 – EARTHWORK, SECTION 7.3.2(5)(c) REMOVAL OF UNSTABLE MATERIAL.*

11.3.7 TRENCHES IN ROCK

Rock will be defined as any naturally occurring or manmade material in such a form that it cannot be readily removed using the equivalent of a 165hp/40,000lb operating weight track-type tractor (bulldozer) with a ripper or a 188hp/63,000lb operating weight hydraulic excavator (crawler mounted backhoe) with “rock teeth” without a significant loss of production. It also includes boulders exceeding one-half (½) cubic yard in volume.

Whenever rock material is encountered in an excavation, the Contractor shall immediately notify the Engineer for field verification. The Engineer shall measure and document the limits of the rock prior to excavation. Any rock removed prior to notification will not be considered for payment. After rock has been measured, trenching shall continue by such means as may be necessary, to a depth of six inches (6") below the outside bottom of the pipe, and to a width in

conformance to *Section 11.3.4 - TRENCH EXCAVATION - WIDTH & DEPTH.*

Blasting for rock excavation will only be allowed with written permission from the Engineer and Fire Chief. The Contractor shall exercise the utmost care to protect the public from harm and to avoid property damage. Blasting shall be done by a State licensed blaster. The Contractor shall comply with all laws, ordinances, insurance, bonding, and applicable safety code requirements and regulations and shall be responsible for all damage caused by the blasting operations. Signals warning persons of danger shall be given before any blast.

Blasting shall be controlled so as to not make any excavation unduly large or irregular. Excessive blasting or overshooting shall not be permitted. The Engineer shall have the authority to order any method of blasting which leads to overshooting or is dangerous to the public or destructive to property or to natural features discontinued. Approved blasting blankets shall be used for all blasting.

11.3.8 QUICKSAND AND GROUNDWATER INFILTRATION

Should running sand, quicksand or groundwater be encountered, the work shall be pushed with the utmost vigor. Groundwater encountered in trench or manhole excavations shall be drained to sumps, through sub-drains, or by other methods to keep the water level below the bottom of the bell of the pipe while joints are being made. Dispose of the water in a manner to prevent damage to adjacent properties . Drainage of groundwater through any sanitary sewer pipeline is prohibited. All dewatering and trench stabilization methods and types of equipment used shall be approved by the Engineer.

If dewatering and trench stabilization is required as a result of the Contractor not properly protecting his work from surface water infiltration, or from sewer or water lines being damaged or broken by the Contractor, the cost shall be borne by the Contractor. In the event such work is required through no fault of the Contractor, it shall be considered extra work and a price shall be negotiated.

11.3.9 EXCAVATION FOR STRUCTURES

Excavation for manholes, and miscellaneous structures shall consist of the removal of all material necessary for construction of the work in conformity with the plans and these specifications.

If rock is encountered, the excavation shall be done in such a manner as to allow the rock to be exposed and prepared for receiving the concrete. All loose and disintegrated rock or thin strata shall be stripped to a clean bed acceptable to the Engineer and in conformance to all applicable items as described in *Section 11.3.7 - TRENCHES IN ROCK*.

Whenever the footing is to rest on any excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation (subgrade), and the final finishing of the surface shall not be done until just before the footing is to be placed. Correction of any over excavated areas shall be at the Contractor's sole expense.

Whenever the subgrade soil is not sufficiently firm, the Contractor is to furnish and compact, according to the direction of the Engineer, select material, as may be required and in conformance to all applicable items as described in *Section 11.3.6 - UNSTABLE SUBGRADE*.

After each excavation is completed, the Contractor shall notify the Engineer, who shall inspect the depth of the excavation and the character of the foundation material. No concrete shall be placed until after the Engineer has approved the depth of the excavation and character of the foundation material.

An Excavation Permit is required for any underground work within the City of Pueblo. The “for-fee” permit shall be obtained from the City Streets Division at 211 E. “D” Street. Any work placed without the benefit of this permit will not be paid for.

11.3.10 PIPE BEDDING LIMITS

Unless stated otherwise on the plans or details or ordered by the Engineer, all pipe shall be bedded in accordance with Class "B" bedding as described below. All classes of bedding shall be properly tamped around the lower half of the pipe (haunches) and horizontally away from the pipe in both directions to the undisturbed trench walls.

(a) CLASS “A” CRADLE BEDDING. The lower part of the pipe exterior shall be bedded in Class "A" bedding material having a thickness under the pipe of one-fourth (1/4) the outside diameter of the pipe or a minimum of six inches (6"), whichever is greater, and extending up the sides of the pipe for a height equal to one-fourth (1/4) of the outside diameter of the pipe. The cradle shall have a minimum width equal to the outside diameter of the pipe plus eight inches (8") and it shall be constructed monolithically without horizontal construction joints. Backfill above the cradle, extending twelve inches (12") above the top of the pipe and the full width of the trench shall be Class "B" bedding material.

(b) CLASS “B” CRADLE BEDDING. The sewer pipe shall be set on a minimum of six inches (6") of Class "B" bedding material carefully shaped to fit the lower part of the conduit exterior for a width of at least 60% of the pipe breadth and for the entire pipe length. After setting the sewer pipe, Class "B" bedding shall be added and properly tamped around the lower half of the pipe (haunches) for the full width of the trench, and the bedding shall be consolidated carefully without disturbing the pipe alignment or grade. Additional Class "B" bedding material shall be added up to a minimum of twelve inches (12") above the top of the pipe for the full width of the trench.

(c) REINFORCED CONCRETE ENCASEMENT. Concrete encasement shall have a minimum thickness of six inches (6") around the pipe. This encasement shall be formed on both sides to produce a rectangular shape and shall be reinforced as shown on the Standard Detail. When required, it shall extend a minimum distance of ten feet (10') on each side of a water main crossing or at the location and the dimensions as shown on the plans. Backfill adjacent to the encasement, extending the full width of the trench shall be class “B” bedding.

(d) REINFORCED CONCRETE ARCH. The pipe shall be embedded in class “B” bedding material having a minimum thickness of six inches (6”) between the barrel and the bottom of the trench excavation and extending to the springline (springline means the cross-section, horizontal centerline of the pipe) of the pipe. The top of the pipe shall be covered with a reinforced concrete arch having a minimum thickness of ¼ the outside diameter or four inches (4”) minimum, measured at the crown of the pipe and having a minimum width equal to the outside diameter plus eight inches (8”). When required, it shall be extended at the location and the dimensions as shown on the plans. Backfill adjacent to the concrete arch, extending the full width of the trench, shall be class “B” bedding.

11.3.11 PIPE LAYING

Pipe shall be protected during handling against impact shocks and free fall. Proper methods shall be used for handling and placing pipe to avoid spalling or breaking and to avoid unnecessary disturbance of the bedding surface in the trench bottom. Pipe shall be kept clean at all times and no pipe that does not conform to these specifications shall be used in the work.

Pipes shall be laid to a true line and at uniform rates of grade between manholes as shown on the plans. The laying of the pipe in prepared trenches shall commence at the lowest point with the spigot ends pointing in the direction of flow. No pipe shall be laid in water or when trench conditions are unsuitable for such work.

The Contractor shall take every precaution necessary to prevent dirt, debris or surface water from entering the existing lines or new construction. Contractor shall exercise reasonable diligence in preventing sewage from seeping into the ground during the removal and replacement of any sanitary sewer main. Best management practices shall be utilized to prevent such seepage of sewer water, which shall include, but are not limited to, the following:

(1) Minimize the amount of time sewer water is allowed to remain in trench.
(2) Channel water from the old pipe to the new pipe with a temporary pipe, impervious trough or gutter, whenever practical.
(3) Hard tie the newly laid pipe and existing pipe during holidays, weekends and nights unless a bypass is used.

All bypass pumping, temporary connections or other work needed to comply with this requirement shall be considered incidental to the sanitary sewer pipe and all costs in connection therewith shall be included in the unit price for the pipe, unless otherwise stated on the plans and specifications.

The Contractor shall submit a plan for handling existing sewage flows while rehabilitating the pipe at the pre-construction meeting for approval by the City. The bypass plan must be designed in accordance with the approved traffic control plans and identify the location of any pumping equipment, temporary discharge piping, pumping and discharge manholes, redundant pumps and piping, the location of nearby waterways or drainages, and the method for diverting runoff around the site. The Contractor shall be responsible to obtain all existing flow measurements in the sewer to determine a bypass plan. Precautions must be taken to ensure that sewage flow control operations do not cause damage to properties being served by the sewers involved. Raw wastewater shall not run freely through any open ditch. Bypass pumping will not be allowed during nonworking hours unless authorized by the Engineer. When 24-hour pumping operations have been approved by the Engineer in residential areas, attenuated pumps will be required to minimize noise disturbance. The Contractor shall provide 100% redundancy on any 24-hour pumping operation, near any waterways or any site deemed necessary by the Engineer. Bypass piping shall be placed in trenches and covered with temporary pavement or metal traffic covers when traffic conditions dictate the need for protection of the piping unless otherwise directed by the Engineer. The Engineer may specify additional design requirements based on specific site conditions.

Each bypass pumping system shall be hydrostatically tested using potable water prior to use. Unless otherwise indicated, water for testing bypass pipelines shall be furnished by the Contractor. The bypass pumping system may require air release valves to release air that may become trapped in the bypass system piping. The bypass pumping system shall be filled at a rate that will not cause any surges or exceed the rate at which air can be released through the air valves. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. Once the system has been successfully filled and all air purged, the piping system exclusive of the pump(s) shall be pressurized to 150% of the calculated working pressure, or 40 psi, whichever is greater, measured at the lowest point along the alignment, and hydrostatically tested for a minimum of 30 minutes. During the test, the entire system shall be visually inspected for leaks and monitored for pressure drops. Any leaks encountered shall be repaired at the Contractors cost, and the hydrostatic pressure test restarted until the system successfully passes the test. Potable water used during the test shall be discharged to the wastewater system at a controlled rate to prevent surcharging of the wastewater system and wastewater service lines.

If the City must provide personnel and equipment to minimize damages, in the event of any failure of the Contractor's sewage flow control operations, the Contractor shall be liable for all costs incurred by the City. The Contractor will be charged $550 per hour that the City of Pueblo crews are onsite, which will be deducted from the amount of the Contractor's final payment.

Service line wyes shall be placed on the sewer main at the points shown on the plans or where directed by the Engineer. The service lines shall be extended to the right-of-way line. All shall be per the requirements of *Section 11.3.14 - SANITARY SEWER SERVICE LINE INSTALLATIONS.*

(a) ALIGNMENT. All pipe shall be laid to the lines and grades given by the Engineer, with joints close and even, butting all around. They shall be carefully centered and shall not deviate more than one inch (1") from line so that when laid, the pipe will form a sanitary sewer with a uniform invert and a straight alignment, unless a specified curve alignment is shown on the plans.

The grade of the pipe shall be obtained by using batter boards and a "top line," batter boards with a double string line having a minimum of four feet (4') separation, a laser beam, or by the use of surveying instruments approved by the Engineer. The grade shall not be obtained by placing a carpenter's level on individual pipes.

If batter boards are used when pipe laying is in progress, the Contractor shall at all times maintain batter boards for a distance covering at least three grade stakes. The elevation of the batter boards shall be determined from the depth of cut as given by the Engineer, and the Contractor shall assign on each crew a person whose duty it shall be to see that the batter boards are in the proper place at all times. It is not intended that these requirements make it necessary for the Contractor to keep a person especially for this purpose, but to provide that a competent person shall be with each crew at all times whose duty it shall be to attend to the placing of the batter boards and the giving of grades to the pipe layer.

If a method other than batter boards is used, the instrument used shall be operated continuously under the supervision of a qualified foreman or superintendent. The pipe grade shall be checked by an alternate method at fifty-foot (50') intervals and upon request of the Engineer.

All PVC pipe shall be tested with a certified mandrel (go-no-go device) prior to construction of surface improvements.

(b) VERTICAL TOLERANCE. All pipe shall be installed within the following range of tolerances. Any pipe not within the specified spot elevation tolerance shall be re-laid.

PIPE GRADE TOLERANCE TABLE		
PIPE DIA. (INCHES)	**GRADE (S) (%)**	
	S≤ 0.50	**S>0.50**
8	±0.02 Ft	±0.04 Ft
10 – 15	±0.03 Ft	±0.04 Ft
18 or larger	±0.04 Ft	±0.04 Ft

In no case shall a section of pipe be accepted if it does not possess a positive grade (i.e., no flat or adverse sections).

(c) JOINTING PIPE. All pipe joints shall be made in the manner and under the conditions described under the various types of joints for the work. Prior to making pipe joints, all

surfaces of the portion of the pipe to be jointed shall be cleaned. All pipe joints shall be watertight when completed.

(1) ELASTOMERIC GASKET JOINTS – The assembly of the gasketed joint shall be performed in general conformance with the recommendations of the pipe manufacturer. The Contractor shall provide a suitable method of installation to ensure the pipe being entered is true and concentric with the previously laid pipe so as to prevent injury to the elastomeric gasket. When jointed, the pipe shall form a smooth and true pipeline.

(i) Mechanical methods shall be employed, if necessary, to pull or push the pipe together with sufficient force to compress the gasket sufficiently to make a watertight joint.

(2) SOLVENT CEMENTED JOINTS - Solvent cemented joints are not allowed on eight-inch (8") diameter and larger pipes unless otherwise approved by the Engineer, in writing. If approved, the assembly shall be made in accordance with ASTM D2855 standard practice. Remove dirt and mud from the bell and spigot. Apply primer liberally to the outside of the spigot and inside of the coupling. Immediately apply cement and make joint by shoving home with 1/4 rotation (within a minute).

(3) OTHER TYPE JOINTS - If any other type of joint is proposed to be used, it shall conform to the requirements of these specifications that apply, and the Contractor shall obtain written approval of the Engineer for its use. Connections to unlike materials must also be pre-approved, in writing, and may require Class “A” bedding (concrete cradle) at the connection joint. When joining pipe sections via a coupler, a Fernco Strong Back RC Series Repair Coupling or an approved equal shielded coupler shall be used to connect the existing to the new sewer pipe.

(d) TRACER WIRE. The work covered by this section of the specifications consists of the furnishing of all labor, supplies, equipment and materials and performing all operations in connection with the installation of tracer wire and appurtenances, as shown on the plans, as herein specified and directed by the Engineer to comply with Senate Bill 18-167. The bill requires that all new underground facilities, including laterals up to the structure or building being served, installed on or after August 8, 2018, must be electronically locatable when installed per section 9-1.5-103(10), C.R.S.

(1) Tracer wire installation shall be performed in such a manner that allows proper access for the connection of line tracing equipment, the proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
(2) Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed. Any damage occurring during installation of the tracer wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
(3) Tracer wire shall be installed at the top of the pipe and secured (taped/tied) at 5' intervals.
(4) Tracer wire must be properly grounded as specified.

(5) Tracer wire on all service laterals/stubs must terminate at an approved tracer wire access box located directly above the utility, at the edge of the road right-of-way but out of the roadway. (See *TRACER WIRE TERMINATION/ACCESS*)
(6) At all mainline dead-ends, tracer wire shall go to ground using an approved connection to a drive-in magnesium ground rod, buried at the same depth as the tracer wire. (See *GROUNDING*).
(7) Mainline tracer wire shall not be connected to existing conductive pipes. Treat it as a mainline dead-end and ground using an approved waterproof connection to a ground rod buried at the same depth as the tracer wire.
(8) All service lateral tracer wires shall be a single wire, connected to the mainline tracer wire using an approved mainline to lateral lug connector, installed without cutting/splicing the mainline tracer wire.
(9) In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall be connected using approved splice connectors and shall be properly grounded at the splice location as specified.
(10) All service lateral tracer wires must be properly connected to the mainline tracer wire to ensure full tracing/locating capabilities from a single connection point. Lay mainline tracer wire continuously, by-passing around the outside of manholes/structures on the north or east side. Tracer wire on all sewer laterals must terminate at the property line with a coil of 6 feet of tracer wire taped directly to the service lateral at the edge of the road right-of-way or at an approved location.
(11) The City of Pueblo Wastewater Department must be contacted to inspect tracer wire installation prior to backfilling any infrastructure that connects to the City's sanitary sewer system.
(12) The following methods shall not be allowed:

(i) Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another
(ii) Tracer wire wrapped around the corresponding utility
(iii) Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.
(iv) Connecting tracer wire to any conductive utilities

11.3.12 BACKFILLING

The line, grade, joints and bedding of the sanitary sewer shall be inspected and approved by the Engineer before backfilling operations commence.

If Class "A" Cradle Bedding or Reinforced Concrete Encasement has been constructed, no backfilling shall commence until the concrete has either attained a compressive strength of 2000 pounds per square inch, or seven (7) days have elapsed.

After the initial backfill (bedding) has been carefully placed in the pipe zone to at least one foot (1') above the top of the pipe, the remainder of the trench shall be backfilled and compacted. Depositing of the backfill material shall be done so that the impact of falling material will not damage the pipe or structures.

Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to the adjacent ground, existing improvements, or improvements installed under the contract. The Contractor shall make their own determination in this regard.

The Contractor shall employ whatever equipment and methods are necessary to obtain the

moisture and required density. All soils within the compaction limits shall be compacted to ninety-five percent (95%) of the maximum dry density as defined by AASHTO T99 (Standard Proctor). Moisture content for all compacted soils shall be within plus or minus 2% of the optimum unless field observation verifies that the soils are unstable at lesser moisture contents. In those cases, the Engineer shall establish a minimum moisture content.

On all sewer installations, compaction tests shall be made by an approved, independent testing laboratory and shall identify the location and depth of the test, the date of the test, the maximum Standard Proctor density and optimum moisture content of the soil, and give the percent of compaction and moisture content of the backfill material at the test location. Compaction tests shall be made at a depth of three feet (3') above the top of the pipe and at two-foot (2') intervals in depth, up to and including the surface. Testing shall be done at a minimum of one location for every 250 feet of main line trench or a fraction thereof and at every manhole or similar structure. Where excavations for service lines branch off the main trench, every fourth service line trench shall be tested.

All test locations shall be randomly spaced as directed by the Engineer. These tests shall be made at the expense of the Contractor and are intended to give the Contractor and City an indication of the effectiveness of the compaction procedure and shall not relieve the Contractor of any provisions of this specification. **All Compaction tests shall be submitted and accepted by the City prior to the construction of any surface improvements.**

If any compaction test should fail to meet the requirements of this section, at least two (2) additional locations shall be tested along the trench, at locations designated by the Engineer, to determine the extent of the non-compliance. After the extent of non-compliance has been determined, that section of trench shall be re-compacted and retested at a minimum of two (2) locations as directed by the Engineer. If the failure occurs at a service lateral, another lateral shall be tested in addition to the non-compliance testing requirements.

In the event of settlement or subsidence of a particular excavation or any part thereof, the Contractor shall be responsible for all repaving, overlay and repair costs occasioned thereby for a period of two (2) years after the project/subdivision acceptance date.

If requested by the Contractor/Developer, and written permission is granted by the City Engineer, backfill for utility trenches may be consolidated using water induced settlement techniques (jetting/puddling). This method of trench backfill consolidation shall only be allowed in those special locations where a failure history exists for trenches using conventional engineered controlled fill. As a condition of permission to use jetting/puddling, the Contractor/Developer must agree in writing to provide a full and complete three (3) year warranty from the final acceptance date, that shall include the repair of any surface amenities to the complete satisfaction of the City which may include a full width asphaltic overlay if warranted.

Where backfill for utility trenches within the roadway section are consolidated using jetting/puddling, the moisture and density requirements within the trench compaction limits stated above shall not apply; however, the compaction limits for the finished roadway subgrade as outlined under *ARTICLE 7 - EARTHWORK* shall apply.

11.3.13 MANHOLE CONSTRUCTION AND ADJUSTMENT

Manhole bases and barrels shall be constructed of the material as specified in *Section 11.2 - MATERIALS*, unless otherwise specified on the plans or by the Engineer. Contractor shall wait a minimum of twenty-four (24) hours before setting manhole barrel sections on cast-in-place bases. No backfilling shall commence around the manhole bases until the concrete has either attained a compressive strength of 2,000 pounds per square inch, or seven (7) days have

elapsed.

The flow channel shall be made to conform in slope and shape to that of the sewer pipe and wherever possible, the lower one-half of the sewer pipe shall be used for the invert of the open flow channel. At intersections with other lines, channels shall be formed with a sweeping curve to minimize turbulence.

When branch mains are being connected to a manhole with collector or backbone mains, the smaller pipe diameter, the branch main, invert must be higher than the larger pipe, the collector or backbone main, to avoid any interruption in flow in the branch main, per *City of Pueblo Sanitary Sewer Design Criteria Manual Table 4.3 Design Depth of Flow*. Unless otherwise specified on the plans or specifications, all manhole channels shall be constructed with a minimum elevation drop as shown:

HORIZONTAL DEFLECTION ANGLE OF SEWER PIPE AT MANHOLE	MINIMUM DROP
0^o	0.10' *
Between 0^o & 45^o	0.20'
45^o to 90^o	0.30'

Changes in direction at the intersections of sewers shall not be greater than 90 degrees.

* The minimum drop at a manhole with a 0-degree pipe deflection can be less than 0.10 feet when the grades of the pipe entering and exiting the manhole are the same and the pipe is laid continuously through the manhole, using the bottom half of the pipe as the channel.

Connection to an existing manhole shall be made so that the inlet flowline is above the existing concrete manhole base. When connection to an existing manhole is allowed, the contractor shall cut into the existing manhole to install the new sewer pipe and provide a water stop and non-shrink grout for a watertight connection. A concrete channel shall be formed within the existing manhole to provide a smooth discharge from the new pipe to the existing channel.

An external drop manhole shall be constructed when the difference between the elevation of the inlet and outlet flowlines is two feet (2') or greater. Internal drop manhole assemblies will not be allowed. See *Manhole Base Section with Drop Assembly Detail, SD24.* Epoxy coating of the manhole may be required at the discretion of the Engineer due to high hydrogen sulfide production from excessive drop distances, per *Section 4.14 of the city of Pueblo Sanitary Sewer Design Criteria Manual.*

When pipe is used as the channel in manholes, no pipe joint shall be allowed in the manhole unless otherwise specified on the plans. Dead end manholes shall have a channel extended a minimum of three feet (3') inside the manhole at the same grade as the sewer pipe.

All manhole ring and covers in streets to be paved shall initially be constructed to a height to the top of the subgrade or twelve inches (12") below the proposed finished pavement grade, whichever is less. When adjusted to a finished pavement grade, the manhole ring and cover shall be constructed so that the top of the manhole ring and cover will be flush ($\pm$ 1/4") with the replacement pavement or the grade established by the Engineer, and shall have at least one (1) four inch (4") thick precast concrete or high density polyethylene adjustment ring. Adjustment rings shall not exceed twelve inches (12") in height. High density polyethylene adjustment rings must be pre-approved by the Engineer before use and be rated for HS-20 loading.

Contractor shall salvage rings and covers removed from existing manholes. Rings and covers

shall become the property of the City.

When connecting to an existing manhole with rebar steps, the steps shall be removed by cutting them flush with the wall of the manhole. Where rebar steps are removed, the exposed rebar ends shall be sealed with a Rustoleum Enamel Paint or an approved equal.

When trenchless methods are used to rehabilitate manholes, the interior surface of the manholes will be coated with 100% solid, self-priming, ultra-high build epoxy applied to a minimum thickness of 125 mils with an airless spray gun applicator. To ensure a 125 mils thickness, a wet film thickness gauge shall be used to verify thickness during the application process. A micro-gauge may be used after application to ensure no shrinkage has occurred after the curing process. The contractor may have an ultrasound on hand to show thickness is being met. Apply epoxy coatings in accordance with the manufacturer's instructions. The epoxy coating shall completely cover all manhole walls and bases to the low flow line of the pipe, unless otherwise directed by the Engineer, to ensure a seal from outside water sources. The Contractor shall sawcut a line, "key", between the metal frame and concrete of the manhole wall. The finished surface on all components of the manhole will be smooth and free of sags, ridges, skips, voids, and pinholes.

A *"Manhole Coating"* form must be submitted for each manhole. The form must be submitted at the Pre-Construction Conference for approval. The Contractor may elect to use a form provided by the City of Pueblo. The report shall be submitted to the engineer within one week of completion of testing or as directed by the City for review of the application process. The coating inspection report shall document: project and manhole identification, coating material, dry film thickness and holiday tests results, adhesion testing results if applicable, and City Engineer's signature to verify test results.

Manholes constructed in areas with excessive groundwater tables or in areas identified as having high concentrations of selenium and/or sulfate in the groundwater, as determined by the City Engineer, will be required to be epoxy coated to eliminate any infiltration.

11.3.14 SANITARY SEWER SERVICE LINE INSTALLATIONS

Service lines shall be installed from the main to the right-of-way line or as shown on plans. Connections to manholes are prohibited unless otherwise approved by the Engineer. Lines shall be inspected and approved by the Engineer or designated entity.

Service lines shall be connected to the sewer main, so that the flowline is at or above the spring line of the pipe for 8" and 10" sewer mains and in the top 1/4 of the pipe for 12" and larger sewer mains. Service lines shall not be connected to the City mainline manholes unless otherwise approved by the Engineer.

Sewer service lines shall not protrude into the interior of the sanitary sewer main. Service lines shall connect to the sanitary sewer main in a manner that creates a watertight joint and provides a smooth, continuous interior pipe surface.

All service lines shall be placed on a slope of one-fourth inch (1/4") per one foot (1') from the main to the property line, unless otherwise specified on the plans, standard details or in writing by the Engineer.

The ends of all service lines shall be plugged and marked for location with a 2" x 4" board or other suitable marker extending two feet (2') above grade and three feet (3') below grade in addition to a three inch (3") wide, green, plastic tape tied to the end of the service line and extending to a point six inches (6") above the ground surface. The Contractor shall assist the

Engineer in measurements and locations of constructed service lines and submit "as built" plans.

When reinstating an existing PVC service via an open trench, the Contractor shall use a hard tie, polyvinyl chloride (PVC) fitting. All other services shall be reinstated using a Fernco Strong Back RC Series Repair Coupling or an approved equal, shielded coupler to connect the existing pipe to the new service pipe. The Contractor shall be responsible for all costs incurred for a service line tap not properly located, to include but not limited to excavation and restoration of the missed service.

Bedding shall meet the requirements of Class "B" as per *Section 11.2.11 – BEDDING FOR PIPE, and Section 11.3.10 – PIPE BEDDING LIMITS* and the backfill material shall be similar to that required for sanitary sewer mains as per *Section 11.2.13 – BACKFILL MATERIAL*. All backfill shall be consolidated by the requirements of *Section 11.3.12 – BACKFILLING.*

11.3.15 TESTING AND INSPECTION

No surface improvements shall be constructed over the new sanitary sewer until all testing and televised inspection of the pipe is accepted by the City, unless otherwise authorized by the City. The Contractor shall conduct the testing and be responsible for furnishing all equipment and labor for testing. The Engineer shall verify the accuracy and acceptability of the equipment used and witness all tests.

Any sanitary sewer line where infiltration or exfiltration tests show leakage in the sewer line and/or manholes exceeding fifty (50) gallons per inch diameter, per mile, per day or pipe deflection exceeding five percent (5%) of the inside diameter, will not be accepted. After acceptable backfilling but before construction of surface improvements over any sewer line, tests shall be run to determine whether these limits are exceeded. At the direction of the Engineer, the section between the first two (2) manholes of all projects may be tested before further construction to permit initial observation of the quality of the construction workmanship. Tests shall also be conducted at any time during construction when in the opinion of the Engineer, the quality of the workmanship is questionable. The type of test conducted shall be at the Engineer's discretion . Whenever the rate of infiltration, exfiltration or deflection is found to exceed the allowable amounts, the Contractor shall stop construction. The Contractor may then be required to provide, at their own expense, televised or photographic visual inspection of the interior of the pipe to help determine the reason for failing the testing. The Contractor shall make the appropriate repairs by methods approved by the Engineer and shall retest the sewer until it is satisfactory. No compensation shall be paid to the Contractor for testing, televising, photographing, repairing, or reconstruction to comply with the allowable amounts.

All gravity sewers will be inspected by closed-circuit television, by the City, after other utility installations and acceptance of all testing, but prior to construction of surface improvements over the new sewer unless otherwise authorized by the City. The Contractor shall thoroughly clean all sewers prior to televising by the City. The City requires five (5) working days advance notice for scheduling the televising and will be allowed five (5) working days to complete the television inspection.

(a) INFILTRATION. In areas where excessive groundwater is encountered or in areas identified as having high concentrations of selenium and/or sulfate in the groundwater, an infiltration test or pneumatic pressure test will be required. An excessive amount of groundwater for testing purposes is defined as the amount of groundwater needed to produce over two feet (2') of hydrostatic pressure on the crown of the pipe along the entire test section. The Contractor will be required to prove this by installing manometer tubes at the ends of the test section in the manholes. The determination of groundwater elevation (installation of manometer tubes) shall be in accordance with *Section 8, of the*

Uni-Bell Plastic Pipe Association - Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe (Uni-B-6). If infiltration is less than the allowable amount, the Contractor will still be required to stop any obvious individual leaks that may be observed by the Engineer when so directed.

(1) INFILTRATION TEST. Infiltration tests shall be made by plugging the end of the sewer section being tested at the upper manhole to prevent the entry of water. The amount of infiltration shall then be measured by placing an approved weir in the lower part of the outlet end of the test section. The time for the test shall be of such duration as necessary to achieve stable flow over the weir, but in no case less than two hours. Determination of flow will be made by the direct reading of a calibrated weir or by hydraulic calculations taken at ten-minute intervals beginning after the first hour of lapsed time.

(2) PNEUMATIC PRESSURE TEST. In preparation for a pipe acceptance test using low pressure air, all pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be sealed at both ends with the pneumatic plugs to be checked. The plugs, installed in accordance with the manufacturer's recommendations, shall hold against a pressure of five (5) pounds per square inch gauge (psig) without bracing and without movement of the plugs out of the pipe. However, during actual testing, the Contractor should internally or externally brace the plugs as an added safety precaution. Plugs found acceptable by this testing shall be placed in the test installation and low-pressure air introduced into the sealed line until the internal air pressure reaches four (4) psig greater than the average back pressure of any groundwater that may be over the pipe but not greater than nine (9) psig. The level of groundwater back pressure shall be determined by averaging the readings of groundwater manometer tubes installed at the manholes of the section of pipe being tested. The air pressure correction, which must be added to a 3.5 psig test starting pressure, shall be calculated by dividing the average vertical height, in feet of groundwater above the invert of the pipe to be tested by 2.31. At least two (2) minutes shall be allowed for the air pressure to stabilize. After the stabilization period, the air hose from the control panel to the air supply shall be disconnected and the pressure shall be decreased to 3.5 psig (plus any required air pressure correction) for the start of timing. The portion of line being tested shall be termed "Acceptable" if the time shown, for the given diameters in the following table, elapses before the air pressure drops 0.5 psig from the test starting pressure.

PIPE DIA. (inches)	MINIMUM TIME (min:sec)	LENGTH (L) FOR A MINIMUM TIME (feet)	TIME FOR LONGER LENGTH (sec)
8	3:47	298	0.760L
10	4:43	239	1.187L
12	5:40	199	1.709L
15	7:05	159	2.671L
18	8:30	133	3.846L
21	9:55	114	5.235L
24	11:20	99	6.837L
27	12:45	88	8.653L

Contractors testing equipment shall have 3/8 inch standard female fitting to accommodate the City inspector's gauge and a regulator or a relief valve set no greater than nine (9) psig to avoid over-pressurizing.

(b) EXFILTRATION. Except in areas where excessive amounts of groundwater are encountered, the Contractor shall measure the rate of exfiltration by either a hydrostatic pressure test or a pneumatic pressure test (as outlined above).

(1) HYDROSTATIC PRESSURE TEST. The section to be tested shall be prepared by plugging the lower end of the section and the inlet sewer or sewers of the upper manholes and filling the pipe and upstream manhole with water to a depth of two feet (2') above the top of pipe at the upstream manhole of the test section or two feet (2') above the normal ground water level at the upstream manhole of the test section, whichever is greater. The maximum internal pipe pressure at the lowest end shall not exceed twenty-five feet (25') of head of water or 10.8 psi. Only after the test section has been acceptably isolated and filled with water can the test period begin. The period shall be two hours in duration. Leakage by exfiltration shall be determined by measuring the drop in the water level in the upstream manhole at the end of the test period. The exfiltration test time period may be extended beyond the minimum two-hour period when necessary to effectively determine the source of leakage when test results are unsatisfactory.

(c) DEFLECTION TESTING. All PVC pipe less than twenty-four inches (24") in diameter shall be tested for deflection, after backfilling, by the Contractor by means of a certified mandrel (go-no-go device). The diameter of the mandrel shall be five percent (5%) less than the inside diameter of the sewer pipe. The mandrel shall be pulled through all installed pipes. All testing shall be under the direction of the Engineer.

Pipe shall be removed, replaced and retested if maximum deflection exceeds five percent of the pipe's nominal internal diameter. Pipe shall be retested for deflection by the City of Pueblo prior to the end of the two-year warranty period. Any pipe showing a deflection in excess of five percent (5%), after testing by the City, shall be removed and replaced by the Contractor.

(d) ACCEPTANCE. Acceptance of the pipe in the tested section will be granted by the Engineer only after all defects such as poor alignment, misplaced pipe, and broken pipe have been remedied, and prescribed testing satisfactorily completed. Acceptance of the pipe does not relieve the Contractor of responsibilities imposed by all other sections of these specifications.

Work accomplished under this section will not be measured, nor will it be paid for directly. This work will be considered as incidental to the sanitary sewer pipe and all costs in connection therewith shall be included in the unit price for the pipe.

(e) MANHOLE TESTING. After the epoxy coating has cured in manholes, it shall be inspected and tested per NACE (National Association of Corrosion Engineers) RP0188 specifications.

(1) Holiday Testing. Every manhole shall be tested using high voltage holiday detection equipment (a spark tester). An induced holiday shall be made into the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays in that particular area. The spark tester shall be initially set per manufacturer’s specification but may be increased if it

is insufficient to detect the induced holiday. All detected holidays shall be marked and repaired per the manufacturer's recommendations.

The Contractor shall submit test results to the Engineer no later than one (1) week after testing the epoxy coating. Approved test results shall include test results, date tested, location of the test and shall be signed by the inspector. No payment shall be made for any manhole prior to manhole forms being submitted.

A failed manhole will have one (1) or more sparks in a single vertical foot. Any pinholes, thin areas, or any other imperfections identified by the holiday test will require a repair per the manufacturer's specifications.

(2) Adhesion Testing. The Contractor shall conduct adhesion testing in accordance with ASTM D4541 and D7234. Three-20-mm dollies will be placed on the bottom, middle and top of the manhole. Prepare dollies with a 3,500 psi strength 24 -hour adhesive and score around the dolly for the testing process. If results fail to meet the results in the table found in the *Epoxy Coating Table, Section 11.2.6 (b),* the test will be considered failed. If two out of three tests fail, additional tests will be performed. Testing will include 25% of the manholes in the Project picked at random. During the testing, if more than 50% of manholes fail of those initially tested, ALL manholes in the Project will be subject to testing or as directed by the Engineer. If subsequent tests fail, all manholes could be considered unacceptable and will be subject to removal and reapplication of epoxy. The Contractor shall repair all test sites after adhesion tests have been performed. No additional cost to the project will be paid to perform all adhesion tests and epoxy coating patch due to testing. A Type V automatic self-aligning adhesion tester shall be used per ASTM 4541 specifications.

(f) TRACER WIRE TESTING. All new tracer wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the Contractor and Engineer, prior to acceptance of ownership. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project. Continuity testing in lieu of actual line tracing shall not be accepted.

11.3.16 CLEANING SEWERS AND APPURTENANCES

The sewers and all appurtenances shall be thoroughly cleaned at the Contractors expense under the direction and to the satisfaction of the Engineer before final acceptance of the work. In the event the City has to perform any cleaning, the Contractor will be charged $550 per hour for the cost of labor, equipment, and materials.

11.3.17 REPLACING SIDEWALKS, CURB AND GUTTER, BASE COURSE, PAVING, ETC.

Where sidewalks, curb and gutter, culverts, etc., are removed within the limits of the work, the Contractor shall compact the backfill as specified under the applicable Article, and shall then replace sidewalks, curb and gutter, culverts, etc., in accordance with the prevailing City Specifications for the class of work involved. Sidewalk and curb and gutter removals shall be in accordance with *ARTICLE – 4 CONCRETE, Section 4.8.3. and Section 4.8.2.* Where grassed areas are encountered, the Contractor shall replace all sod with sod of similar characteristics to that adjacent.

A Concrete Permit is required for all concrete work within the City of Pueblo. A "no fee" Concrete Permit shall be issued by the City Engineering Division for City funded projects. Any

concrete work placed without benefit of both permit and inspection by Public Works will not be paid for.

11.3.18 GRAVEL SURFACED STREETS OR ALLEYS

When trenches are excavated in streets or alleys which have only a gravel surface, the Contractor shall replace such surfacing on a compacted backfill with gravel conforming to *ARTICLE 6 - AGGREGATE BASE CONSTRUCTION, CLASS 6*, equal in depth to that which originally existed or a minimum thickness of two inches (2"). The surface shall conform to the street or alley grade as set by the Engineer. Where the completed surface settles below the finished grade, additional gravel base course material shall be placed and compacted immediately to restore the roadbed surface to finished grade and to allow drainage.

11.3.19 CONCRETE AND ASPHALT PAVEMENT REMOVAL AND REPLACEMENT

When concrete pavement is removed, the removal shall be to an existing joint or to a sawed joint which is made prior to the removal.

The final edges of the asphalt removed and replaced shall be along a straight line, neatly sawed to a depth which allows the pavement to be removed with no disturbance to the asphalt left in place.

The edges of the pavement (either concrete or asphalt) removal and replacement shall extend one foot (1') beyond the edge of the excavation required for pipe installation. The edges of the pavement shall be clean, straight, and free from jagged intrusions and loose pieces. If the edges of the pavement are not straight, the Contractor shall saw cut back to a point where a straight edge can be maintained or overlay the asphalt patch with a minimum of 3x the nominal aggregate size asphaltic overlay, extending two feet (2') beyond the edges of the asphalt patch. Concrete or asphalt removed from the trench surface shall not be used in the initial backfill, and all pieces exceeding eight inches (8") in any dimension shall be removed from the site.

If the distance from the lip line of the curb & gutter to the trench is less than four feet (4’), all asphalt shall be removed from lip to the trench line.

11.3.20 ASPHALT PAVED STREETS

When trenches for public mains are excavated in streets that have an asphalt surface, the Contractor shall replace such surfacing as follows:

(a) Place controlled low strength materials (CLSM) (flowable fill) having a minimum thickness of two (2) feet below the hot asphalt bituminous pavement.

(b) Place hot bituminous asphalt pavement wearing surface having a minimum compacted thickness equal to the original pavement, or four inches (4"), whichever is greater.

All the foregoing materials and methods of application shall comply with *ARTICLE 6 - AGGREGATE BASE CONSTRUCTION and ARTICLE 8 - PAVEMENT.*

Outside of trench areas, the Contractor shall restore damaged bituminous surfaced streets to the condition which existed prior to construction. The Contractor shall make these repairs at their own expense if the damage is a result of their operations.

11.3.21 CONCRETE PAVED STREETS

When trenches are excavated in streets constructed of concrete, the Contractor shall replace said concrete with an equivalent concrete pavement. Said concrete pavement shall have a

minimum thickness conforming to *ARTICLE 8 - PAVEMENT* and shall be placed on six inches (6") of Class 6 base conforming to *ARTICLE 6 - AGGREGATE BASE CONSTRUCTION.*

Outside of trench areas, the Contractor shall restore damaged concrete surfaced streets to the condition which existed prior to construction. The Contractor shall make these repairs at their own expense if the damage is a result of their operations.

11.3.22 CONCRETE CURB AND GUTTER, SIDEWALK, DRIVEWAY, ALLEY PAN AND DIP REMOVAL

Concrete curb and gutter, sidewalks, driveways, alley pans and dips shall be removed to the limits designated by the Engineer. All joints (except expansion joints) shall be saw cut prior to removal unless otherwise directed by the Engineer. Any concrete broken or disturbed by the Contractor outside of the designated limits shall be replaced at the expense of the Contractor at no cost to the project. Sawing shall be considered incidental and subsidiary to the pipeline excavation. See *ARTICLE 4 – CONCRETE* for additional requirements.

11.3.23 CITY RESERVES RIGHT TO DO REPAVING OR RESURFACING OF STREETS

The City reserves the right to do the repaving or resurfacing of the streets even though the Proposal lists quantities for doing such work. The Engineer may direct the Contractor to omit any portion or all repaving or resurfacing, in which case the Contractor shall not be entitled to any adjustment or allowance in contract prices.

11.3.24 ASPHALT OR CONCRETE UNAVAILABLE OR INCLEMENT WEATHER ON COMPLETION OF BACKFILL

Upon completion of backfill operations, if hot bituminous asphalt or concrete is unavailable or the weather is inclement, a temporary asphalt surface - cold mix or other approved material - having a two inch (2") minimum thickness shall be installed immediately on the surface of the trench, cut, or hole in an asphalt or concrete street, walk, curb and gutter, etc. before the Contractor leaves the excavation site or continues the trench to the next block, intersection, or alley, unless otherwise allowed by the Engineer. Cold mix asphalt and its placement shall be furnished at the Contractor's expense and shall not be a pay item.

As soon as hot bituminous asphalt or concrete becomes available, the temporary asphalt surface shall be removed and replaced with permanent asphalt or concrete in accordance with the prevailing City construction and material specifications for the class of work involved by the Contractor. See *ARTICLE 8 – PAVEMENT* for additional requirements.

11.3.25 GREASE AND SAND INTERCEPTORS

Grease interceptors and sand interceptors shall have a minimum of two (2) compartments and shall be capable of the separation and retention of grease and the storage of settled solids. Interceptor design shall conform with the requirements of the *Plumbing Code per Section 16-8-4 of the Pueblo Municipal Code.* A control manhole over each compartment for monitoring purposes shall be required and installed at the owner/operator’s sole expense. Covers shall have a gas tight fit. The interceptor shall be designed, constructed and installed for the calculated loading. Flow control devices shall be required where the water flow through the interceptor may exceed its rated flow. Interceptors shall be installed in a location outside the building which is easily accessed at all times for inspections, cleaning and proper maintenance, including pumping.

Grease interceptors and sand interceptors shall be vented in accordance with the Plumbing Code. The vent shall terminate not less than six (6) inches above the flood-rim level or in accordance with the manufacturers' instructions.

Grease interceptor and sand interceptor capacity calculations shall be performed by the food or engine service facility based on the size and type of operation according to the formula contained in the Plumbing Code. Where sufficient capacity cannot be achieved with a single unit, installation of interceptors in a series is required.

Grease or sand interceptors shall be constructed at the Contractor/Developer's expense and shall not be a pay item.

11.4 METHOD OF MEASUREMENT

Method of measurement for sanitary sewer construction shall be as follows:

(a) Manholes – Each manhole removed and/or constructed of various sizes shall be counted for payment by the contract unit. Each manhole repaired using cementitious material and/or epoxy coating of various sizes shall be measured by the vertical foot from the invert of the manhole to the top rim of the manhole.

(b) Sanitary Sewer Pipe - The length of sanitary sewer pipe of various sizes and types shall be measured in linear feet along the alignment of the centerline of the pipe from the face of the manhole to face of the manhole unless a connection is made to an existing stub.

(c) CLSM (Flowable Fill) – Flowfill (when required) will be measured by the individual weigh tickets for each truckload. Weigh tickets shall be from state certified scales, shall be furnished to the inspector, signed by the driver and include the following information:

Date
Time Dispatched
Quantity in Cubic Yard
Project
Destination
Truck No.
Material Type

(d) Service Lines - The length of service lines of various sizes shall be measured in linear feet along the alignment of the centerline of the pipe for actual pipe installed.

(e) Reconnect Service Lines - Each service line reconnected to the sanitary sewer main shall be counted for payment.

(f) Earthwork, Excavation, Trenching and Backfilling - Unless otherwise specified, these items will not be measured for separate payment but will be considered as incidental to the item to which it applies and shall be included in the unit price for that item, unless rock is encountered as described in section *11.3.8 - TRENCHES IN ROCK.*

(g) Rock Excavation - Rock excavation shall be measured for payment by the cubic yard. In measuring the number of cubic yards of rock excavation, the width of the trench excavated will be multiplied by the average depth from the surface of the rock to a point six (6) inches below the outside bottom of the sewer pipe. This result multiplied by the length of the trenched rock and divided by twenty-seven (27) will give the number of cubic yards allowed for payment.

(h) Trench Stabilization Material - Approved material used to stabilize the subgrade shall be measured for payment by the ton as evidenced by weight tickets for each truckload or fraction thereof.

(i) Imported Backfill Material - Approved backfill material to replace unsatisfactory material shall be measured for payment by the ton as evidenced by weight tickets for each truckload or fraction thereof.

(j) Class "A" Concrete Cradle Bedding - Concrete cradle bedding shall be measured for payment by the linear foot.

(k) Class "B" Pipe Bedding - Pipe bedding will not be measured for separate payment but will be considered as incidental to the sanitary sewer pipe and all costs in connection therewith shall be included in the unit price for the pipe.

(l) Reinforced Concrete Encasement - Reinforced concrete encasement shall be measured for payment by the linear foot.

(m) Gravel Surface Replacement - Aggregate base to replace the gravel lost during excavation on gravel surfaced streets or alleys will be measured by the individual weigh tickets for each truckload from state certified scales. Weigh tickets shall be furnished to the inspector, signed by the driver and include the following information:

Date
Time Dispatched
Gross Weight
Tare Weight
Net Weight
Project
Destination
Truck No.
Material Type
State allowable Gross Vehicle Weight (GVW)

(n) Sidewalk and Driveway Replacement - Sidewalk and driveway replacement shall be measured for payment in square feet of concrete of the specified thickness measured in place, completed and accepted.

(o) Curb and Gutter Replacement - Curb and gutter replacement will be measured for payment in accordance with all applicable items as described in *ARTICLE 4 - CONCRETE, Section 4.8.2 - Method and Payment.*

(p) Curb and Gutter, Sidewalk, Driveway, Alley Pans, Dips, and Concrete and Bituminous Pavement Removal - The removal and disposal of curb and gutter, sidewalk, driveway, alley pans, dips, and concrete and bituminous pavement will not be measured for separate payment but will be considered as incidental to the pipe and structure items and all costs in connection therewith shall be included in the unit price for that item, unless otherwise noted in the bid schedule.

(q) Concrete Pavement Replacement - Concrete pavement replacement shall be measured for payment on the linear foot basis of the specified thickness, completed and accepted, measured in place along the centerline of the sewer main or service lines.

(r) Hot Bituminous Pavement Replacement - Hot bituminous pavement replacement shall be measured for payment on the linear foot basis of the specified thickness, completed and accepted, measured in place along the centerline of the sewer main or service lines.

(s) Concrete Alley Pan, Dip or Double Gutter Replacement - The replacement of concrete

alley pans, dips, and double gutters shall be measured for payment in square feet of concrete of the specified thickness, measured in place, completed and accepted.

11.5 BASIS OF PAYMENT

All costs in connection with the proper, safe and successful completion of the work, including furnishing all materials, equipment, supplies, and appurtenances; equipment and tools; and performing all necessary labor and supervision to fully complete the work in accordance with these specifications and the standard details, shall be included in the unit and lump sum prices bid. All work not specifically set forth as a pay item in the Proposal shall be considered a subsidiary obligation of the Contractor and all costs in connection therewith shall be included in the prices bid. When there is no unit price shown in the proposal, the price will be negotiated.

Basis of payment for sanitary sewer construction shall be as follows:

a. Manholes – Constructed manholes will be paid for at the contract unit price per manhole and this shall include the ring and cover castings and adjustment sections, precast sections, and all items incidental to complete the manhole, in accordance with these specifications and the Standard Details.Manholes repaired using cementitious material and/or epoxy will be paid for at the contract unit price for various sizes which are placed, tested and accepted as measured in the field. Payment will only be made after manhole forms have been submitted and approved.
b. Sanitary Sewer Pipe - Sanitary sewer pipe will be paid for at the contract unit price for the various sizes and types, installed complete in place. Said price shall include all excavation, shoring, bedding, joint materials, plugs, bypass pumping, temporary connections, connection to existing manholes, all other materials, to construct in accordance with these specifications and the *Standard Details and Pavement Impact Fees as outlined in Section 12-6-4.1 of the City Code of Ordinance*. No payment will be made for pipe until backfilling, compaction tests, deflection (go-no-go) test, exfiltration and/or infiltration tests have been accepted by the Engineer.
c. Tracer Wire – Tracer wire will be paid for at the contract unit price for the tracer wire and appurtenances, installed complete in place. Said price shall include all wire, access boxes, grounding, and all other materials, to construct in accordance with these specifications and the Standard Details. No payment will made for tracer wire until the tracer wire has been accepted by Engineer.
d. CLSM (Flowable Fill) - Payment shall be made by the number of cubic yards delivered and placed in accordance with the plans and specifications and accepted by the Engineer. Any material delivered to the site without a weight ticket will not be paid for.
e. Service Lines and Reinstate Service Lines - Service lines and the reconnection of service lines will be paid for at the contract unit price and shall be full compensation for placed and accepted pipe, including all fittings, plugs and markers in accordance with these specifications.
f. Rock Excavation - Rock excavation will be paid for at the contract unit price and shall include the payment for any additional foundation or bedding material required and disposal of the rock removed which will not meet the requirements for backfill.
g. Trench Stabilization Material - Trench stabilization material will be paid for at the contract unit price and shall include all work to furnish the approved material and the disposal of the unsuitable material.
h. Imported Backfill Material - Imported backfill material will be paid for at the contract unit price and shall include all work to furnish the suitable material and disposal of the unsuitable material.

i. Class "A" Cradle Bedding - Payment for Class "A" Cradle Bedding, will be paid for at the contract unit price, complete in place.
j. Reinforced Concrete Encasement- Reinforced concrete encasement will be paid for at the contract unit price, complete in place.
k. Gravel Surface Replacement – Payment shall be made for by the number of tons delivered and placed in accordance with the plans and specifications and accepted by the Engineer. Material delivered in trucks that exceed the rated GVW (Gross Vehicle Weight) will be used but the excess over GVW will not be paid for. Any material delivered to the site without a weight ticket will not be paid for.
l. Sidewalk and Driveway Replacement- Sidewalk and driveway replacement will be paid for at the contract unit price, complete in place.
m. Curb and Gutter Replacement - Curb and gutter replacement will be paid for at the contract unit price, complete in place.
n. Concrete Pavement Replacement - Concrete pavement replacement will be paid for at the contract unit price and shall include furnishing and placing concrete pavement, and base under the new concrete, if required.
o. Hot Bituminous Pavement Replacement - Hot bituminous pavement replacement shall be paid for at the contract unit price, complete in place.
p. Concrete Alley Pan, Dip or Double Gutter Replacement - The replacement of concrete alley pans, dips, and double gutters shall be paid for at the contract unit price, complete in place. Said unit price shall include replacement with the specified thickness of concrete, reinforcing bars and base material, if required.

11.6 PRIVATE SEWERS

11.6.1 DESCRIPTION

Private sanitary sewers are not allowed unless otherwise authorized by the City Engineer, and consistent with the requirements of the Sanitary Sewer Design Criteria and Policies. The information covered by this specification consists of construction standards, inspections, and minimum requirements for “Private Sewers.” The term “Private Sewers” as used in these specifications shall mean a building sewer which receives the discharge from more than one (1) building drain and conveys it to a public sewer and is installed and maintained by an approved designated authority. Private sewers are not part of the public sanitary sewer system.

11.6.2 PLANS AND DATA

Profiles of the ground or a detailed utility plan shall be shown on the plans for the work. The Contractor must satisfy themselves regarding the character of the material to be excavated and the work to be done.

11.6.3 MATERIALS

The requirements for *Section 11.2 – MATERIALS* are applicable to private sewers. It is the intent of this section to include Section 11.2 by reference and all provisions are applicable as though they were listed herein, unless specifically excepted or modified. In addition, cleanout covers (when required) shall withstand H-20 loading in traffic areas.

11.6.4 CONSTRUCTION REQUIREMENTS

Many portions of Section 11.3 are applicable to private sewers; however, there are some exceptions and discrepancies. It is the intent of this section to include Section 11.3 by reference and all provisions are applicable as though they were listed herein, unless specifically

excepted or modified. All references to the negotiation of “extra work” are deleted for private sewers.

Section 11.3.08 – TRENCHES IN ROCK is amended to read as follows:
Whenever rock material is encountered, as defined in *Section 11.3.8*, the Contractor shall immediately notify the Engineer. The Engineer will then direct the Contractor as deemed necessary.

Section 11.3.11(b) – CLASS “B” BEDDING is amended to read as follows:

The sewer pipe shall be set on a minimum of four inches (4”) of Class “B” Bedding material carefully shaped to fit the lower part of the conduit exterior for a width of at least 60% of the pipe breadth and for the entire pipe length. After setting the sewer pipe, Class “B” Bedding shall be added and properly tamped around the lower half of the pipe (haunches) for the full width of the trench, and the bedding shall be consolidated carefully without disturbing the pipe alignment or grade. For eight-inch (8”) diameter and larger pipe, additional Class “B” Bedding material shall be added up to a minimum of twelve inches (12”) above the top of the pipe for the full width of the trench.

Section 11.3.16 – TESTING AND INSPECTION, delete all references to the City televising the sanitary sewer main.

11.6.5 PERMITS AND FEES

Prior to installing any private sewer main, the Contractor shall obtain a permit from the Regional Building Authority. An inspection fee shall be assessed to all private sewers. The fee shall be paid prior to the issuance of the permit and the amount shall be in accordance with the fee schedule established by the Regional Building Authority. If a private sewer is installed without obtaining a permit, the Contractor will be required to pay two (2) times the regular fee schedule and/or will be required to pothole the sewer at various locations as directed by the Engineer. Cut sheets shall be submitted for review and approval to the City of Pueblo – Department of Public Works, two (2) working days prior to the start of construction.

ARTICLE 12

STORM SEWERS

12.1 GENERAL

12.1.1 DESCRIPTION

The work covered by this specification consists of furnishing all labor, equipment, tools, materials necessary to install storm sewer pipe and appurtenances as shown on the plans and as specified herein. The term "Storm Sewer" as used in these specifications also applies to "Culverts" and all provisions apply unless noted otherwise.

12.1.2 PLANS AND DATA

Profiles of the ground or a detailed utility plan shall be shown on the plans for the work. The Contractor must satisfy himself regarding the character of the material to be excavated and the work to be done.

12.1.3 SITE INVESTIGATION

Contractor acknowledges the nature and location of the work, the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, uncertainties of weather, physical conditions at the site, the character/quality of surface and subsurface materials to be encountered, the character of equipment and facilities needed prior to and during the work, and all other matters which can in any way affect the work or the cost thereof under this contract. Failure by Contractor to acquaint himself with all the available information concerning these conditions will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the work.

12.2 MATERIALS

12.2.1 PIPE MATERIALS

Acceptable storm drain construction materials to be used for all public infrastructure include ASTM C76 Class III reinforced concrete pipe (RCP) and High Performance (HP) Storm Polypropylene Pipe manufactured by Advanced Drainage System, Inc. (or approved equal). Approved HP Storm Polypropylene Pipe diameters range in size from 15” to 60”. Other materials may be considered on a case-by-case basis for private development projects that will not be publicly maintained. **Only the type of pipe designated on construction documents will be allowed.**

Acceptable storm drain construction materials to be used for private development projects include ASTM C76 Class III reinforced concrete pipe (RCP), High Density Polyethylene (HDPE) with smooth interior, High Performance (HP) Storm Polypropylene Pipe manufactured by Advanced Drainage System, Inc. (or approved equal), or Polyvinyl Chloride (PVC). **Only the type of pipe designated on construction documents will be allowed.**

For pipes sizes larger than 60 inches in diameter, **only RCP will be allowed.**

When plastic pipe with flared end sections is to be installed, the end section shall be steel or reinforced concrete as approved by the Engineer. Concrete collars will be required to join

reinforced concrete flared end section to the plastic pipe. Plastic flared end sections are not acceptable.

12.2.2 REINFORCED CONCRETE PIPE (RCP)

Concrete pipe shall be made using Type I/II cement or a 7-sack mix design and shall be a minimum of Class III unless shown otherwise on the drawings, and shall conform to the following AASHTO / ASTM designation:

	AASHTO	ASTM
Storm Drain and Sewer Pipe (RCP)	M 170	C76
Precast Manhole Sections	M 199	C 478
Arch Pipe	M 206	C 506
Elliptical Pipe	M 207	C 507
Joints, Using Rubber Gaskets	M 315	C 473
Precast Reinforced Concrete Box Sections	M 259	C 1577 or C 1433
Joints, Using Rubber Gaskets (Box Culverts)		C 1677
Joints, Using Mastic Gaskets		C 1990

Prior to pipe laying operations, the Contractor shall submit a letter from the pipe manufacturer certifying that the minimum areas of steel (RCP) and concrete strengths are in compliance with the applicable AASHTO specification and strength classification. The pipe manufacturer's facility shall be certified annually by the American Concrete Pipe Association. Representatives from the City shall be allowed full access to the facility to observe all phases of the pipe manufacturing process and to review all records pertaining to pipe testing. The City reserves the right to reject pipe based upon visual observations of apparent defects or departures from the tolerance standards.

Joints for storm drains or manholes shall be either bell and spigot or tongue and groove. Jointing material for concrete pipe shall be a preformed, flexible plastic sealing compound which conforms to Federal Specification SS-S-00210 (GSA-FS6) "Sealing Compound Preformed Plastic for Expansion Joints and Pipe Joints". The sealant shall be made of top-grade vulcanized butyl rubber which is compressible and has a tacky surface for adherence to the joint. The material shall be capable of being installed in the temperature range from zero to one-hundred degrees Fahrenheit (0 - 100°F).

12.2.3 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

High density polyethylene pipe shall have a smooth interior wall (Type S) and shall conform to AASHTO M 294. Joints shall be a gasketed bell and spigot fitting. Acceptable products are "N-12 WT IB" as manufactured by Advanced Drainage Systems, Inc. or an approved equal. The joining of pipe shall be in strict conformance with the manufacturer's recommendations or the Contract Documents, whichever is more stringent. Only pipe diameters 15" through 36" will be allowed. Installation of High-Density Polyethylene pipe (HDPE) must meet the following conditions described below:

(a) Where there are discrepancies between HDPE pipe installation specifications and City of Pueblo Standard Specifications, the more stringent specifications will apply.

(b) Where HDPE pipe enters a manhole, flowable fill must be used to ensure proper support beneath the pipe. Flowable fill must be installed to the spring line of the highest HDPE pipe and within the area of manhole excavation.

(c) Upon completion of installation and backfill, the contractor must demonstrate that the pipe has not deflected more than 5% of the pipe diameter, including manufacturing tolerances.

(d) HDPE pipe may not be used in Public Right-of-Way or adjacent to a street that has classification as a Collector or higher designation.

(e) The maximum allowable height of backfill as measured from the top of pipe to finished grade shall be limited to ten feet (10').

12.2.4 HIGH PERFORMANCE POLYPROPYLENE PIPE (HPPP)

Only pipe diameters 15" through 60" pipe will be allowed. High Performance Polypropylene Pipe supplied shall be smooth interior with annular exterior corrugation meeting the requirements of ASTM F2881 for respective diameters.

Pipe shall be joined using bell & spigot joints, meeting the requirements of ASTM F2881. The join shall be watertight according to the requirements of ASTM 3212. Gaskets shall meet the requirements of ASTM F477.

Fittings shall conform to ASTM F2881. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM 3212. Gaskets shall meet the requirements of ASTM F477.

All High Performance Polypropylene Pipe storm sewer shall be installed in accordance with ASTM D2321. Please refer to the HPPP Storm Trench Installation Detail for all other installation requirements.

12.2.5 BEDDING FOR PIPE

(a) CLASS "B" BEDDING – Suitable material for RCP shall be Class "B" bedding a well-graded crushed stone. When tested by means of laboratory sieves it shall conform to the following requirements: (AASHTO M43, NO. 67 gradation)

SIEVE SIZE	PERCENT PASSING
1 in.	100
¾ in.	90
3/8 in.	20 – 55
No. 4	0 – 10
No. 8	0 – 5

When crushed gravel or stone is used, at least 50 percent, by weight, of the particles retained on the No. 4 sieve and above shall have at least two (2) fractured faces.

(b) CLASS I OR II BEDDING – Suitable material for HDPE and HPPP shall be Class I or II. The contractor shall provide documentation for material specification to engineer. Fill shall be placed in six (6)-inch lifts with a minimum compaction of 95% per the city standards for both cohesive and cohesion less soils. Unless otherwise noted by the engineer, minimum bedding thickness shall be 6" for all pipe sizes. The

middle 1/3 beneath the pipe invert shall be loosely placed. See ADS's "109 Classes of Embedment and Backfill Materials Detail" for bedding specifications.

12.2.6 TRENCH STABILIZATION MATERIAL

Backfill for unstable subgrade conditions shall be select material as approved by the Engineer. Contractor shall submit a sample and sieve analysis for City Engineer's review and approval prior to delivery of the materials to the site.

12.2.7 CONCRETE MANHOLES

Unless otherwise specified on the plans, or approved by the City Engineer, manholes shall be constructed of precast concrete barrels and cones with cast-in-place concrete bases. Bases may be precast if placed on six inches (6") of compacted gravel bedding extending a minimum of twelve inches (12") around the base or the width of the excavation-whichever is greater. In the event severe groundwater conditions are encountered, the thickness of the gravel bedding below the manhole base shall be increased to twelve inches (12"). Alternate construction methods may be required as approved by the Engineer on a case-by-case basis. The concrete channel and bench within precast bases shall be poured on site after the storm sewer pipe is set to grade. Where possible, manhole channel shall be storm sewer pipe with the upper portion removed. Precast concrete barrels and cones shall conform to ASTM C478 Standard Specifications except that the wall thickness may be either wall A or wall B as described in ASTM C76

Standard Specifications. Provide eccentric cones for all manholes greater than six feet (6') deep, and flat lids for manholes six feet (6') deep or less as shown on the drawings. Manholes shall conform to the Standard Details shown on the plans. Concrete used in the construction of all storm sewer structures shall conform to those portions of ARTICLE 4 – CONCRETE and ARTICLE 5 – STRUCTURAL CONCRETE, which are applicable.

All joints in the manhole barrel, cone, grade adjustment rings, and flat top sections shall be sealed with a preformed flexible plastic sealing compound conforming to Federal Specification SS-S-00210 (GSA-FS6). All joint surfaces shall be cleaned prior to applying the sealant. The outside of the manhole joints shall be wrapped with a butyl adhesive tape sealant that conforms to Federal Specification SS-S-00210 (GSA-FS6). The eccentric cone section shall be situated so that the slope of the cone section is pointing toward the downstream direction.

All pipe penetrations shall be an approved flexible connection, mechanical seal, water stop, or non-shrink grout to reduce infiltration and exfiltration. When grouting is necessary at a water stop connection, non-shrink grout shall be used.

Manholes are required whenever there is a change in size, direction, elevation, grade, or where there is a junction of two or more drains. A manhole may be required at the beginning and the end of the curved section of storm drain. The maximum spacing between manholes is 500 feet for pipes with a vertical dimension of 42 inches and larger, and 400 feet for pipes with a diameter of less than 42 inches. The required manhole size shall be in accordance with values shown below:

Storm Drain Diameter (inches)	Manhole Diameter (feet)
15 to 18	4
>18 to <42	5
42 to 54	6
Larger than 54	Appropriate manhole size from CDOT Standard Plan No. M-604-20

Larger manhole diameters or a junction structure may be required when large diameter pipe alignments are not straight through manholes or when more than one storm drain line goes through the manhole. A special structure is required for 42-inch or larger pipe when the angle of deflection is more than 45 degrees.

12.2.8 INLETS

Inlets (Catch Basins) shall be constructed of cast-in-place concrete in accordance with the standard detail of the type and size shown on the drawings. Precast concrete inlets may be used when approved by the Engineer with the added requirements shown on the "Pre-Cast Inlet Detail". Shop drawings for all precast inlets must be submitted to the Engineer for approval prior to installation. If differing site conditions require modifications to the precast inlet, the cost to modify or replace the inlet will be borne solely by the contractor. Inlets fabricated prior to the completion of the inlet piping will be at the contractor's risk.

The standard inlets permitted for use in the city are provided in the below:

Standard Inlet Types in City of Pueblo	
Inlet Type	**Use Permitted**
CDOT Type R Curb Opening	All street types
Slotted Inlet Parallel to Flow	Streets or open areas
CDOT Type D	Streets or open areas
CDOT Type C Grate	All streets with a roadside or median ditch
CDOT/Denver 13 Valley Grate	Alleys or drives with a valley gutter (private areas only)
Denver No. 16 Combination	All street types

The City may consider other inlet types for retrofit projects if the applicant demonstrates that the City's standard inlet types are unsuitable. The use of inlet types that are not listed in the Table above will require a variance.

Further guidance and requirements are provided in the *City of Pueblo Drainage Criteria Manual, April 2023.*

12.2.9 MANHOLE RING AND COVER ADJUSTMENT

(a) CONCRETE GRADE RINGS. Reinforced concrete grade rings may be used in the adjustment of manhole rings. Grade rings shall have a minimum thickness of two inches (2") and maximum thickness of six inches (6"). Total adjustment height shall not exceed the tolerances as shown on the Standard Details.

(b) HIGH DENSITY POLYETHYLENE (HDPE) GRADE RINGS. High Density Polyethylene grade rings may be used in the adjustment of manhole rings. Grade rings shall be rated for HS-20 loading. Total adjustment height shall not exceed the tolerances as shown on the Standard Details.

12.2.10 CASTINGS AND MANHOLE RING & COVERS

Iron castings shall conform to the requirements of AASHTO M306. Gray iron used in the casting shall conform to AASHTO M105, Class 35B, unless otherwise specified.

Castings shall be boldly filleted at angles and the risers shall be sharp and perfect. Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes or other defects in positions affecting their strength for services intended. The ring and covers for manholes and all storm sewer appurtenances shall be straight and shall fit properly together so that traffic will not cause them to rattle. Rough spots, which prevent a suitable fitting, shall be removed by grinding. Manhole castings shall be Neenah R-1706, Deeter 1258, East Jordan Ironworks 2430 or approved equal. The informational logo “No Dumping / Drains to River” shall be cast on the covers. Other castings shall be as shown on the Standard Details. See City Standard Details for additional information.

12.2.11 RIPRAP

Riprap shall consist of hard, dense, sound, rough fractured stone as nearly cubical as practicable. Thin slab type stones and flaking rock shall not be used. The stone shall have a specific gravity of at least 2.5. Concrete rubble is not acceptable for use as rip rap unless approved by the Engineer.

Stones shall be well graded in order that the voids can be filled. At least fifty percent (50%) of the mass shall be stones equal to or larger than the stone size called for on the plans. Stone size shall not be larger than the thickness of the riprap layer.

Riprap shall be placed to conform to the plan details. The larger size stones composing the riprap material shall be placed first and roughly arranged in close contact. The spaces between the larger stones shall then be filled with smaller stone of suitable size, so placed as to leave the surface evenly stepped, conforming to the contour required. The material may be machine placed with sufficient hand work to accomplish requirements of this specification.

Excavation for riprap shall be made to a neat line. Allowance will not be made for work outside of the neat line.

All riprap shall require filter fabric as specified in section 12.2.12 FILTER FABRIC.

12.2.12 FILTER MATERIAL

Class A filter material shall consist of free draining sand, gravel, or crushed stone. The material shall be uniformly graded from coarse to fine and shall meet the following gradation requirements:

SIEVE SIZE	PERCENT PASSING
3”	100
¾”	20-90
No. 4	0-20
No. 200	0-3

12.2.13 FILTER FABRIC

Filter fabric shall be a nonwoven polypropylene material conforming to the minimum performance specifications outlined below and designed for use under riprap. Acceptable products are Supac 4NP manufactured by Phillips 66, 0401T manufactured by Advanced Drainage Systems, Inc., or an approved equal.

Min. Thickness (mils) ASTM D1777	40
Min. Grab Strength (md/cd, %) ASTM D4632	50
Min. Grab Elongation (md/cd, %) ASTM D4632	50
Min. Burst Strength (psi) ASTM D3786	155
Min. Puncture Strength (lbf) ASTM D4833	55
Min. Permeability (cm/sec) ASTM D4491	0.2
Max. A.O.S. (Std. Sieve) ASTM D4751	35

12.2.14 TRACER WIRE

Refer to Standard Detail Drawings SD31 thru SD36.

12.3 CONSTRUCTION REQUIREMENTS

12.3.1 WATER LINE AND SANITARY SEWER CROSSINGS

Where storm sewer mains cross water mains, sanitary sewers or other non-potable lines, the storm sewer pipe shall be a minimum of eighteen inches (18") clear distance vertically below the water main or sanitary sewer. If this clear distance is not feasible, the crossing utility section must be designed and constructed so as to protect the water main or sanitary sewer. Minimum protection shall consist of the installation of an impervious and structural sewer. For example:

(a) REINFORCED CONCRETE ENCASEMENT. The sanitary sewer pipe shall be reinforced with a reinforced concrete encasement. The encasement shall be at least six inches (6") thick and extend a distance of ten feet (10’) either side of the water main or storm sewer. See Section 11.3.11 - PIPE BEDDING LIMITS, REINFORCED CONCRETE ENCASEMENT.

(b) JOINT CENTERING. The sewer shall be constructed such that one length of pipe, at least eighteen feet (18') long, shall be centered over the water main or storm sewer. Joints between the sewer pipe and special length pipe (18' section of pipe) shall be encased in a concrete collar at least six inches (6”) thick and extending at least six inches (6”) either side of the joint.

In all cases, proper soil compaction, suitable backfill or other structural protection shall be provided to preclude settling and/or failure of either pipe.

12.3.2 RAILROAD AND HIGHWAY CROSSINGS

At all railroad and highway crossings extreme care shall be exercised to safeguard life and property. All storm sewer work under and adjacent to railroads and highways shall be accomplished to the satisfaction of a representative of the railroad company and/or Colorado Department of Transportation (CDOT) and the Engineer. The Contractor shall obtain at his own expense all permits, bonds, and insurances necessary for the execution of his work, and/or required by the appropriate railroad or CDOT. Contractor shall submit a plan for approval for crossing railroads or highways unless otherwise shown on drawings.

12.3.3 EXCAVATION - GENERAL

All excavation for storm sewer and/or manhole construction will be considered as unclassified excavation. Excavation shall conform to ARTICLE 7 – EARTHWORK, Section 7.3.2 General Excavation.

12.3.4 TRENCH EXCAVATION - WIDTH AND DEPTH

The width of the trench shall provide adequate space for workers to place, join the pipe, and bed the pipe properly.

The minimum width of the trench from a plane six inches (6") below the pipe to a plane twelve inches (12") above the pipe shall be a minimum of nine inches (9") clear on each side from the undisturbed edge of the trench wall to the outside diameter of the pipe. This minimum trench width shall also be used for measurement of trenches in rock.

In order to protect the pipe from external loads in excess of those used in the design of the pipe, it is necessary to limit the width of the lower portion of the trench below an elevation 12 inches above the top of the installed pipe to 6” below the invert of the pipe. The trench from a plane six inches (6") below the pipe to a plane twelve inches (12") above the pipe shall be excavated so the trench walls are as close to vertical as possible. The maximum trench width within this zone will not be limited but shall be kept as narrow as possible.

When using a movable trench support, care shall be exercised not to disturb the pipe location, jointing and bedding material. Any voids left in the bedding material by support removal shall be carefully filled with additional bedding material and properly tamped. The width and slope of the trench from a plane twelve inches (12") above the pipe to the top of the ground shall be determined by the Contractor. Considering factors shall include, but not be limited to; all safety requirements; type of material being excavated; equipment used; widths of dedicated right-of-ways; and adjacent structures, property, and utilities.

The trench bottom shall be constructed to provide a firm, stable and uniform support for the full length of the pipe. Except in ledge rock, water bearing earth, or where a special pipe bedding is called for in the contract documents, the rough excavation of trenches shall extend no less than six inches (6") below the bottom of the pipe.

Correction of a trench grade that is too low shall be done by compacting select material of the types designated by the Engineer, over the entire width of the trench to 95% of AASHTO T99. Such work required due to over excavation will not be included for payment.

Trench excavation shall meet the requirements of ARTICLE 7 – EARTHWORK, SECTION 7.3.2(5) TRENCH EXCAVATION.

12.3.5 HANDLING EXCAVATED MATERIAL

The material excavated from trenches that is suitable for backfill shall be kept so as not to significantly alter drainage flow patterns, endanger the work and to be of as little inconvenience as possible to the traveling public and the occupants of the abutting properties. Free access must be maintained at all times to driveways, fire hydrants, water valves, gas valves, existing manholes, etc., in the vicinity of the work.

Where lines are located in alleys or in any other case where the Contractor proposes to deposit material on private property, written permission shall be obtained from the owner of the property prior to placing any material on the property. The Contractor shall be held responsible for any damage to private property.

Materials encountered during clearing of the right-of-way and excavation of the trench such as rubbish, organic material, abandoned foundations and any other material which are not satisfactory for use as backfill in the opinion of the Engineer, shall be removed from the site and disposed of by the Contractor at his own expense.

12.3.6 UNSTABLE SUBGRADE

Where unstable subgrade conditions are encountered, as determined by the Engineer, the Contractor may be required to excavate below subgrade elevation and backfill the unstable area with material as per Section 12.2.6 - TRENCH STABILIZATION MATERIAL. The material approved by the Engineer shall be used to an elevation six inches (6") below the bottom of the pipe. The extra depth of excavation and backfill shall be as ordered by the Engineer, and only when ordered by the Engineer.

If the unstable condition is a result of the Contractor not properly protecting his work from surface water infiltration, or from sewer or water lines damaged or broken by the Contractor, the cost shall be borne by the Contractor. If the unstable soil condition is the result of ground water infiltration and other causes beyond the control of the Contractor, the extra foundation material ordered by the Engineer will be paid for.

Unstable subgrade shall meet the requirements of ARTICLE 7 – EARTHWORK, SECTION 7.3.2(5)(c) REMOVAL OF UNSTABLE MATERIAL.

12.3.7 TRENCHES IN ROCK

Rock will be defined as any naturally occurring or manmade material in such a form that it cannot be readily removed using the equivalent of a 165hp/40,000lb operating weight track-type tractor (bulldozer) with a ripper or a 188hp/63,000lb operating weight hydraulic excavator (crawler mounted backhoe) with “rock teeth” without a significant loss of production. It also includes boulders exceeding one-half (½) cubic yard in volume.

Whenever rock material is encountered in an excavation, the Contractor shall immediately notify the Engineer for field verification. The Engineer shall measure and document the limits of the rock prior to excavation. Any rock removed prior to notification will not be considered for payment. After rock has been measured, trenching shall continue by such means as may be necessary, to a depth of six inches (6") below the outside bottom of the pipe, and to a width in conformance to Section 12.3.4 - TRENCH EXCAVATION - WIDTH & DEPTH.

Blasting for rock excavation will only be allowed with the written permission from the Engineer and Fire Chief. The Contractor shall exercise the utmost care to protect the public from harm and to avoid property damage. Blasting shall be done by a State licensed blaster. The Contractor shall comply with all laws, ordinances, insurance, bonding, and applicable safety code requirements and regulations and shall be responsible for all damage caused by the blasting operations. Signals warning persons of danger shall be given before any blast.

Blasting shall be controlled as not to make any excavation unduly large or irregular. Excessive blasting or overshooting shall not be permitted. The Engineer shall have authority to order any method of blasting discontinued which leads to overshooting or is dangerous to the public or destructive to property or to natural features. Approved blasting blankets shall be used for all blasting.

12.3.8 QUICKSAND AND GROUNDWATER INFILTRATION

Should running sand, quicksand or groundwater be encountered, the work shall be pushed with utmost vigor. Groundwater encountered in trench or manhole excavations shall be drained to sumps, through sub-drains, or by other methods to keep the water level below the bottom of the bell of the pipe while joints are being made. Dispose of the water in a manner to prevent damage to adjacent property. Drainage of groundwater through any sanitary sewer pipeline is prohibited. Drainage of ground water during construction through any storm sewer pipeline will be allowed. All dewatering and trench stabilization methods and type of equipment used shall be approved by the Engineer and in compliance with the City’s MS4 permit.

If dewatering and trench stabilization is required as a result of the Contractor not properly protecting his work from surface water infiltration, or from sewer or water lines damaged or broken by the Contractor, the cost shall be borne by the Contractor. In the event such work is required through no fault of the Contractor, it shall be considered extra work and a price shall be negotiated.

12.3.9 EXCAVATION FOR STRUCTURES

Excavation for manholes, inlets, vaults, and miscellaneous structures shall consist of the removal of all material necessary for construction of the work in conformity with the plans and these specifications.

If rock is encountered, the excavation shall be done in such a manner as to allow the rock to be exposed and prepared for receiving the concrete. All loose and disintegrated rock or thin strata shall be stripped to a clean bed acceptable to the Engineer and in conformance to all applicable items as described in Section 12.3.7 - TRENCHES IN ROCK.

Whenever the footing is to rest on any excavated surface other than rock, special care shall be

taken not to disturb the bottom of the excavation (subgrade), and the final finishing of the surface shall not be done until just before the footing is to be placed. Correction of any over excavated areas shall be at the Contractor's sole expense.

Whenever the subgrade soil is not sufficiently firm, the Contractor is to furnish and compact, according to the direction of the Engineer, select material, as may be required and in conformance to all applicable items as described in Section 12.3.6 - UNSTABLE SUBGRADE.

After each excavation is completed, the Contractor shall notify the Engineer, who shall make an inspection of the depth of the excavation and character of the foundation material. No concrete shall be placed until after the Engineer has approved the depth of the excavation and character of the foundation material.

An Excavation Permit is required for any underground work within the City of Pueblo. The “no-fee” permit shall be obtained from the City Streets Division at 211 E. “D” Street. Any work placed without benefit of this permit will not be paid for.

12.3.10 PIPE BEDDING LIMITS

Unless stated otherwise on the plans or details or ordered by the Engineer, RCP pipe shall be bedded in accordance with Class "B" bedding as described below and HPPP & HDPE pipe shall be bedded in accordance with Class “I” or “II” bedding as described below. All classes of bedding shall be properly tamped around the lower half of the pipe (haunches) and horizontally away from the pipe in both directions to the undisturbed trench walls.

(a) CLASS “B” CRADLE BEDDING. The sewer pipe shall be set on a minimum of six inches (6") of Class "B" bedding material carefully shaped to fit the lower part of the conduit exterior for a width of at least 60% of the pipe breadth and for the entire pipe length. After setting the sewer pipe, Class "B" bedding shall be added and properly tamped around the lower half of the pipe (haunches) for the full width of the trench, and the bedding shall be consolidated carefully without disturbing the pipe alignment or grade. Additional Class "B" bedding material shall be added up to the spring line of the pipe.

(b) CLASS I or II BEDDING. The storm sewer pipe shall be set on a minimum of six inches (6") of Class "I" or “II” bedding material carefully shaped to fit the lower part of the conduit exterior for a width of at least 60% of the pipe breadth and for the entire pipe length. After setting the storm sewer pipe, Class "I" or “II” bedding shall be added and properly tamped around the lower half of the pipe (haunches) for the full width of the trench, and the bedding shall be consolidated carefully without disturbing the pipe alignment or grade. Additional Class "I" or “II” bedding material shall be added up to a minimum of twelve inches (12") above the top of the pipe for the full width of the trench.

12.3.11 PIPE LAYING

Before any pipe laying shall occur cutsheets shall be submitted to the Stormwater Utility Division for approval. No pipe laying shall occur prior to cutsheet approval. Cutsheets shall match the approved subdivision construction drawings on file with the City. See below for further cutsheet requirements:

a) 25 ft stake intervals

b) Stationing matching approved plans
c) Field Stationing
d) Grade
e) Cut/Fill
f) Slope
g) Description of pipe section

Pipe shall be protected during handling against impact shocks and free fall. Proper methods shall be used for handling and placing pipe to avoid spalling or breaking and to avoid unnecessary disturbance of the bedding surface in the trench bottom. Pipe shall be kept clean at all times and no pipe shall be used in the work which does not conform to these specifications. Pipes shall be laid to a true line and at uniform rates of grade between manholes and/or inlets as shown on the plans. The laying of the pipe in prepared trenches shall commence at the lowest point with the spigot ends pointing in the direction of flow. No pipe shall be laid in water or when trench conditions are unsuitable for such work.

The Contractor shall take every precaution necessary to prevent dirt, debris or surface water from entering the existing lines or new construction.

The Contractor shall submit a plan for handling existing storm sewer flows while rehabilitating the pipe at the pre-construction meeting for approval by the City. The bypass plan must be designed in accordance with the approved traffic control plans and identify the location of any pumping equipment, temporary discharge piping, pumping and discharge manholes, redundant pumps and piping, the location of nearby waterways or drainages, and the method for diverting runoff around the site. The Contractor shall be responsible to obtain all existing flow measurements in the storm sewer to determine a bypass plan. Precautions must be taken to ensure that storm sewer flow control operations do not cause damage to property being served by the storm sewers involved. Bypass pumping will not be allowed during nonworking hours unless authorized by the Engineer. When 24-hour pumping operations have been approved by the Engineer in residential areas, attenuated pumps will be required to minimize noise disturbance. The Contractor shall provide 100% redundancy on any 24-hour pumping operation, near any waterways or any site deemed necessary by the Engineer. Bypass piping shall be placed in trenches and covered with temporary pavement or metal traffic covers when traffic conditions dictate the need for protection of the piping unless otherwise directed by the Engineer. The Engineer may specify additional design requirements based on specific site conditions.

Each bypass pumping system shall be hydrostatically tested using potable water prior to use. Unless otherwise indicated, water for testing bypass pipelines shall be furnished by the Contractor. The bypass pumping system may require air release valves to release air that may become trapped in the bypass system piping. The bypass pumping system shall be filled at a rate which will not cause any surges or exceed the rate at which air can be released through the air valves. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. Once the system has been successfully filled and all air purged, the piping system exclusive of the pump(s) shall be pressurized to 150% of the calculated working pressure, or 40 psi, whichever is greater, measured at the lowest point along the alignment, and hydrostatically tested for a minimum of 30 minutes. During the test, the entire system shall be visually inspected for leaks and monitored for pressure drop. Any leaks encountered shall be repaired at the Contractors cost, and the hydrostatic pressure test restarted until the system successfully passes the test. Potable water used during the test shall be discharged to the stormwater system at a controlled rate to prevent surcharging of the

stormwater system.

If the City must provide personnel and equipment to minimize damages, in the event of any failure of the Contractor's storm sewer flow control operations, the Contractor shall be liable for all costs incurred by the City. The Contractor will be charged $550 per hour that the City of Pueblo crews are onsite, which will be deducted from the amount of the Contractor's final payment.

a) ALIGNMENT. All pipe shall be laid to the lines and grades given by the Engineer with joints close and even, butting all around. They shall be carefully centered and shall not deviate more than one inch (1") from line so that when laid will form a storm sewer with a uniform invert and a straight alignment unless a specified curve alignment is shown on the plans.

   The grade of the pipe shall be obtained by the use of batter boards and a "top line," batter boards with a double string line having a minimum of four feet (4') separation, a laser beam, or by the use of surveying instruments approved by the Engineer. The grade shall not be obtained by placing a carpenter's level on individual pipes.

   If batter boards are used, the Contractor shall at all times where pipe laying is in progress, maintain batter boards for a distance covering at least three grade stakes. The elevation of the batter boards shall be determined from the depth of cut as given by the Engineer, and the Contractor shall keep on each crew a person whose duty it shall be to see that the batter boards are in proper place at all times. It is not intended that these requirements shall make it necessary for the Contractor to keep a person especially for this purpose, but to provide that a competent person shall be with each crew at all times whose duty it shall be to attend to the placing of the batter boards and the giving of grades to the pipe layer.

   If a method other than batter boards is used, the instrument used shall be operated continuously under the supervision of a qualified foreman or superintendent. The pipe grade shall be checked by an alternate method at fifty-foot (50') intervals and upon request of the Engineer.

b) VERTICAL TOLERANCE.

   In no case shall a section of pipe be accepted if it does not possess a positive grade (i.e., no flat or adverse sections). Any pipe not within 0.50% of the existing or designed slope shall be re-laid.

c) JOINTING PIPE. All pipe joints shall be made in the manner and under the conditions described under the various types of joints for the work. Preparatory to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned. All pipe joints shall be watertight when completed.

   (1) HPPP & HPDE JOINTS – Pipe shall be joined using a bell & spigot joint meeting the requirements of ASTM F2881. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477

      (i) Mechanical methods shall be employed, if necessary, to pull or push the pipe together with sufficient force to compress the gasket sufficiently to make a watertight joint.

   (2) REINFORCED CONCRETE PIPE (RCP) JOINTS – Pipe joints shall conform with ASTM C990-09.

(3) OTHER TYPE JOINTS - If any other type of joint is proposed to be used, it shall conform to the requirements of these specifications that apply, and the Contractor shall obtain written approval of the Engineer for its use. Connections to unlike materials must also be pre-approved, in writing, and may require Class “A” bedding (concrete cradle) at the connection joint. When joining pipe sections via a coupler, a Fernco Strong Back RC Series Repair Coupling or an approved equal shielded coupler shall be used to connect the existing to the new sewer pipe.

d) TRACER WIRE – Refer to Standard Detail Drawings SD 32 – SD 39.

12.3.12 BACKFILLING

The line, grade, joints and bedding of the storm sewer shall be inspected and approved by the Engineer before backfilling operations commence.

After the initial backfill (bedding) has been carefully placed in the pipe zone to at least one foot (1') above the top of the pipe, the remainder of the trench shall be backfilled and compacted. Depositing of the backfill material shall be done so that impact of falling material will not damage the pipe or structures.

Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements, or improvements installed under the contract. The Contractor shall make their own determination in this regard.

The Contractor shall employ whatever equipment and methods that are necessary to obtain the moisture and required density. All soils within the compaction limits shall be compacted to ninety-five percent (95%) of the maximum dry density as defined by AASHTO T99 (Standard Proctor). Moisture content for all compacted soils shall be within plus or minus 2% of optimum unless field observation verifies that the soils are unstable at lesser moisture contents. In those cases, the Engineer shall establish a minimum moisture content.

On all storm sewer installations, compaction tests shall be made by an approved independent testing laboratory and shall identify the location and depth of the test, the date of the test, the maximum Standard Proctor density and optimum moisture content of the soil and give the percent of compaction and moisture content of the backfill material at the test location. Compaction tests shall be made at a depth of three feet (3') above the top of the pipe and at two-foot (2') intervals in depth, up to and including the surface. Testing shall be done at a minimum of one location for every 250 feet of main line trench or fraction thereof and at every manhole or similar structure. An additional compaction test is required for each inlet pipe run and may be taken along the pipe or at the inlet at the discretion of the Engineer.

All test locations shall be randomly spaced as directed by the Engineer. These tests shall be made at the expense of the Contractor and are intended to give the Contractor and City an indication of the effectiveness of the compaction procedure and shall not relieve the Contractor of any provisions of this specification. **All Compaction tests shall be submitted and accepted by the City prior to construction of any surface improvements.**

If any compaction test should fail to meet the requirements of this section, at least two (2) additional locations shall be tested along the trench, at locations designated by the Engineer, to

determine the extent of the non-compliance. After the extent of non-compliance has been determined, that section of trench shall be re-compacted and retested at a minimum of two (2) locations as directed by the Engineer. If the failure occurs at a lateral, another lateral shall be tested in addition to the extent of non-compliance testing requirements.

In the event of settlement or subsidence of a particular excavation or any part thereof, the Contractor shall be responsible for all repaving, overlay and repair costs occasioned thereby for a period of two (2) years after the project/subdivision acceptance date.

If requested by the Contractor/Developer, and written permission is granted by the City Engineer, backfill for utility trenches may be consolidated using water induced settlement techniques (jetting/puddling). This method of trench backfill consolidation shall only be allowed in those special locations where a failure history exists for trenches using conventional engineered controlled fill. As a condition of permission to use jetting/puddling, the Contractor/Developer must agree in writing to provide a full and complete three (3) year warranty from the final acceptance date, that shall include repair of any surface amenities to the complete satisfaction of the City which may include a full width asphaltic overlay if warranted.

Where backfill for utility trenches within the roadway section are consolidated using jetting/puddling, the moisture and density requirements within the trench compaction limits stated above shall not apply; however, the compaction limits for the finished roadway subgrade as outlined under ARTICLE 7 - EARTHWORK shall apply.

12.3.13 MANHOLE CONSTRUCTION AND ADJUSTMENT

All provisions of Section 11.3.13 are applicable except that drop manholes are not required unless specified on the drawings.

Manhole bases and barrels shall be constructed of the material as specified in Section 12.2 - MATERIALS, unless otherwise specified on the plans or by the Engineer. Contractor shall wait a minimum of twenty-four (24) hours before setting manhole barrel sections, on cast-in-place bases. No backfilling shall commence around manhole bases until the concrete has either attained a compressive strength of 2,000 pounds per square inch, or seven (7) days have elapsed.

The flow channel shall be made to conform in slope and shape to that of the storm sewer pipe and wherever possible, the lower one-half of the storm sewer pipe shall be used for the invert of the open flow channel. At intersections with other lines, channels shall be formed with a sweeping curve to minimize turbulence.

Unless otherwise specified on the plans or specifications, all manhole channels shall be constructed with a minimum elevation drop as shown:

HORIZONTAL DEFLECTION ANGLE OF SEWER PIPE AT MANHOLE	MINIMUM DROP
0°	0.10'
Between 0° & 45°	0.20'
45° to 90°	0.30'

Changes in direction at intersections of sewers shall not be greater than 90 degrees.

Connection to an existing manhole shall be made so the inlet flowline is above the existing concrete manhole base. When connection to an existing manhole is allowed, the contractor shall cut into the existing manhole to install the new sewer pipe and provide a water stop and non-shrink grout for a watertight connection. A concrete channel shall be formed within the existing manhole to provide a smooth discharge from the new pipe to the existing channel.

For vertical drops greater than 8 feet, special designs are required that address potential cavitation and energy dissipation. These situations will require special review. See Design and Construction of Urban Stormwater Management Systems (WEF and ASCE 1992) for guidelines for drop shaft structures.

All manhole ring and covers in streets to be paved shall initially be constructed to a height to top of subgrade or twelve inches (12") below the proposed finished pavement grade, whichever is less. When adjusted to a finished pavement grade, the manhole ring and cover shall be so constructed that the top of the manhole ring and cover will be flush (± 1/4") with the replacement pavement or the grade established by the Engineer, and shall have at least one (1) four inch (4") thick precast concrete or high density polyethylene adjustment rings Adjustment rings shall not exceed twelve inches (12") in height. High density polyethylene adjustment rings must be pre-approved by the Engineer before use and be rated for HS-20 loading.

Contractor shall salvage rings and covers removed from existing manholes. Rings and covers shall become the property of the City.

12.3.14 TESTING AND INSPECTION

Replace section 11.3.15 - TESTING AND INSPECTION with the following:

Prior to acceptance or payment, the Contractor must provide compaction test results to the City for the backfill compaction tests required in Section 12.3.12 - BACKFILLING.

All storm sewers will be inspected by closed-circuit television, by the City, after other utility installations and acceptance of all testing, but prior to construction of surface improvements over the new storm sewer unless otherwise authorized by the City. The Contractor shall thoroughly clean all storm sewers prior to televising by the City. The City requires five (5) working days advance notice for scheduling the televising and will be allowed five (5) working days to complete the television inspection.

At the City's request, deflection testing by use of a mandrel shall be completed for HPPP and HDPE storm sewer pipe by the contractor or independent agency and paid for by the contractor or owner/developer. Deflection testing shall be done prior to paving and not less than thirty days after installation. The maximum allowable deflection shall not exceed five percent (5%) during the testing. Pipes larger than 36" in diameter may be entered and deflection levels measured directly. Pipe shall be removed, replaced, and retested if maximum deflection exceeds five percent of the pipe's internal diameter.

Pipe shall be inspected by closed-circuit television by the City of Pueblo prior to the end of the two-year warranty period. Any pipe showing damage that could impact the functionality of the pipe e.g., joint disconnection, pipe cracking, gouges, warping, ponding shall be replaced by the Contractor, at their expense. A deflection test may also be performed in which case if excess of

five percent deflection is found the pipe shall be removed and replaced by the Contractor, at their expense.

Acceptance of the pipe will be granted by the Engineer only after all defects such as poor alignment, mislaid pipe, and broken or damaged pipe have been remedied, and the prescribed testing has been satisfactorily completed. Acceptance of the pipe does not relieve the Contractor of the responsibilities imposed by all other sections of these specifications.

12.3.15 CLEANING SEWERS AND APPURTENANCES

The storm sewers and all appurtenances shall be thoroughly cleaned at the Contractors expense under the direction and to the satisfaction of the Engineer before final acceptance of the work. In the event the City has to perform any cleaning, the Contractor will be charged $550 per hour for the cost of labor, equipment, and materials.

12.3.16 REPLACING SIDEWALKS, CURB AND GUTTER, BASE COURSE, PAVING, ETC.

Where sidewalks, curb and gutter, culverts, etc., are removed within the limits of the work, the Contractor shall compact the backfill as specified under the applicable Article, and shall then replace sidewalks, curb and gutter, culverts, etc., in accordance with prevailing City Specifications for the class of work involved. Sidewalk and curb and gutter removals shall be in accordance with ARTICLE – 4 CONCRETE, Section 4.8.3. and Section 4.8.2. Where grassed areas are encountered, the Contractor shall replace all sod with sod of similar characteristics to that adjacent.

A Concrete Permit is required for all concrete work within the City of Pueblo. A “no fee” Concrete Permit shall be issued by the City Engineering Division for City funded projects. Any concrete work placed without benefit of both permit and inspection by Public Works will not be paid for.

12.3.17 STORM SEWER REHABILITATION SPECIFICATIONS

If any part of a stormwater RCP, HDPE, HPPP, or PVC main or lateral is removed or damaged to facilitate a private utility main installation or replacement, then the stormwater main or lateral must be replaced from the point of damage to the nearest inlet or manhole. If any part of a stormwater Vitrified Clay Pipe (VCP) main or lateral is removed or damaged to facilitate a private utility main installation or replacement, then the entire stormwater main or lateral must be replaced including appurtenant structures that may crumble as a result of the replacement. Metallic pipes, including corrugated metal pipes (CMPs) and cast-iron pipes (CIPs), are subject to corrosion and must be Closed-circuit television (CCTV) inspected by the Stormwater Utility Department to determine the condition of metallic pipes. The condition of the metallic pipe will determine the extent of replacement required. Deviations from this requirement must be approved in writing by the Director of Public Works. In no instance will a patch of the break or a repair sleeve in the stormwater pipe be allowed. The stormwater pipe must be installed at the same grade it was found prior to being disturbed. The Stormwater Utility Department must approve the pipe size and material and perform inspections during installation of the damaged stormwater pipe.

The City of Pueblo maintains a list of qualified contractors who have been through a vetting process and possess the qualifications to perform stormwater point repair projects. Only contractors from this list will be allowed to repair damaged stormwater infrastructure. When a point repair project arises, Stormwater Department staff will evaluate the repairs needed,

determine the unit quantities for the work required and determine which of the qualified contractors would be able to complete the repairs at the lowest cost by using the unit prices provided by each contractor in their bid. The point repair will then be offered to the contractor providing the lowest cost.

Compaction testing shall be performed in accordance with Section 12.3.13 of the City of Pueblo Standard Construction Specifications and Standard Details and testing shall be included for the bedding material.

12.3.18 GRAVEL SURFACED STREETS OR ALLEYS

When trenches are excavated in streets or alleys which have only a gravel surface, Contractor shall replace such surfacing on a compacted backfill with gravel conforming to ARTICLE 6 - AGGREGATE BASE CONSTRUCTION, CLASS 6, equal in depth to that which originally existed or a minimum thickness of two inches (2"). The surface shall conform to the street or alley grade as set by the Engineer. Where the completed surface settles below finished grade, additional gravel base course material shall be placed and compacted immediately to restore the roadbed surface to finished grade and allow drainage.

12.3.19 CONCRETE AND ASPHALT PAVEMENT REMOVAL AND REPLACEMENT

When concrete pavement is removed, the removal shall be to an existing joint or to a sawed joint which is made prior to removal.

The final edges of asphalt removed and replaced shall be along a straight line neatly sawed to a depth which allows the pavement to be removed with no disturbance to the asphalt left in place.

The edges of pavement (either concrete or asphalt) removal and replacement shall extend one foot (1') beyond the edge of the excavation required for pipe installation. The edges of the pavement shall be clean, straight, and free from jagged intrusions and loose pieces. If the edges of the pavement are not straight, the Contractor shall saw cut back to a point where a straight edge can be maintained or overlay the asphalt patch with a minimum of 3x the nominal aggregate size asphaltic overlay extending two feet (2') beyond the edges of the asphalt patch. Concrete or asphalt removed from the trench surface shall not be used in the initial backfill, and Article 12-3-24 all pieces exceeding eight inches (8") in any dimension shall be removed from the site.

If the distance from the lip line of the curb & gutter to the trench is less than 4 feet (4’), all asphalt shall be removed from lip to the trench line.

12.3.20 ASPHALT PAVED STREETS

When trenches for public mains are excavated in existing streets having an asphalt surface, the Contractor shall replace such surfacing as follows:

(a) Place controlled low strength materials (CLSM) (flowable fill) having a minimum thickness of one (1) foot below the hot asphalt bituminous pavement.

(b) Place hot bituminous asphalt pavement wearing surface having a minimum compacted thickness equal to the original pavement, or four inches (4"), whichever is greater.

All the foregoing materials and methods of application shall comply with ARTICLE 6 - AGGREGATE BASE CONSTRUCTION and ARTICLE 8 - PAVEMENT.

Outside of trench areas, the Contractor shall restore damaged bituminous surfaced streets to the condition which existed prior to construction. The Contractor shall make these repairs at their own expense if the damage is a result of their operations.

12.3.21 CONCRETE PAVED STREETS

When trenches are excavated in streets constructed of concrete, the Contractor shall replace said concrete with an equivalent concrete pavement. Said concrete pavement shall have a minimum thickness conforming to ARTICLE 8 - PAVEMENT and shall be placed on six inches (6") of Class 6 base conforming to ARTICLE 6 - AGGREGATE BASE CONSTRUCTION.

Outside of trench areas, the Contractor shall restore damaged concrete surfaced streets to the condition which existed prior to construction. The Contractor shall make these repairs at his own expense if the damage is a result of his operations.

12.3.22 CONCRETE CURB AND GUTTER, SIDEWALK, DRIVEWAY, ALLEY PAN AND DIP REMOVAL

Concrete curb and gutter, sidewalks, driveways, alley pans and dips shall be removed to the limits designated by the Engineer. All joints (except expansion joints) shall be saw cut prior to removal unless otherwise directed by the Engineer. Any concrete broken or disturbed by the Contractor outside of the designated limits shall be replaced at the expense of the Contractor at no cost to the project. Sawing shall be considered incidental and subsidiary to the pipeline excavation. See ARTICLE 4 – CONCRETE for additional requirements.

12.3.23 ASPHALT OR CONCRETE UNAVAILABLE OR INCLEMENT WEATHER ON COMPLETION OF BACKFILL

Upon completion of backfill operations, if hot bituminous asphalt or concrete is unavailable or the weather is inclement, a temporary asphalt surface - cold mix or other approved material - having a two inch (2") minimum thickness shall be installed immediately on the surface of the trench, cut, or hole in an asphalt or concrete street, walk, curb and gutter, etc. before the Contractor leaves the excavation site or continues the trench to the next block, intersection, or alley, unless otherwise allowed by the Engineer. Cold mix asphalt and its placement shall be furnished at the Contractor's expense and shall not be a pay item.

As soon as hot bituminous asphalt or concrete becomes available, the temporary asphalt surface shall be removed and replaced with permanent asphalt or concrete in accordance with prevailing City construction and material specifications for the class of work involved by the Contractor. See ARTICLE 8 – PAVEMENT for additional requirements.

12.4 METHOD OF MEASUREMENT

Method of measurement for storm sewer construction shall be as follows:

(a) Inlets and Manholes - Each inlet or manhole constructed will be counted for payment by the contract unit.

(b) Storm Sewer Pipe - The length of storm sewer pipe of various sizes and types shall be

measured in feet along the centerline of acceptably laid storm sewer from inside of wall to inside of wall of manholes and/or inlets, or to end of pipe (excluding flared end sections).

(c) Riprap - Shall be measured by the ton as evidenced by weight tickets or by the cubic yard as measured in the field. Method shall be determined by the bid schedule.

(d) Flared End Section - Flared end sections shall be counted and paid for as each unit installed.

12.5 BASIS OF PAYMENT

Basis of payment for storm sewer construction shall be as follows:

(a) Inlets and Manholes - Payment for inlets and manholes shall be full compensation to construct the complete unit in accordance with these specifications and the Standard Details. It shall include the ring and cover castings, concrete adjustment rings or brick, and all items incidental to the manhole or inlet.

(b) Storm sewer pipe - Storm sewer pipe will be paid for at the contract unit price for the various sizes and types, installed complete in place. Said price shall include all joint materials, plugs, and other materials to construct in accordance with these specifications, and the standard details. It shall include but not be limited to all costs associated with excavation, shoring, bedding, pipe placement, backfill, compaction, water for compaction, clean-up, landscape restoration, etc. No payment will be made for pipe until backfilling, compaction tests, deflection (go-nogo) test have been accepted by the Engineer.

(c) Riprap - Payment for this item shall be full compensation for all labor and material to furnish and install the riprap, including filter fabric and filter material, and excavation, in accordance with these specifications. Class A filter material shall be included in the bid price for riprap and not paid for separately.

(d) Flared End Section - Payment for this item shall be full compensation for all labor and materials to furnish and install the flared end section, including excavation, backfill, coupling adapters and necessary grading to match to a channel or ditch flowline.

REVISION	10/17/2022	09/03/2024			

city of PUEBLO colorado

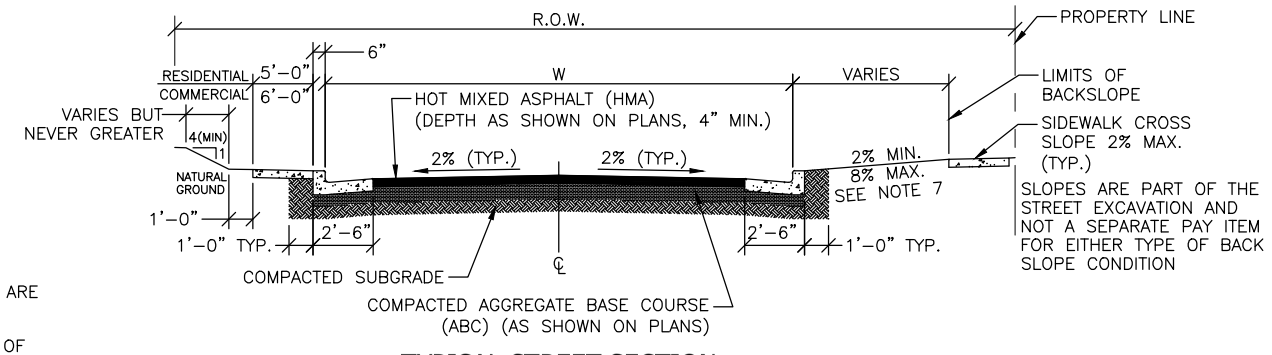
TYPICAL STREET INTERSECTION

PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION
211 EAST "D" ST. PUEBLO, CO 81003
(719) 553-2295 PHONE

SD1

DRAWN BY: JM
CHECKED BY: BQ
APPROVED BY: CR

NOTE: R.O.W. WIDTH AND DIMENSION "W" TO BE SHOWN ON THE PLANS



TYPICAL STREET SECTION

NO SCALE

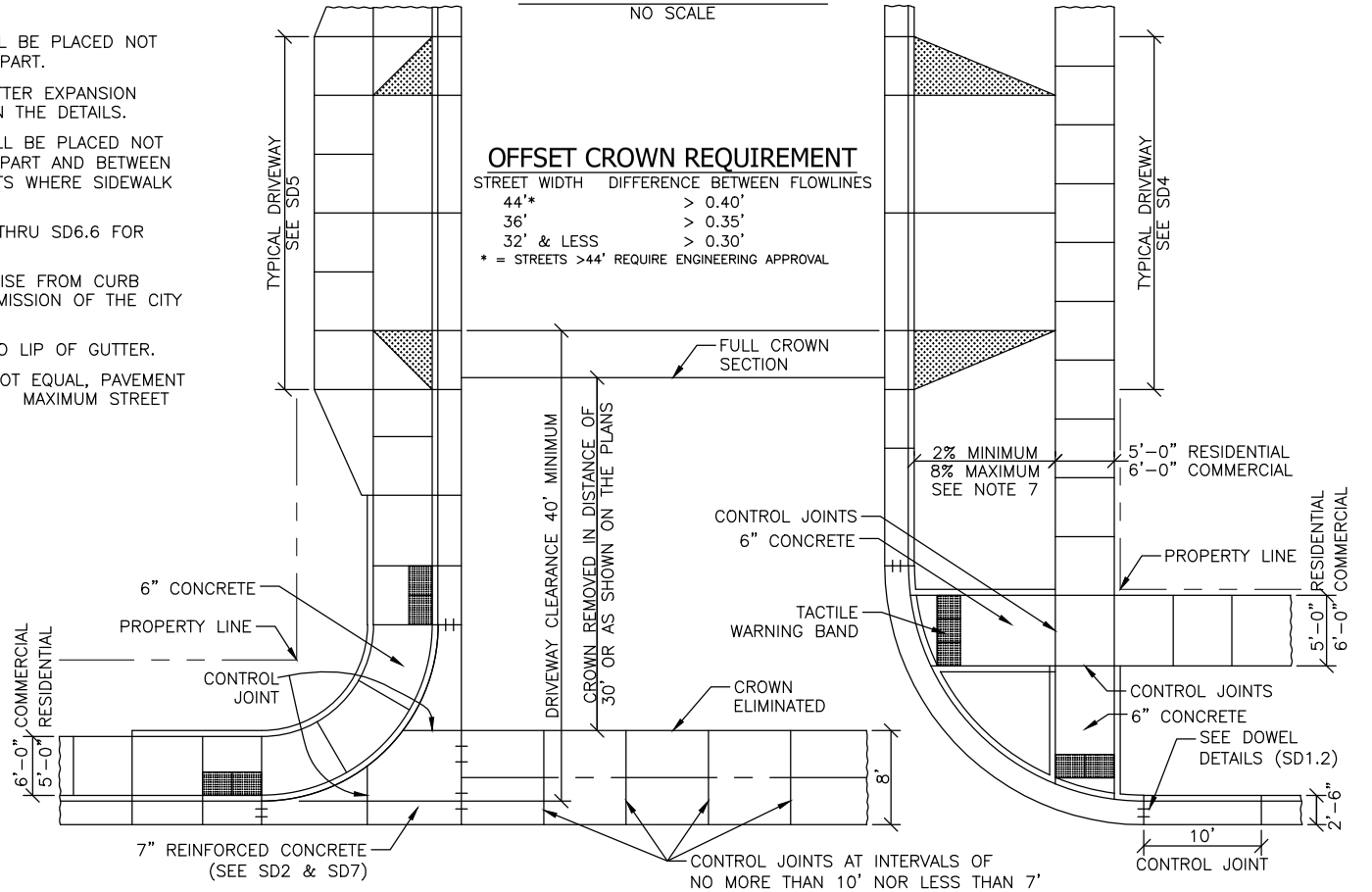
NOTES:

1. ALL UTILITY FIXTURES ENCROACHING ON CONSTRUCTION ARE TO BE MOVED BY OTHERS.
2. ½" EXPANSION JOINTS SHALL BE PLACED AT INTERVALS OF NOT MORE THAN ONE HUNDRED (100) FEET SLOPES IN SIDEWALKS.
3. DOUBLE GUTTER EXPANSION JOINTS SHALL BE PLACED NOT MORE THAN TWO HUNDRED (200) FEET APART.
4. ALL CURB AND GUTTER AND DOUBLE GUTTER EXPANSION JOINTS SHALL BE DOWELED AS SHOWN IN THE DETAILS.
5. CURB & GUTTER EXPANSION JOINTS SHALL BE PLACED NOT MORE THAN TWO HUNDRED (200) FEET APART AND BETWEEN CURB & GUTTER AND SIDEWALK AT POINTS WHERE SIDEWALK ABUTS BUILDING.
6. SEE CURB RAMP DETAILS SD4 & SD6.1 THRU SD6.6 FOR ADDITIONAL REQUIREMENTS.
7. ADA REQUIREMENTS CONTROL MAXIMUM RISE FROM CURB HEAD. MAY EXCEED 8% ONLY WITH PERMISSION OF THE CITY ENGINEER.
8. SLOPE PAVEMENT AT 2% FROM CROWN TO LIP OF GUTTER.
9. WHEN THE FLOW LINE ELEVATIONS ARE NOT EQUAL, PAVEMENT SHALL BE SLOPED 2% FROM HIGHER LIP. MAXIMUM STREET CROSS GRADE SHALL NOT EXCEED 4%.

OFFSET CROWN REQUIREMENT

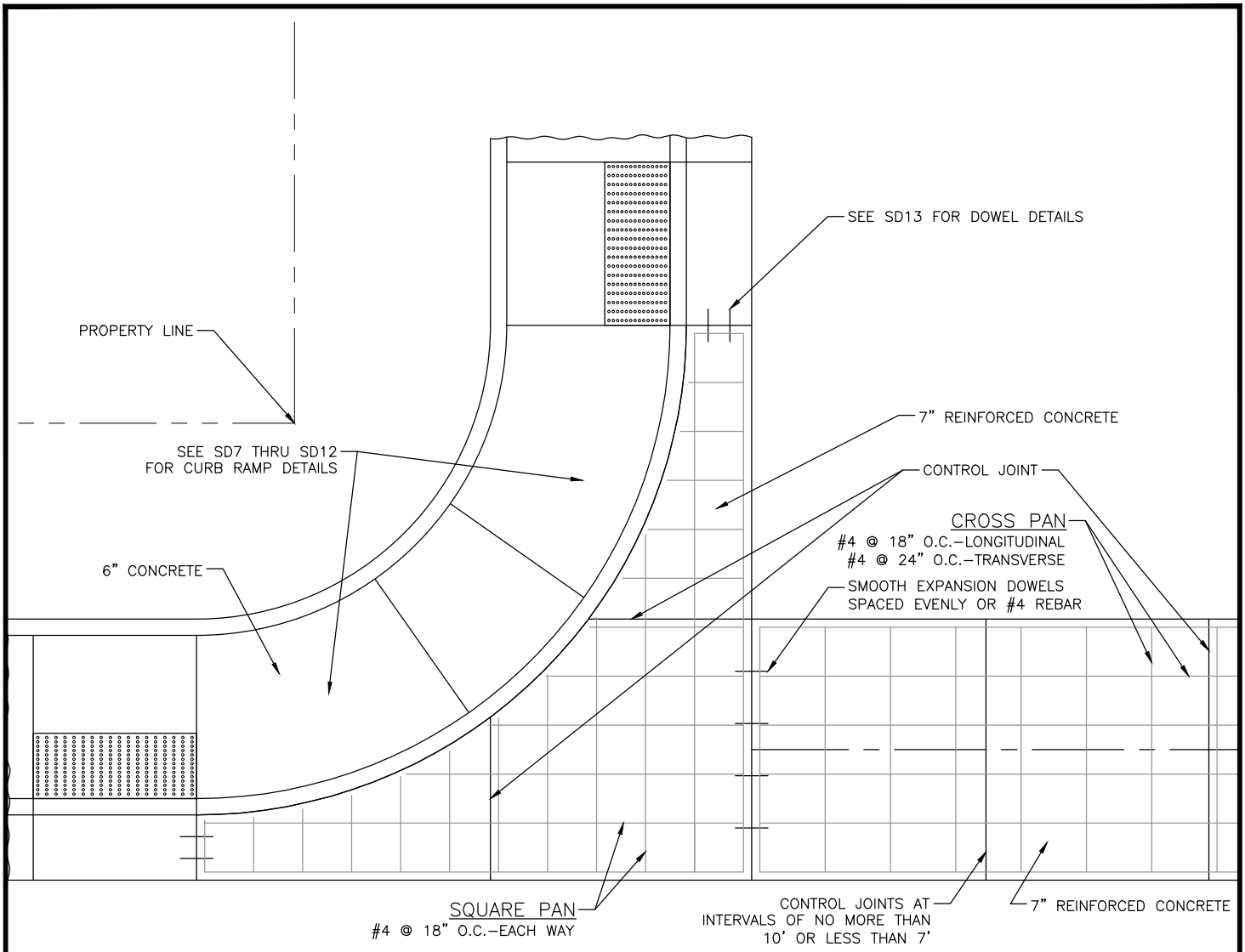
STREET WIDTH	DIFFERENCE BETWEEN FLOWLINES
44'*	> 0.40'
36'	> 0.35'
32' & LESS	> 0.30'

* = STREETS >44' REQUIRE ENGINEERING APPROVAL



PLAN OF TYPICAL STREET INTERSECTION

NO SCALE



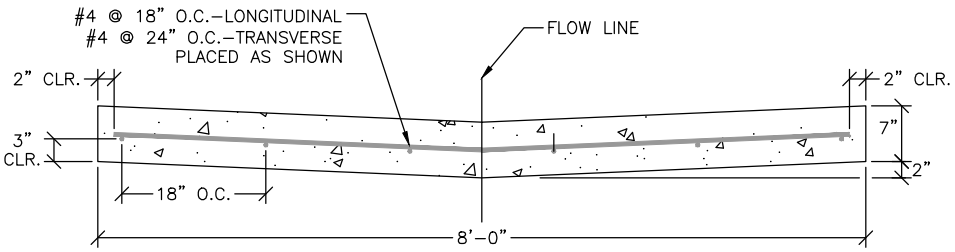
PLAN OF TYPICAL SQUARE PAN & CROSS PAN

SCALE: 1"=5'–0"

NOTES:

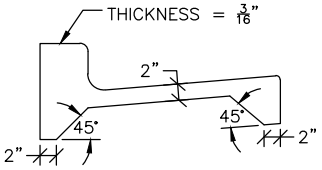
1. THE CONTRACTOR SHALL USE #4–GRADE 60 REINFORCING BARS.
2. ALL REINFORCING SHALL BE SECURELY TIED AND PROPERLY SUPPORTED USING APPROVED CHAIRS.
3. DOUBLE GUTTER EXPANSION JOINTS SHALL BE PLACED NOT MORE THAN TWO HUNDRED (200) FEET APART.
4. ALL CURB AND GUTTER AND DOUBLE GUTTER EXPANSION JOINTS SHALL BE DOWELED AS SHOWN IN THE DETAILS. (SEE SD13 FOR DOWELED DETAILS)
5. SEE CURB RAMP DETAILS FOR CONTROL AND EXPANSION JOINT LOCATIONS AT CORNERS.

09/03/2024 10/17/2022 REVISION	city of PUEBLO colorado	**SQUARE PAN & CROSS PAN DETAIL**	SD2
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR



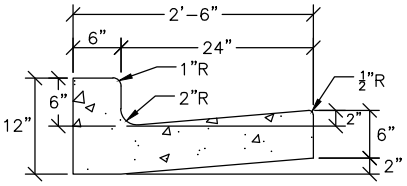
CROSS PAN DETAIL

SCALE: 1"=2'–0"



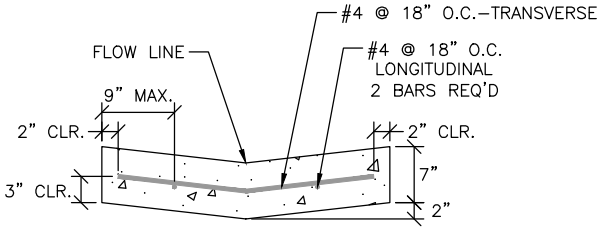
TEMPLATE

SCALE: 1"=2'–0"

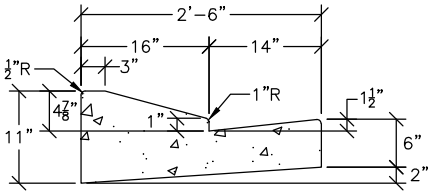


STANDARD CURB & GUTTER

SCALE: 1"=2'–0"

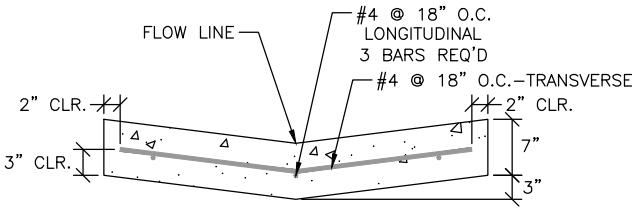


3'-0" GUTTER

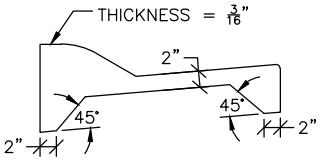


MODIFIED RAMP CURB & GUTTER

SCALE: 1"=2'–0"

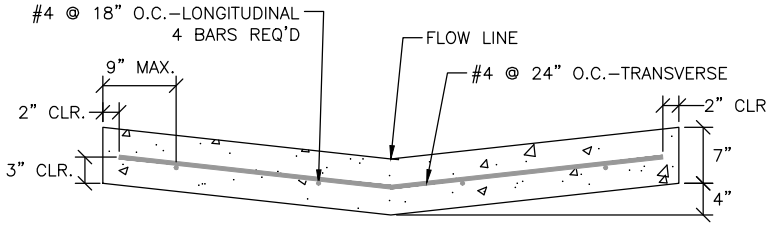


4'-0" GUTTER



TEMPLATE

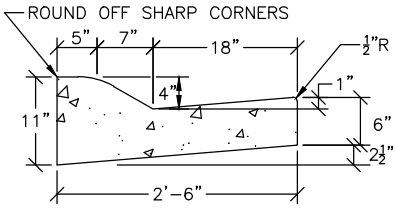
SCALE: 1"=2'–0"



6'-0" GUTTER

DOUBLE GUTTER DETAILS

SCALE: 1"=2'–0"

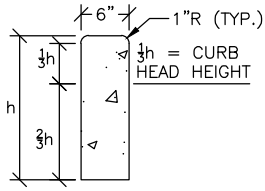


ROLLED CURB & GUTTER

SCALE: 1"=2'–0"

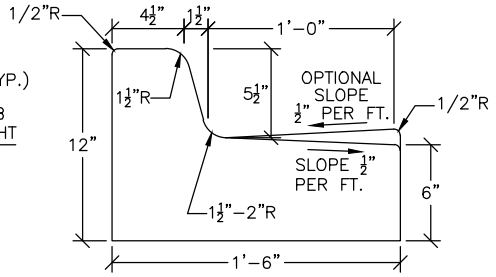
NOTES:

1. PROVIDE 2–#4 REINFORCING BARS IN GUTTER SECTIONS AT ALLEYS – SEE SD5 & SD6.
2. PROVIDE TOOLED CONTROL JOINTS @ 10' O.C. ALL CURB AND GUTTER SHALL HAVE EXPANSION JOINTS AT 200 FEET O.C.–MAXIMUM.
3. SEE APPLICABLE DETAILS FOR GUTTER SLOPE MODIFICATIONS AT CURB RAMPS.



6" CURB HEAD

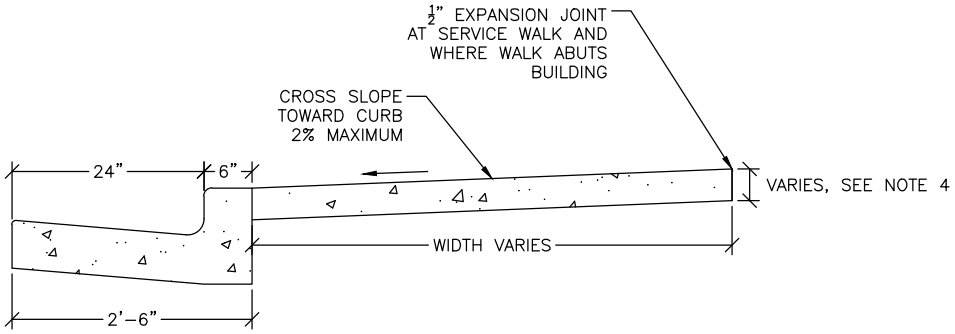
SCALE: 1"=2'–0"



CURB & GUTTER TYPE 2
SECT. 1-B

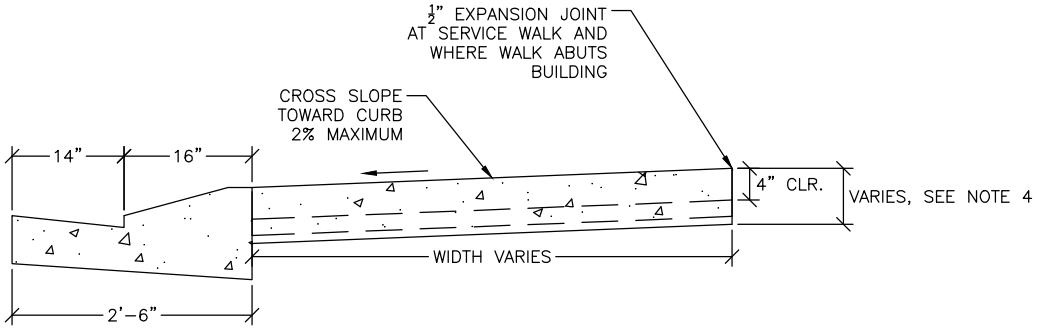
SCALE: 1"=1'–0"

	city of PUEBLO colorado	**CONCRETE CURB & GUTTER, DOUBLE GUTTER AND CROSS PAN**	SD3
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM
10/17/2022			CHECKED BY: BQ
REVISION			APPROVED BY: CR



SIDEWALK DETAIL

SCALE: 1"=2'-0"



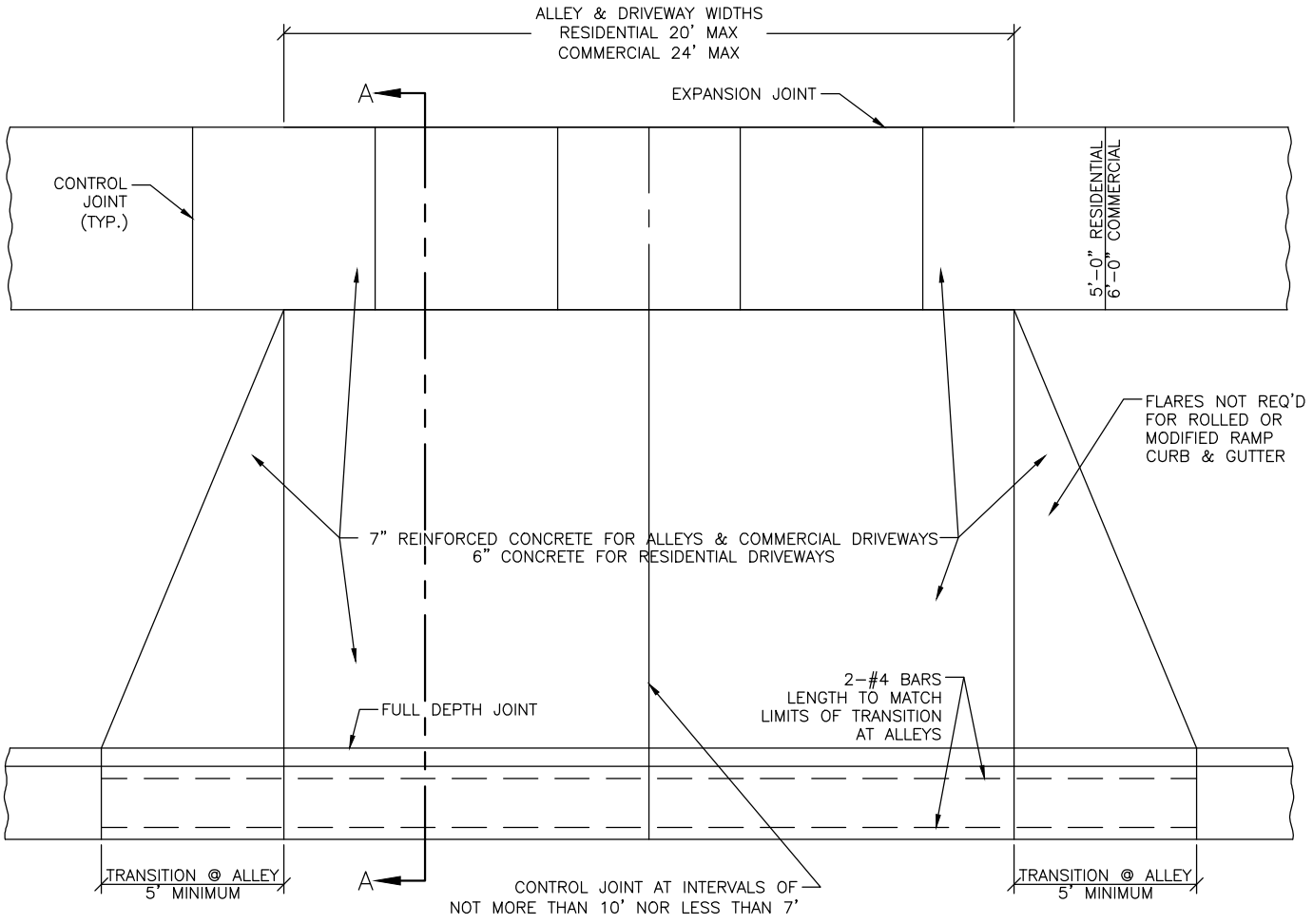
SIDEWALK DETAIL

SCALE: 1"=2'-0"

NOTES:

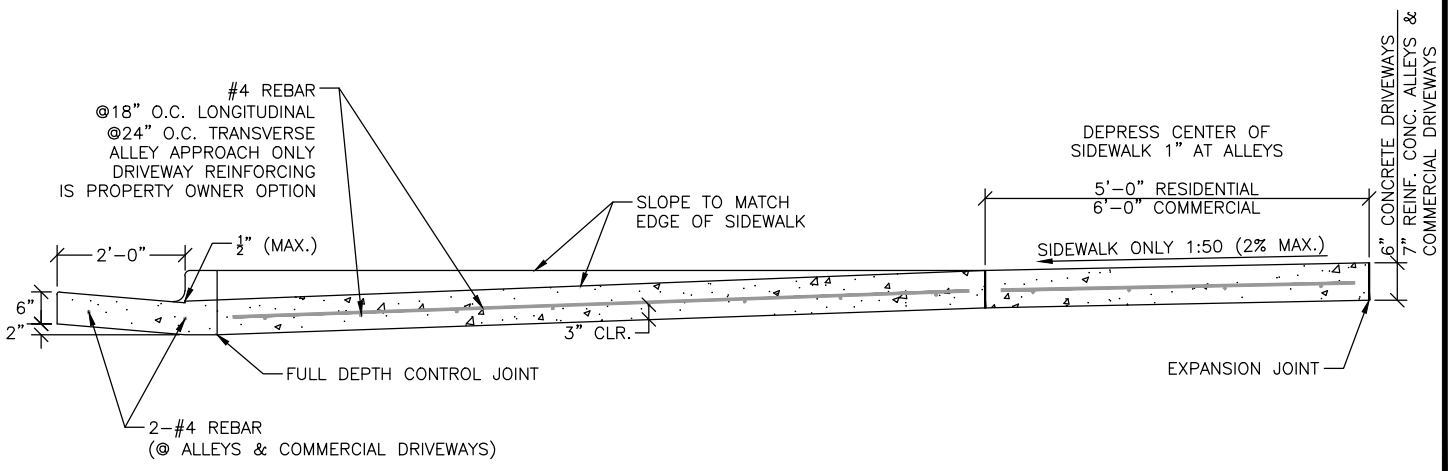
1. THAT PORTION OF ANY SIDEWALK AT A DRIVEWAY CROSSING OR AT ANY PROBABLE DRIVEWAY CROSSING MUST BE AT LEAST 6" THICK. THIS REGULATION APPLIES TO ALL NEW SIDEWALK CONSTRUCTION AND ALL SIDEWALK REPLACEMENT.
2. ½" EXPANSION JOINTS SHALL BE PLACED AT INTERVALS OF NOT MORE THAN ONE HUNDRED (100) FEET APART IN SIDEWALKS.
3. CONTROL JOINTS ARE TO BE AT 5' UNLESS OTHERWISE DIRECTED BY THE CITY.
4. SIDEWALK CONCRETE THICKNESS IS TO BE CONSTRUCTED AT 7" REINFORCED AT COMMERCIAL DRIVEWAYS AND ALLEYS; 6" AT RESIDENTIAL DRIVEWAYS AND 4" AT ALL OTHER LOCATIONS.

09/03/2024 10/17/2022 REVISION	city of PUEBLO colorado	**ATTACHED SIDEWALK DETAILS**	SD4
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR



PLAN OF TYPICAL ALLEY APPROACH & DRIVEWAY DETAIL FOR SETBACK SIDEWALK

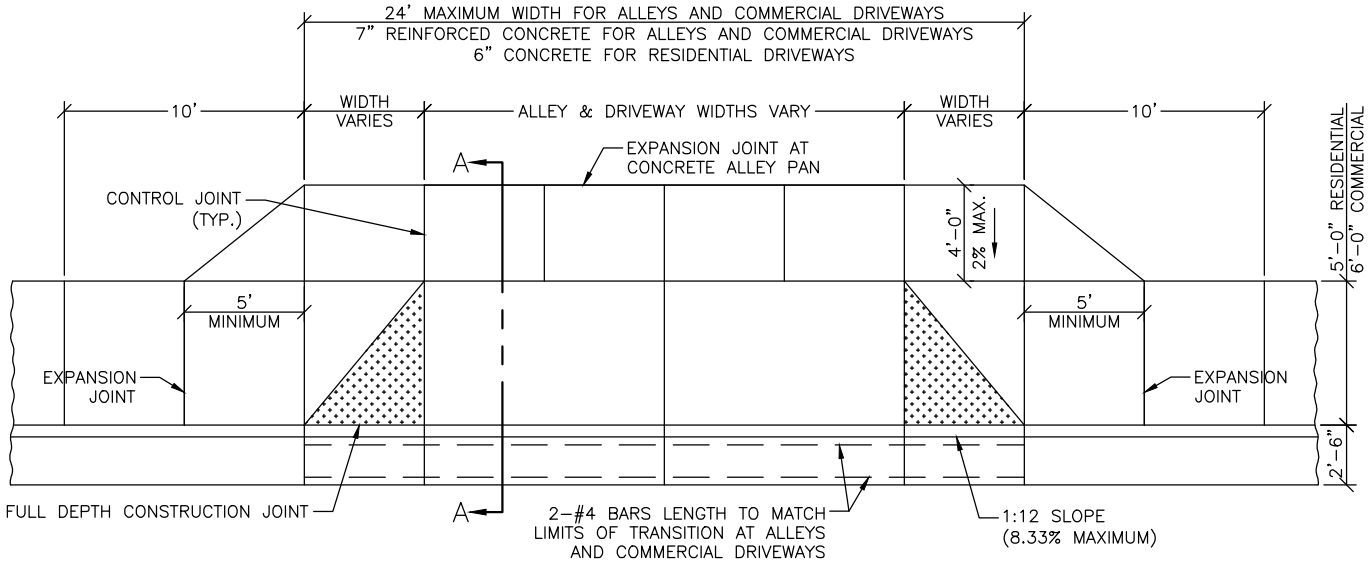
SCALE: 1"=5'-0"



SECTION A-A - ALLEY & DRIVEWAY GUTTER DETAIL

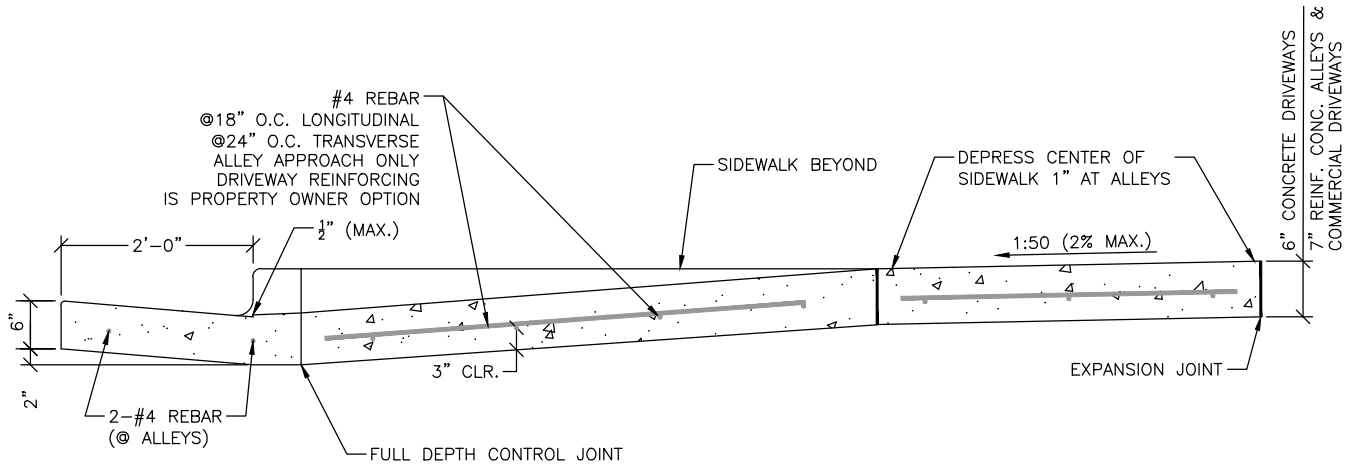
SCALE: 1"=3'-0"

09/03/2024 10/17/2022 REVISION	city of PUEBLO colorado	**TYPICAL ALLEY APPROACH & DRIVEWAY DETAIL FOR SETBACK SIDEWALK** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD5 DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR



PLAN OF TYPICAL ALLEY APPROACH & DRIVEWAY DETAIL FOR ATTACHED SIDEWALK

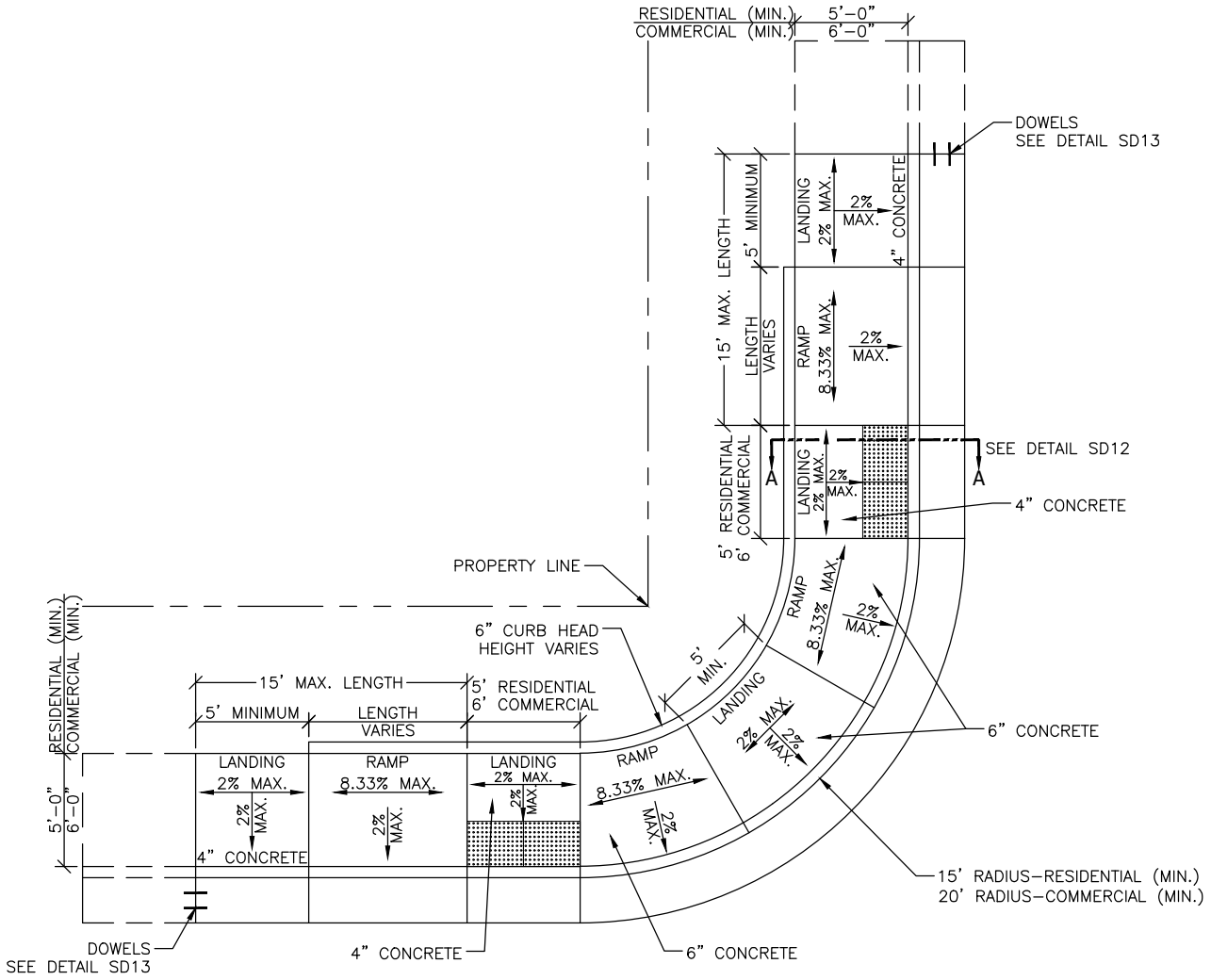
SCALE: 1"=8'-0"



SECTION A-A - ALLEY & DRIVEWAY GUTTER DETAIL

SCALE: 1"=2'-0"

	city of PUEBLO colorado	**TYPICAL ALLEY APPROACH & DRIVEWAY DETAIL FOR ATTACHED SIDEWALK**	SD6
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM
10/17/2022			CHECKED BY: BQ
REVISION			APPROVED BY: CR



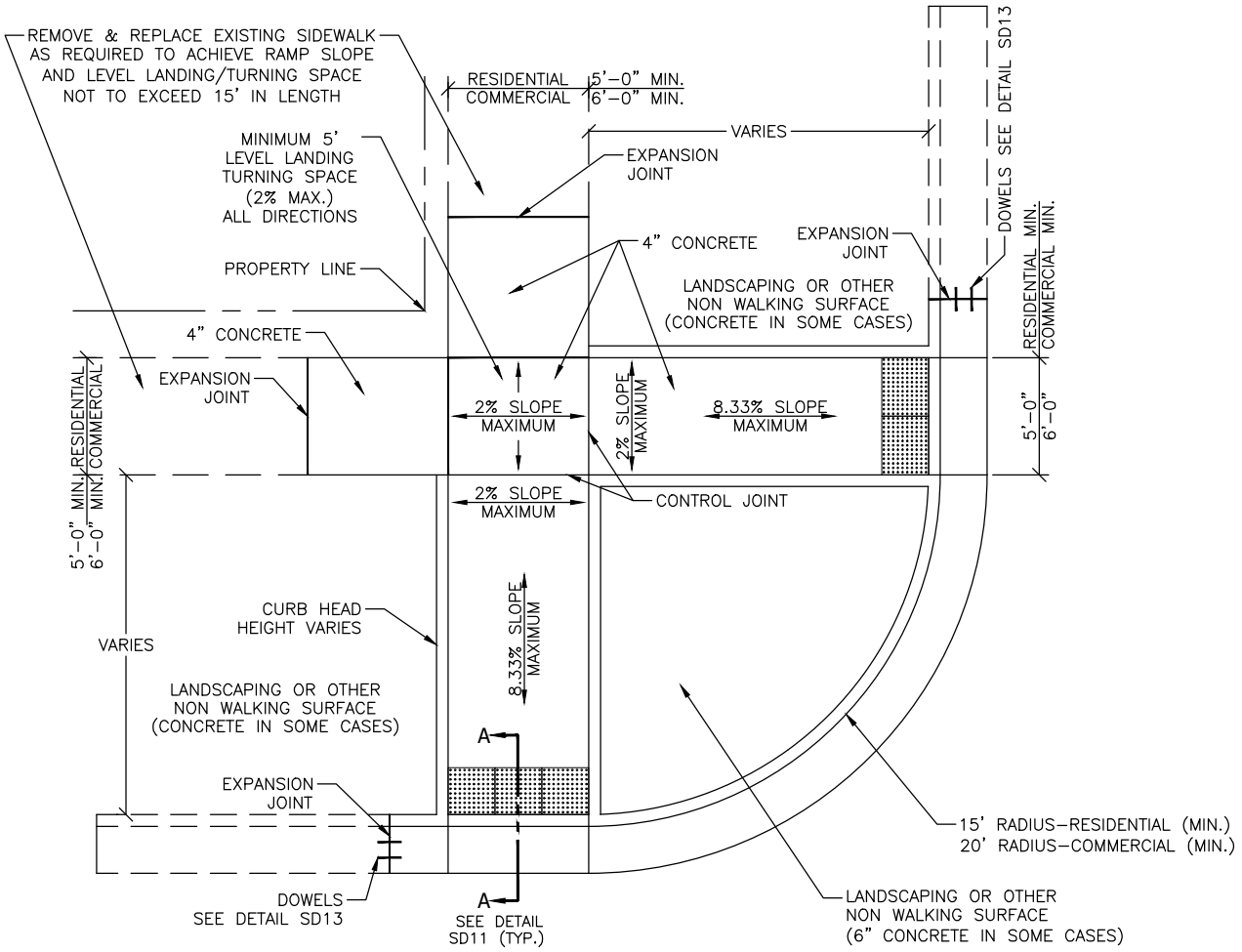
TYPE A RAMP

SCALE: 1"=8'-0"

NOTES:

1. ALL CURB RAMPS SHALL BE CONSTRUCTED TO CONFORM TO ALL APPLICABLE PROVISIONS OF THE PUBLIC RIGHT-OF-WAY ACCESSIBILITY GUIDELINES (PROWAG) LATEST EDITION.
2. RAMP SLOPES SHALL NOT BE STEEPER THAN 8.33%. DIMENSIONS AND OR ARRANGEMENTS SHOWN SHALL BE MODIFIED AS NECESSARY TO MEET THIS REQUIREMENT.
3. LOCATION OF RAMPS MAY BE ADJUSTED TO FIT FIELD CONDITIONS AS DIRECTED BY THE ENGINEER.
4. ALL CROSS SLOPES SHALL NOT EXCEED 2%.

09/03/2024 10/17/2022 REVISION	city of PUEBLO colorado	**CURB RAMP DETAILS - TYPE A RAMP** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD7 DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR



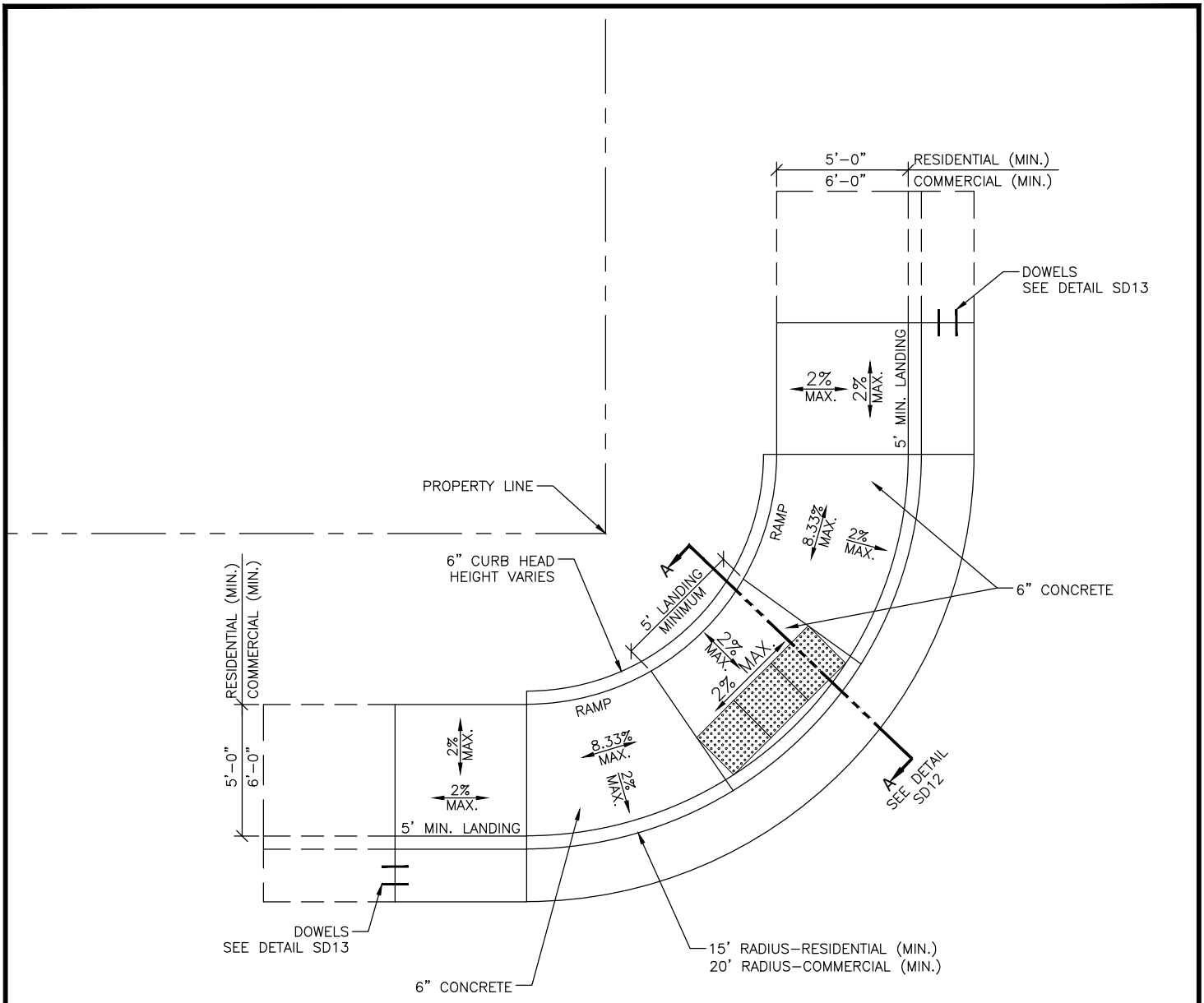
TYPE B RAMP

SCALE: 1"=8'-0"

NOTES:

1. ALL CURB RAMPS SHALL BE CONSTRUCTED TO CONFORM TO ALL APPLICABLE PROVISIONS OF THE PUBLIC RIGHT-OF-WAY ACCESSIBILITY GUIDELINES (PROWAG) LATEST EDITION.
2. RAMP SLOPES SHALL NOT BE STEEPER THAN 8.33%. DIMENSIONS AND OR ARRANGEMENTS SHOWN SHALL BE MODIFIED AS NECESSARY TO MEET THIS REQUIREMENT.
3. LOCATION OF RAMPS MAY BE ADJUSTED TO FIT FIELD CONDITIONS AS DIRECTED BY THE ENGINEER.
4. ALL CROSS SLOPES SHALL NOT EXCEED 2%.

	city of PUEBLO colorado	**CURB RAMP DETAILS - TYPE B RAMP**	SD8
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR
10/17/2022			
REVISION			



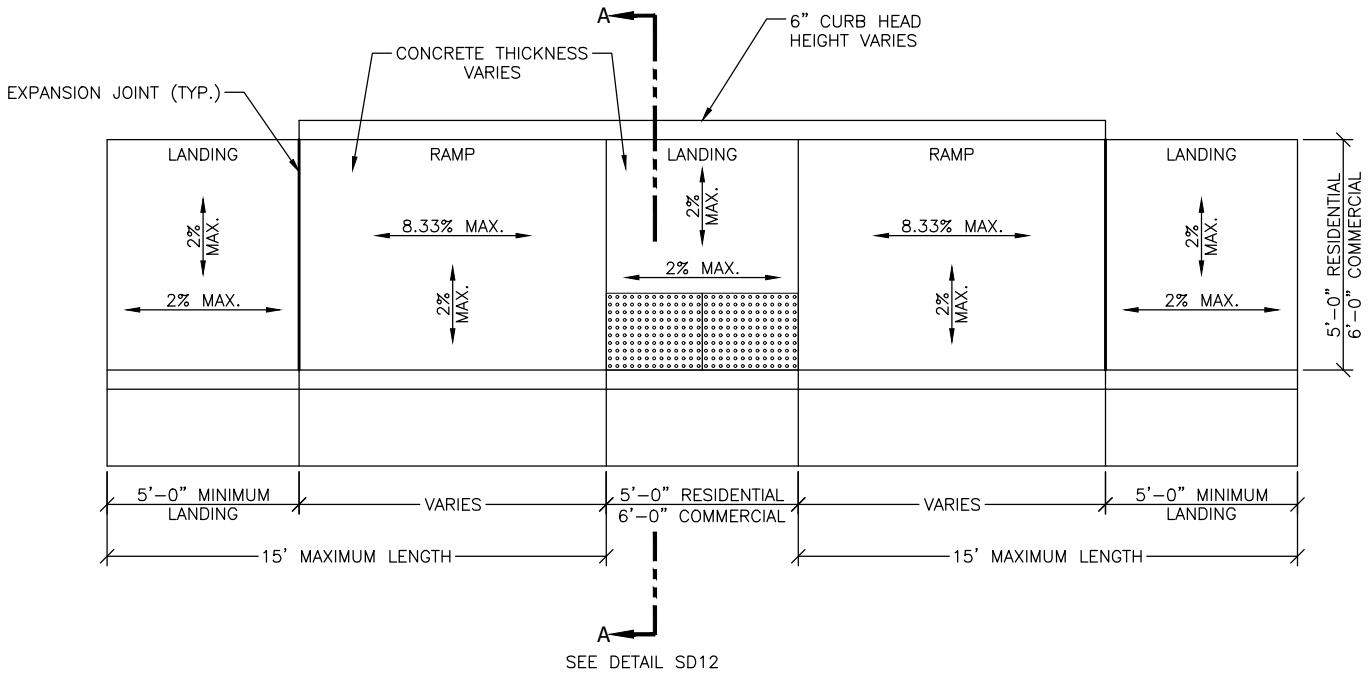
TYPE C RAMP

SCALE: 1"=6'-0"

NOTES:

1. ALL CURB RAMPS SHALL BE CONSTRUCTED TO CONFORM TO ALL APPLICABLE PROVISIONS OF THE PUBLIC RIGHT-OF-WAY ACCESSIBILITY GUIDELINES (PROWAG) LATEST EDITION.
2. RAMP SLOPES SHALL NOT BE STEEPER THAN 8.33%. DIMENSIONS AND OR ARRANGEMENTS SHOWN SHALL BE MODIFIED AS NECESSARY TO MEET THIS REQUIREMENT.
3. LOCATION OF RAMPS MAY BE ADJUSTED TO FIT FIELD CONDITIONS AS DIRECTED BY THE ENGINEER.
4. ALL CROSS SLOPES SHALL NOT EXCEED 2%.

09/03/2024 10/17/2022 REVISION	city of PUEBLO colorado	**CURB RAMP DETAILS - TYPE C RAMP** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD9 DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR



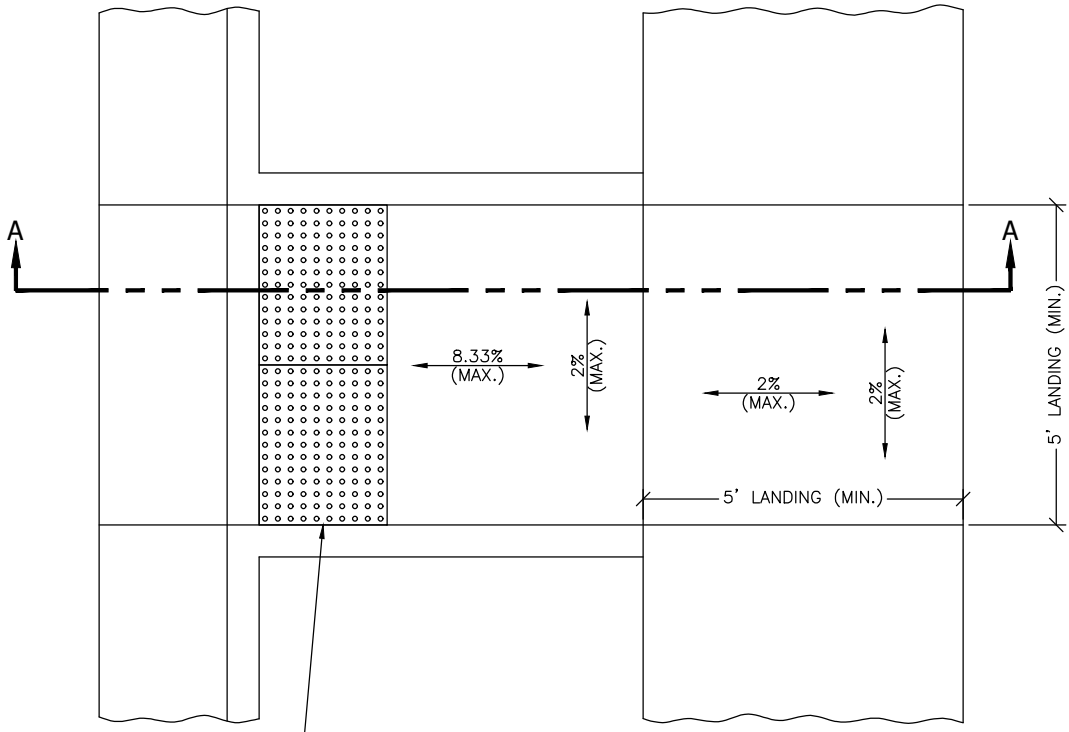
TYPE D RAMP

SCALE: 1"=5'-0"

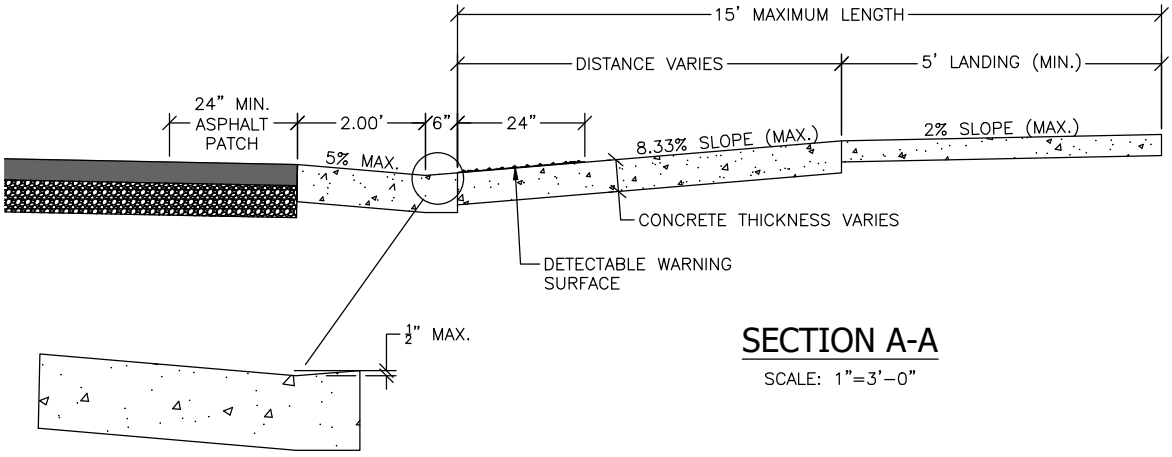
NOTES:

1. ALL CURB RAMPS SHALL BE CONSTRUCTED TO CONFORM TO ALL APPLICABLE PROVISIONS OF THE PUBLIC RIGHT-OF-WAY ACCESSIBILITY GUIDELINES (PROWAG) LATEST EDITION.
2. RAMP SLOPES SHALL NOT BE STEEPER THAN 8.33%. DIMENSIONS AND OR ARRANGEMENTS SHOWN SHALL BE MODIFIED AS NECESSARY TO MEET THIS REQUIREMENT.
3. LOCATION OF RAMPS MAY BE ADJUSTED TO FIT FIELD CONDITIONS AS DIRECTED BY THE ENGINEER.
4. ALL CROSS SLOPES SHALL NOT EXCEED 2%.

09/03/2024 10/17/2022 REVISION	city of PUEBLO colorado	**CURB RAMP DETAILS - TYPE D RAMP** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD10 DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR



DETECTABLE WARNING SURFACES SHALL BE 24'' WIDE AT THE BOTTOM OF EACH RAMP (UNLESS SHOWN OTHERWISE) AND SHALL EXTEND THE FULL WIDTH OF THE RAMP. SEE STANDARD DETAIL SD6.1 THRU SD6.4

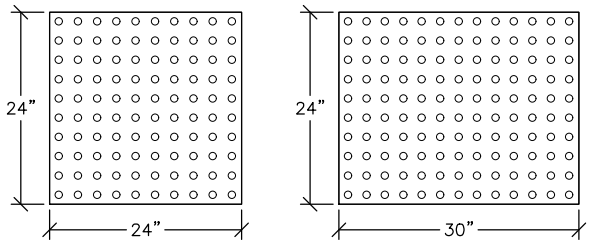


SECTION A-A

SCALE: 1"=3'-0"

NOTES:

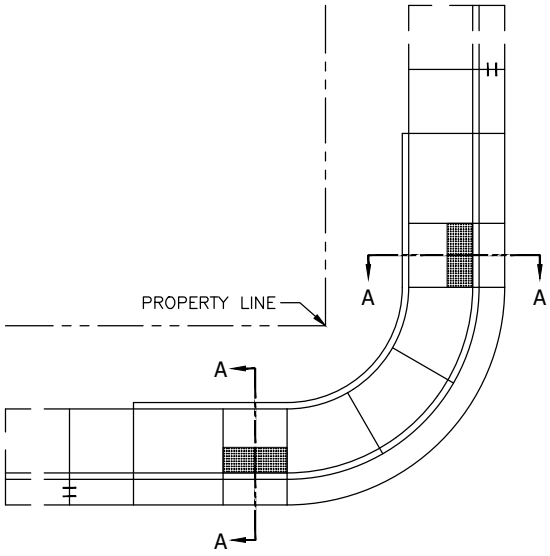
1. DETECTABLE WARNING SURFACES SHALL COMPLY WITH SECTION R305 OF THE PUBLIC RIGHT-OF-WAY ACCESSIBILTY GUIDELINES (PROWAG) LATEST EDITION.
2. ALL CURB RAMPS SHALL BE CONSTRUCTED TO CONFORM TO ALL APPLICABLE PROVISIONS OF THE PUBLIC RIGHT-OF-WAY ACCESSIBILITY GUIDELINES (PROWAG) LATEST EDITION.
3. RAMP SLOPES SHALL NOT BE STEEPER THAN 8.33%. DIMENSIONS AND OR ARRANGEMENTS SHOWN SHALL BE MODIFIED AS NECESSARY TO MEET THIS REQUIREMENT.
4. LOCATION OF RAMPS MAY BE ADJUSTED TO FIT FIELD CONDITIONS AS DIRECTED BY THE ENGINEER.
5. ALL CROSS SLOPES SHALL NOT EXCEED 2%.



DETECTABLE WARNING SURFACE

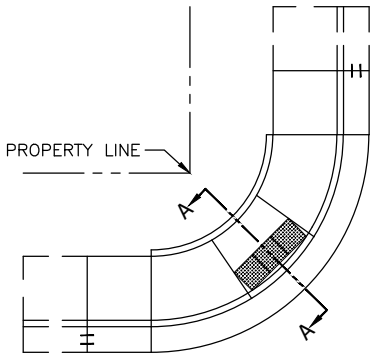
SCALE: 1"=2'-0"

	city of PUEBLO colorado	**CURB RAMP DETAILS - DETECTABLE WARNING SURFACES**	SD11
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM
10/17/2022			CHECKED BY: BQ
REVISION			APPROVED BY: CR



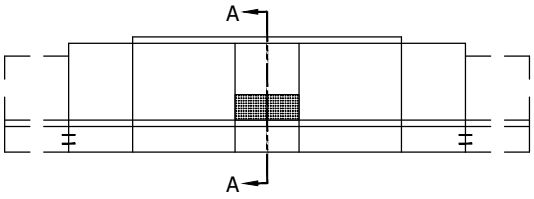
TYPE A RAMP

SCALE: 1"=15'–0"



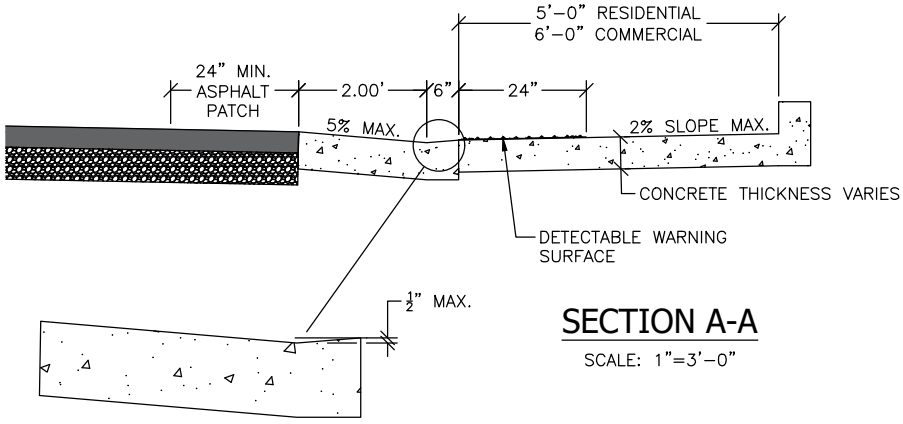
TYPE C RAMP

SCALE: 1"=15'–0"



TYPE D RAMP

SCALE: 1"=15'–0"



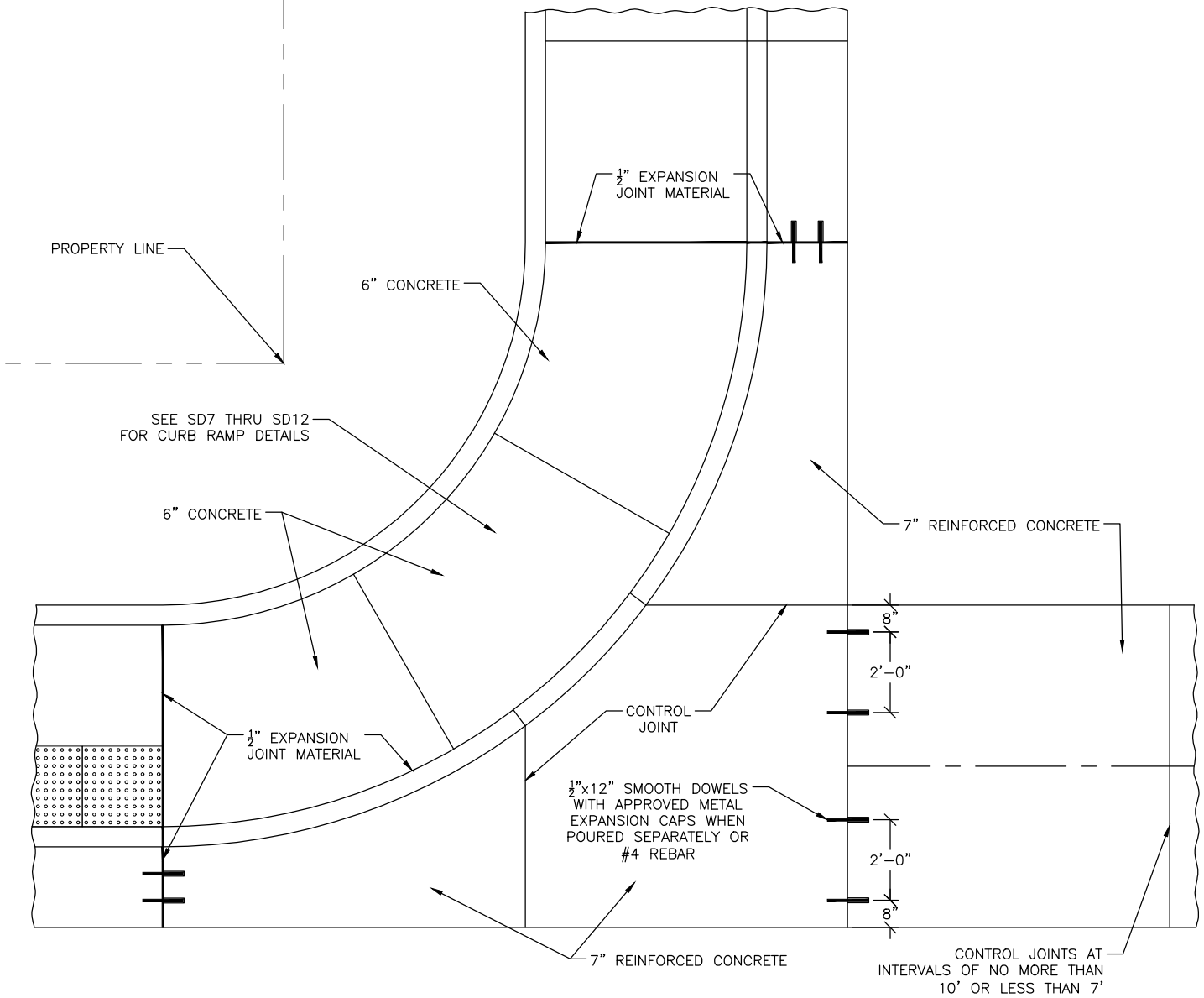
SECTION A-A

SCALE: 1"=3'–0"

NOTES:

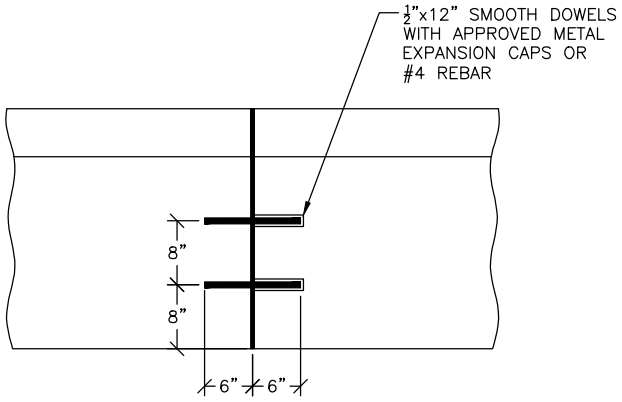
1. DETECTABLE WARNING SURFACES SHALL COMPLY WITH SECTION R305 OF THE PUBLIC RIGHT–OF–WAY ACCESSIBILTY GUIDELINES (PROWAG) LATEST EDITION.
2. ALL CURB RAMPS SHALL BE CONSTRUCTED TO CONFORM TO ALL APPLICABLE PROVISIONS OF THE PUBLIC RIGHT–OF–WAY ACCESSIBILITY GUIDELINES (PROWAG) LATEST EDITION.
3. RAMP SLOPES SHALL NOT BE STEEPER THAN 8.33%. DIMENSIONS AND OR ARRANGEMENTS SHOWN SHALL BE MODIFIED AS NECESSARY TO MEET THIS REQUIREMENT.
4. LOCATION OF RAMPS MAY BE ADJUSTED TO FIT FIELD CONDITIONS AS DIRECTED BY THE ENGINEER.
5. ALL CROSS SLOPES SHALL NOT EXCEED 2%.

	city of PUEBLO colorado	**CURB RAMP DETAILS - CROSS SECTION**	SD12
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM
10/17/2022			CHECKED BY: BQ
REVISION			APPROVED BY: CR



SQUARE PAN AND CROSS PAN

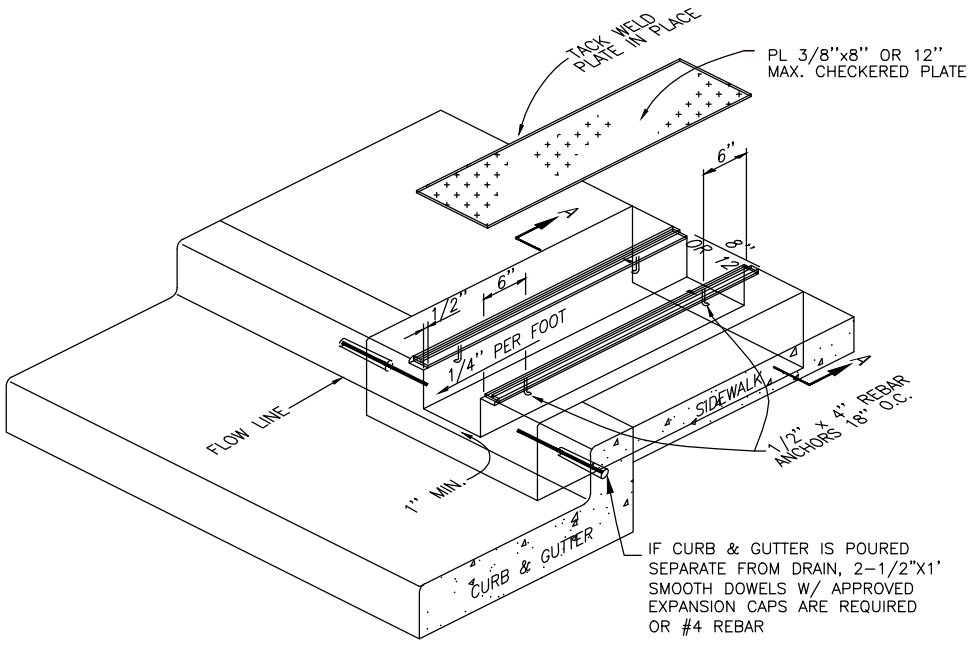
SCALE: 1"=2'-0"



DOWEL DETAIL

SCALE: 1"=2'-0"

09/03/2024	city of PUEBLO colorado	**EXPANSION JOINT & DOWEL DETAILS**	SD13
10/17/2022		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM CHECKED BY: BQ
REVISION			APPROVED BY: CR



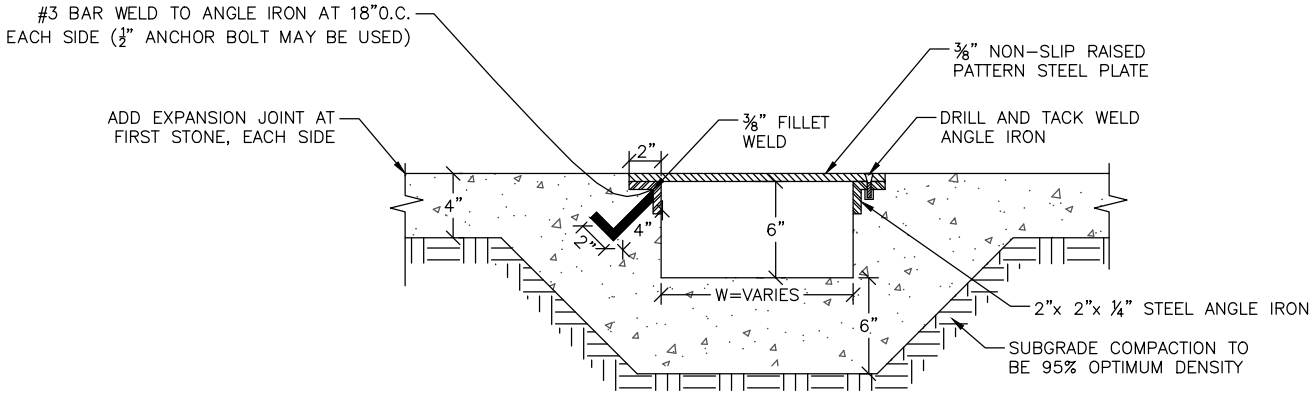
NOTES:
ALL STEEL SHALL RECEIVE ONE COAT RED OXIDE METAL PRIMER AND ONE FIELD COAT BLACK ENAMEL.

FOR INSTALLATION OF A SIDEWALK DRAIN WHERE THERE IS EXISTING CURB AND GUTTER A FIVE (5') FOOT MINIMUM SECTION OF CURB AND GUTTER MUST BE REMOVED.

REMOVAL OF JUST THE CURB HEAD FOR INSTALLATION OF A SIDEWALK DRAIN WILL NOT BE ALLOWED

SIDEWALK DRAIN DETAIL

SCALE: 1"=2'-0"



FOR "W" > 12", REQUIRES APPROVAL FROM CITY ENGINEER

SECTION A-A

SCALE: 1"=2'-0"

REVISION
10/17/2022
09/03/2024
04/22/2025

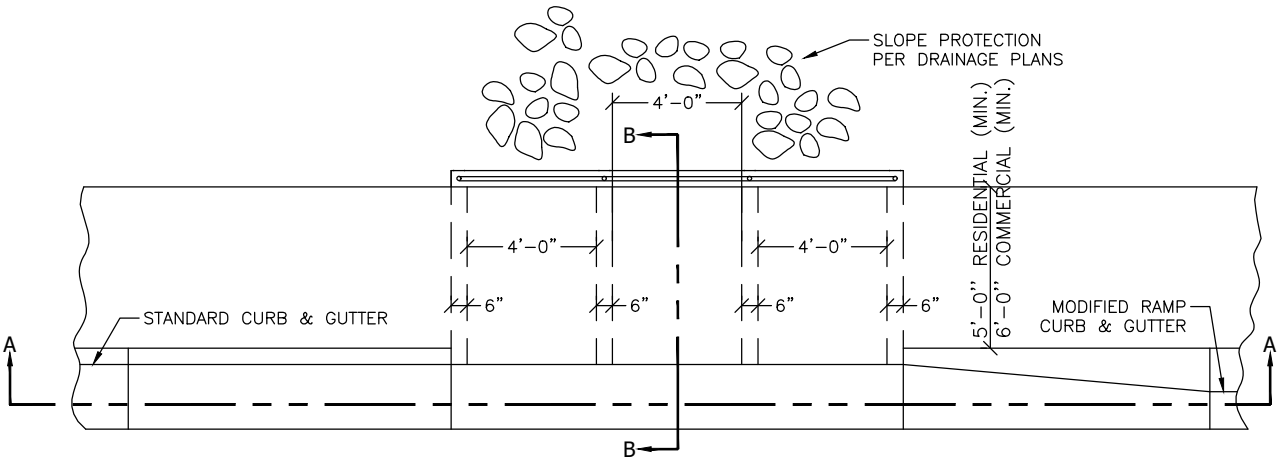
city of PUEBLO colorado

SIDEWALK DRAIN DETAIL

PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION
211 EAST "D" ST. PUEBLO, CO 81003
(719) 553-2295 PHONE

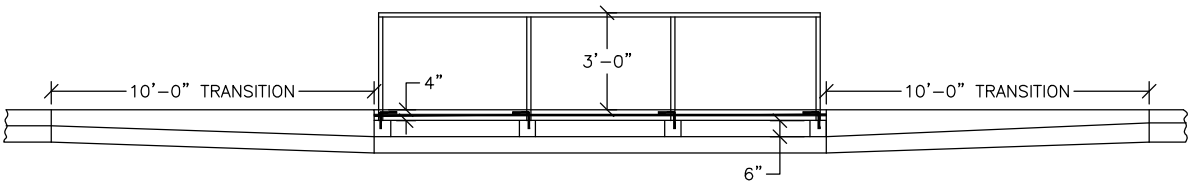
SD14

DRAWN BY: JM
CHECKED BY: BQ
APPROVED BY: CR



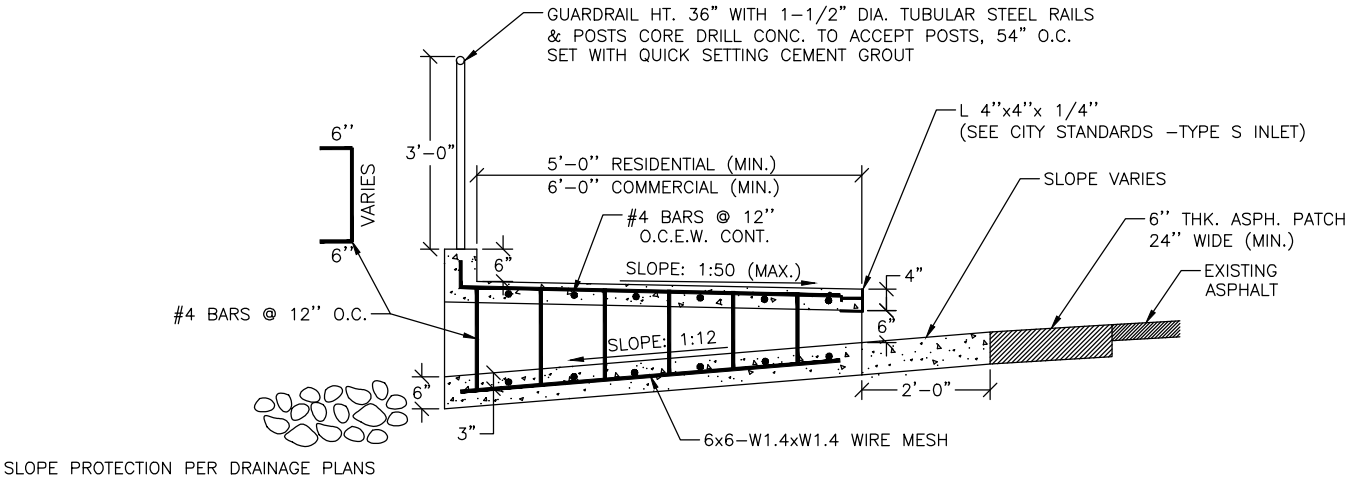
CURB DRAINAGE DETAIL

SCALE: 1"=6'-0"



SECTION A-A

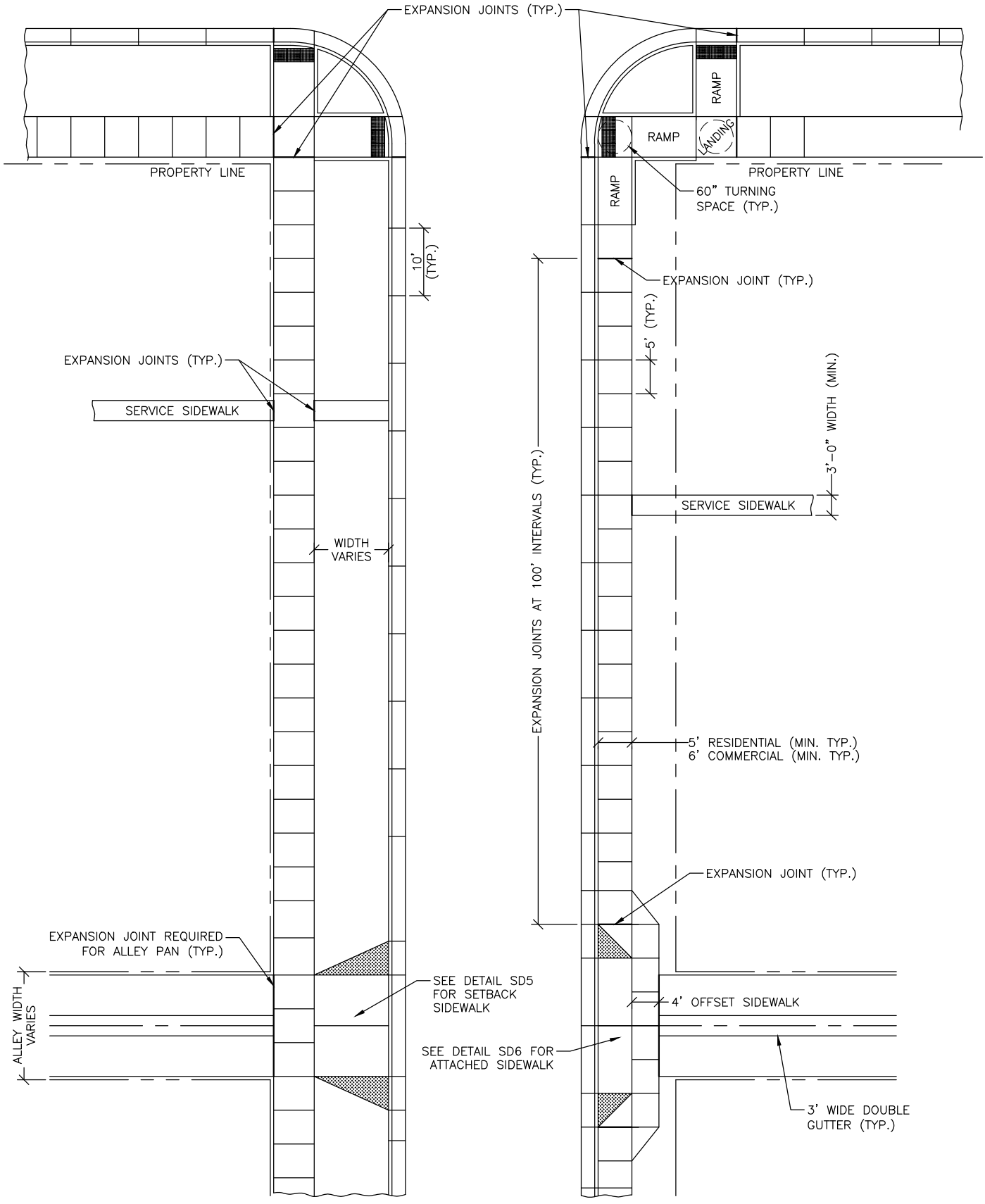
SCALE: 1"=6'-0"



SECTION B-B

SCALE: 1"=3'-0"

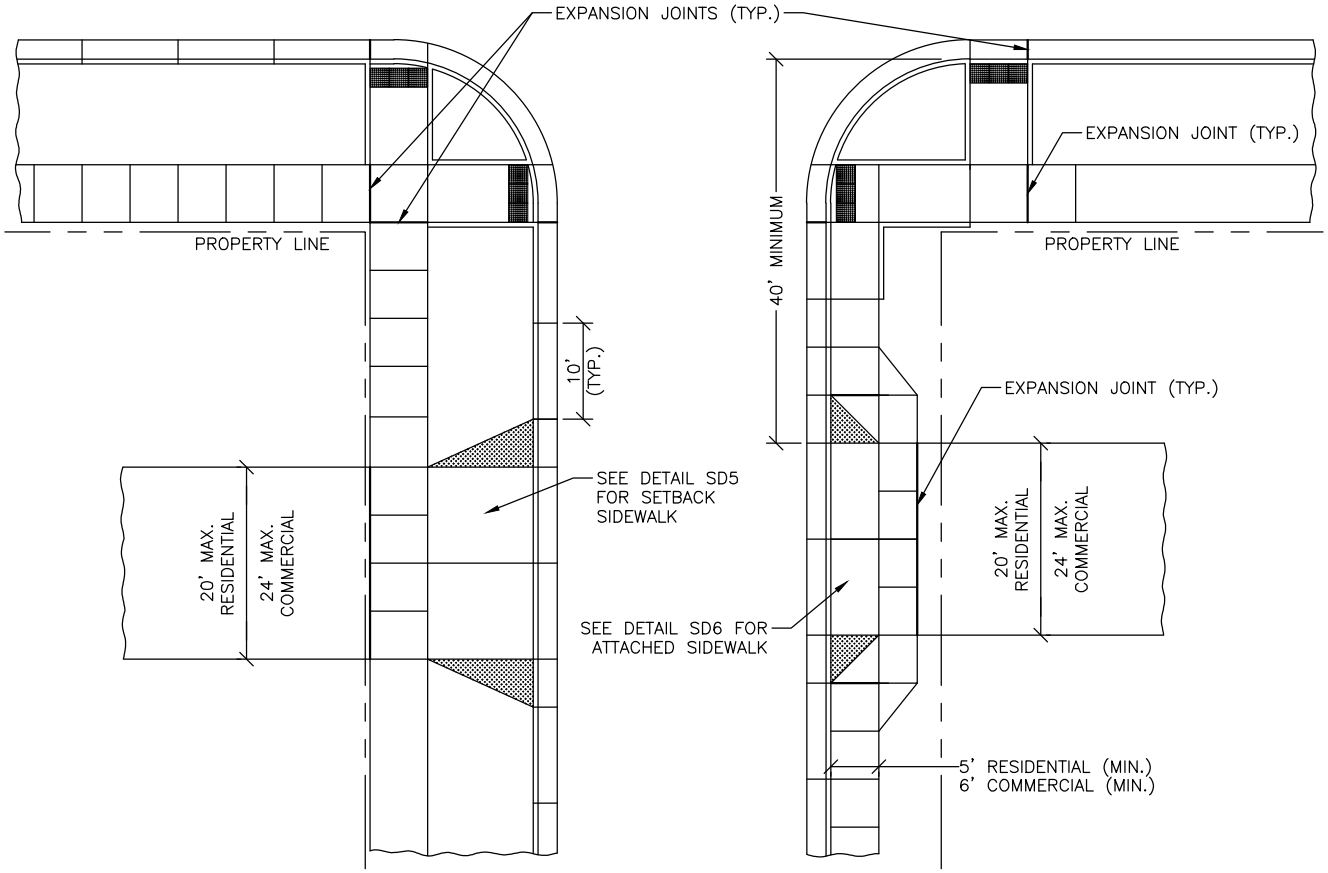
09/03/2024 01/01/2021 REVISION	city of PUEBLO colorado	**SIDEWALK CULVERT DETAIL** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD15 DRAWN BY: JM CHECKED BY: CR APPROVED BY: CR



JOINT PLACEMENT AND WIDTH STANDARDS

SCALE: 1''=20'-0''

09/03/2024	city of PUEBLO colorado	**JOINT PLACEMENT & WIDTH STANDARDS FOR SIDEWALK, C&G AND ALLEYS**	SD16
01/01/2021		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR
REVISION			

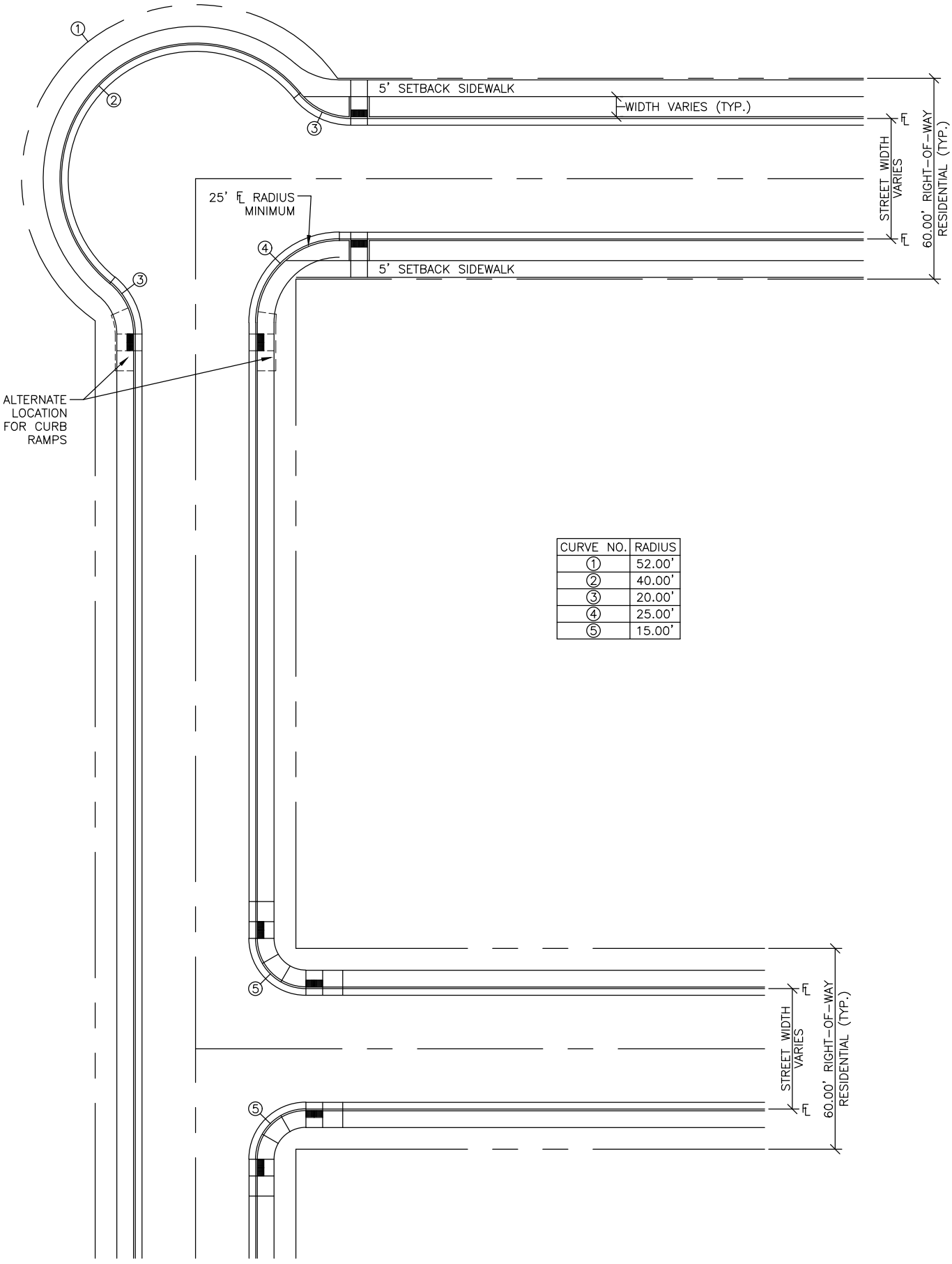


GENERAL REQUIREMENTS FOR DRIVEWAYS

SCALE: 1''=20'-0''

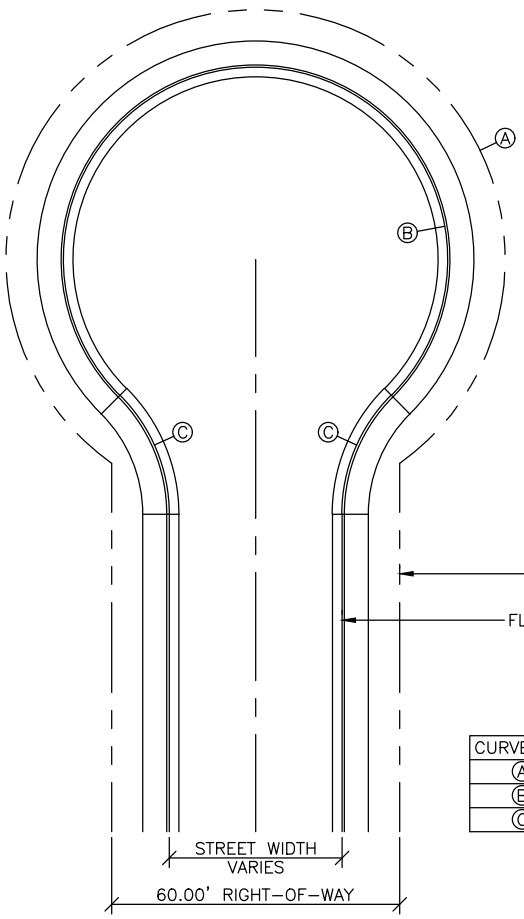
NOTES:
1. PORTION OF ANY SIDEWALK AT DRIVEWAY CROSSINGS OR FUTURE DRIVEWAY CROSSINGS MUST HAVE A MINIMUM CONCRETE THICKNESS OF 6". THIS APPLIES TO ALL NEW CONSTRUCTION AND REPLACEMENT OF ANY SIDEWALK.
2. DRIVEWAY WIDTHS GREATER MAXIMUM WIDTHS SHOWN ABOVE REQUIRE APPROVAL FROM THE TRAFFIC ENGINEER.

09/03/2024 01/01/2021 REVISION	city of PUEBLO colorado	**GENERAL REQUIREMENTS FOR DRIVEWAYS** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD17 DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR

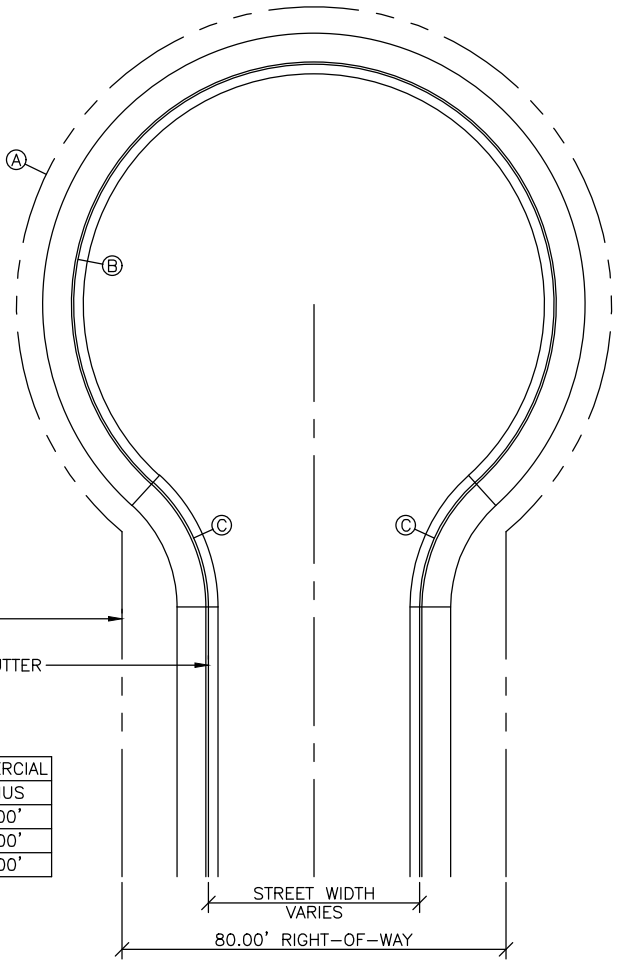


CURVE NO.	RADIUS
①	52.00'
②	40.00'
③	20.00'
④	25.00'
⑤	15.00'

		KNUCKLE AND "T" INTERSECTION DETAIL	SD18
09/03/2024	city of PUEBLO colorado	PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM CHECKED BY: BQ
10/17/2022			APPROVED BY: CR
REVISION			

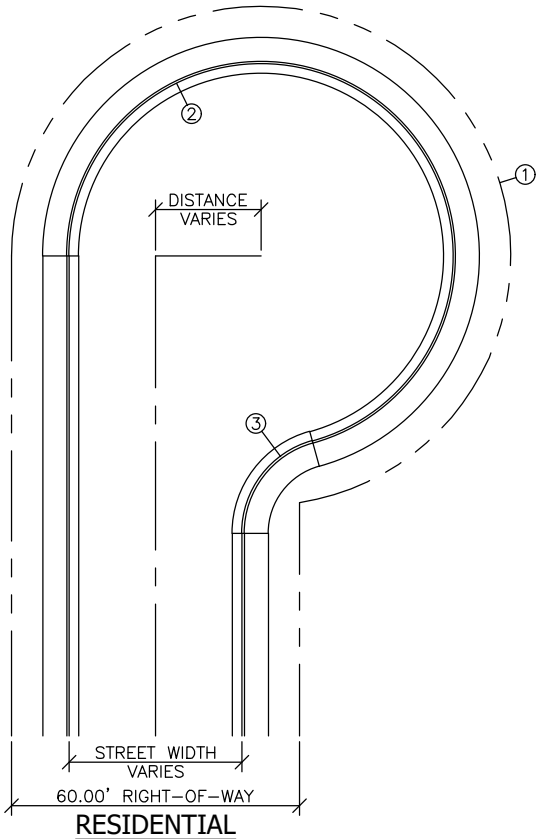


RESIDENTIAL



COMMERCIAL

CURVE NO.	RESIDENTIAL RADIUS	COMMERCIAL RADIUS
Ⓐ	52.00'	62.00'
Ⓑ	40.00'	50.00'
Ⓒ	35.00'	35.00'



RESIDENTIAL

CURVE NO.	RESIDENTIAL RADIUS
①	52.00'
②	40.00'
③	20.00'

09/03/2024		
10/17/2022		
REVISION		

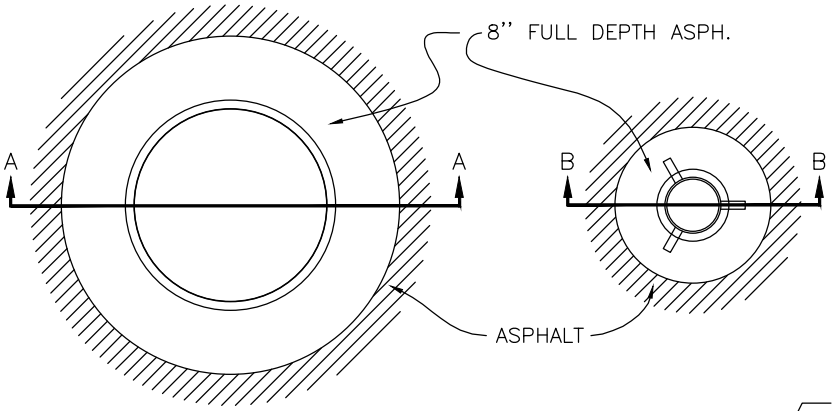
city of PUEBLO colorado

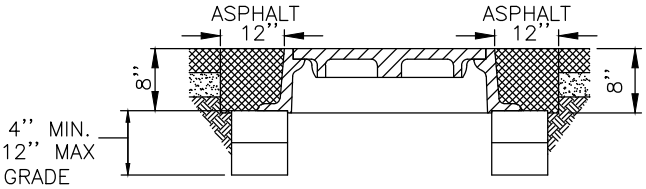
CUL-DE-SAC DETAIL

PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION
211 EAST "D" ST. PUEBLO, CO 81003
(719) 553-2295 PHONE

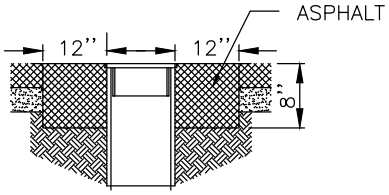
SD19

DRAWN BY: JM
CHECKED BY: BQ
APPROVED BY: CR

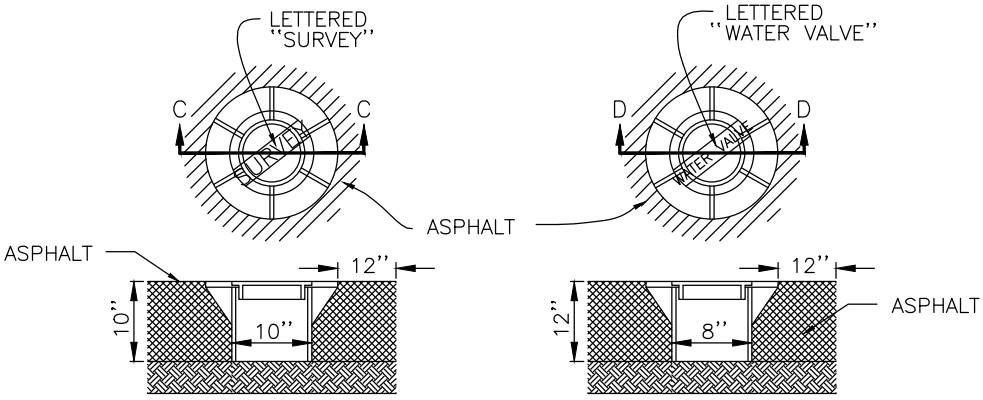




MANHOLE RING
SECTION A-A
NOT TO SCALE



GAS VALVE BOX
SECTION B-B
NOT TO SCALE



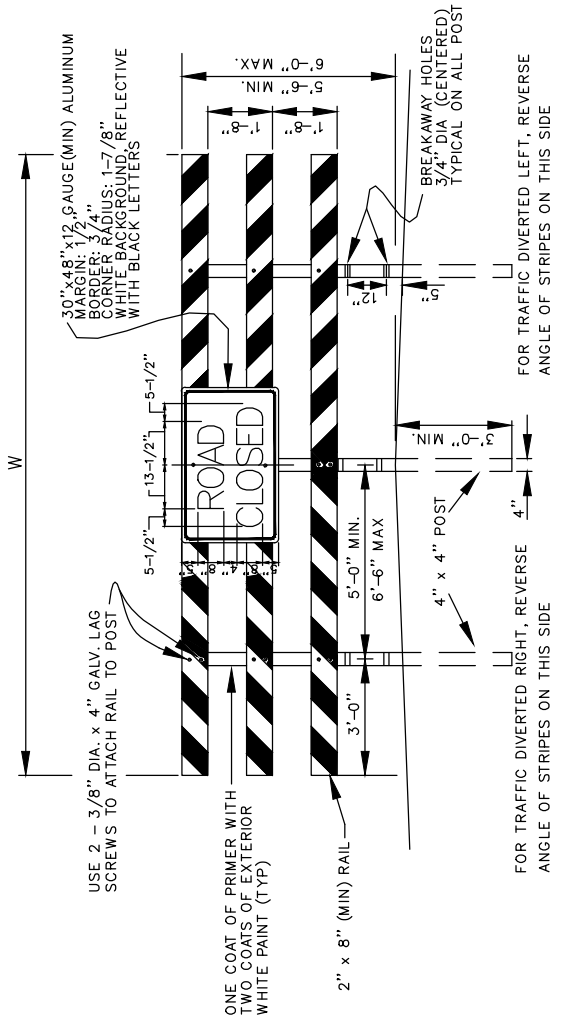
MONUMENT BOX
SECTION C-C
NOT TO SCALE

WATER VALVE BOX
SECTION D-D
NOT TO SCALE

ADJUSTMENT DETAILS

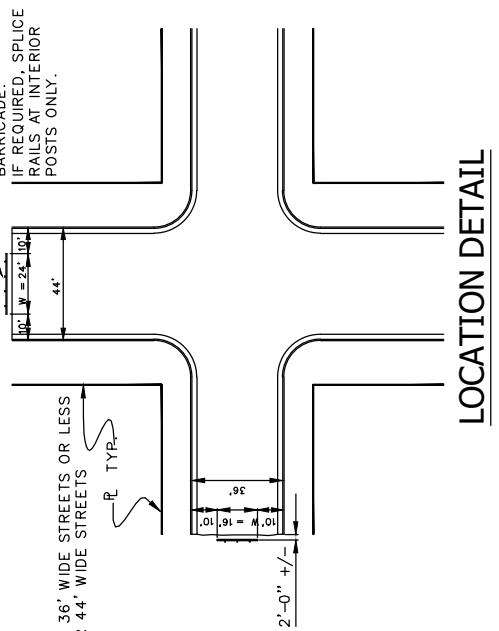
NOTES:
1. ALL RINGS TO BE SET 1/4" BELOW FINISH GRADE.

09/03/2024 10/17/2022 REVISION	city of PUEBLO colorado	**ADJUSTMENT DETAILS** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD20 DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR



CONSTRUCTION DETAIL

NO SCALE

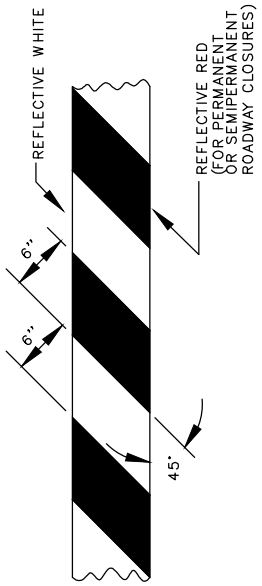


LOCATION DETAIL

NO SCALE

NOTE

W = 16' FOR 36' WIDE STREETS OR LESS
W = 24' FOR 44' WIDE STREETS



RAIL STRIPING DETAIL

NO SCALE

GENERAL NOTES

1. FIELD LOCATION TO BE DETERMINED BY TRAFFIC ENGINEER.
2. ALL REFLECTIVE SURFACES SHALL BE SMOOTH SURFACE TYPE REFLECTIVE SHEETING OR APPROVED EQUAL.
3. ALL TIMBER SHALL BE GRADE NO. 2 OR BETTER, (DOUGLAS FIR, LARCH OR HEM-FIR.)
4. ALL POSTS SHALL BE PRESERVATIVE TREATED IN ACCORDANCE WITH AWPB-FDN STANDARDS.
5. ATTACH "ROAD CLOSED" SIGN TO POST WITH 2-3/8" DIA. x 4" GALV. LAG SCREWS. WHERE W = 24', PLACE SIGN ON POST LOCATED ON RIGHT SIDE OF BARRICADE CENTER.
6. PAINT FOR RAILS AND POSTS SHALL BE SHERWIN WILLIAMS A-100 ALKYD EXTERIOR WOOD PRIMER A-100 ALKYD EXTERIOR WOOD PRIMER WITH A-100 LATEX HOUSE AND TRIM PAINT (SERIES A8) OR APPROVED EQUAL.

09/03/2024
10/17/2022
REVISION

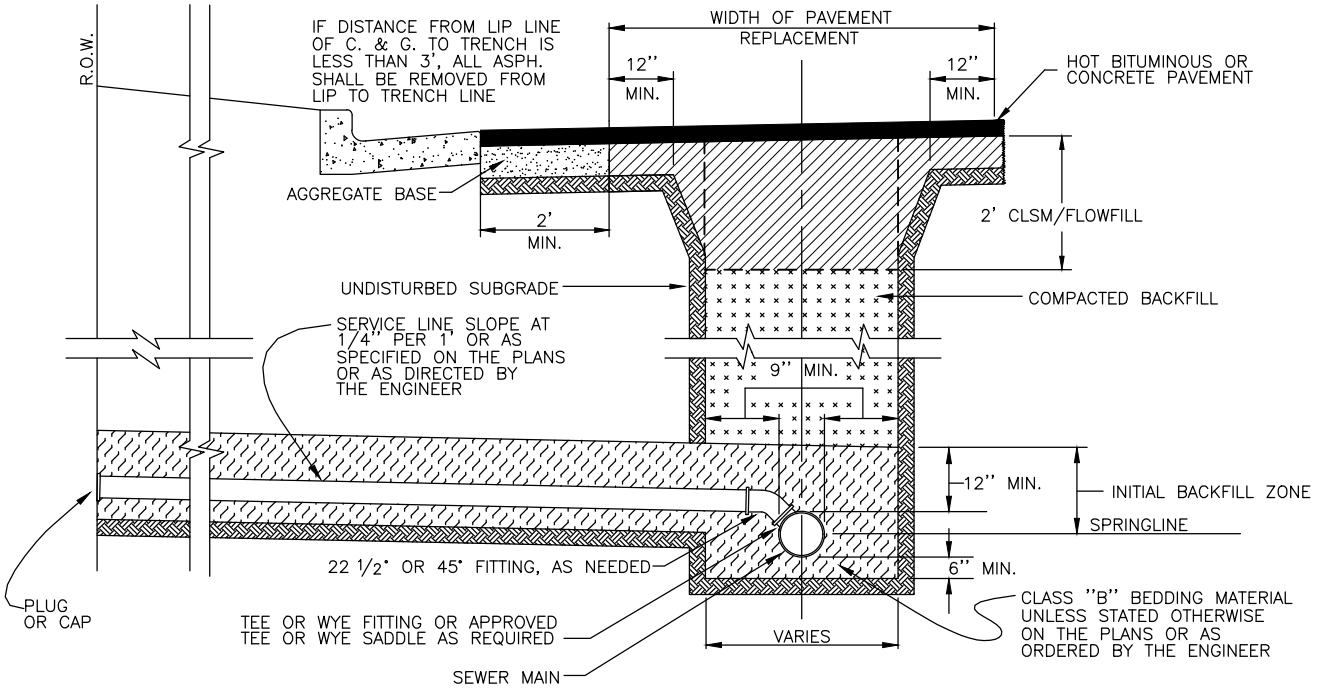
city of PUEBLO colorado

STANDARD TYPE III BARRICADE

SD21

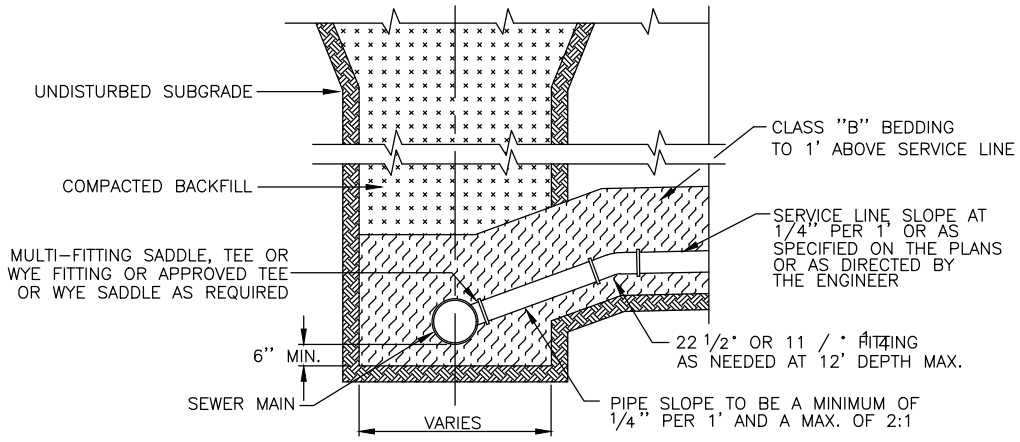
PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION
211 EAST "D" ST. PUEBLO, CO 81003
(719) 553-2295 PHONE

DRAWN BY: JM
CHECKED BY: BQ
APPROVED BY: CR



TRENCH DETAIL FOR SANITARY SEWER MAIN AND SERVICE LINES

SCALE: 1"=3'-0"



SANITARY SEWER SERVICE INSTALLATION FOR MAINS GREATER THAN 12 FEET DEEP

SCALE: 1"=3'-0"

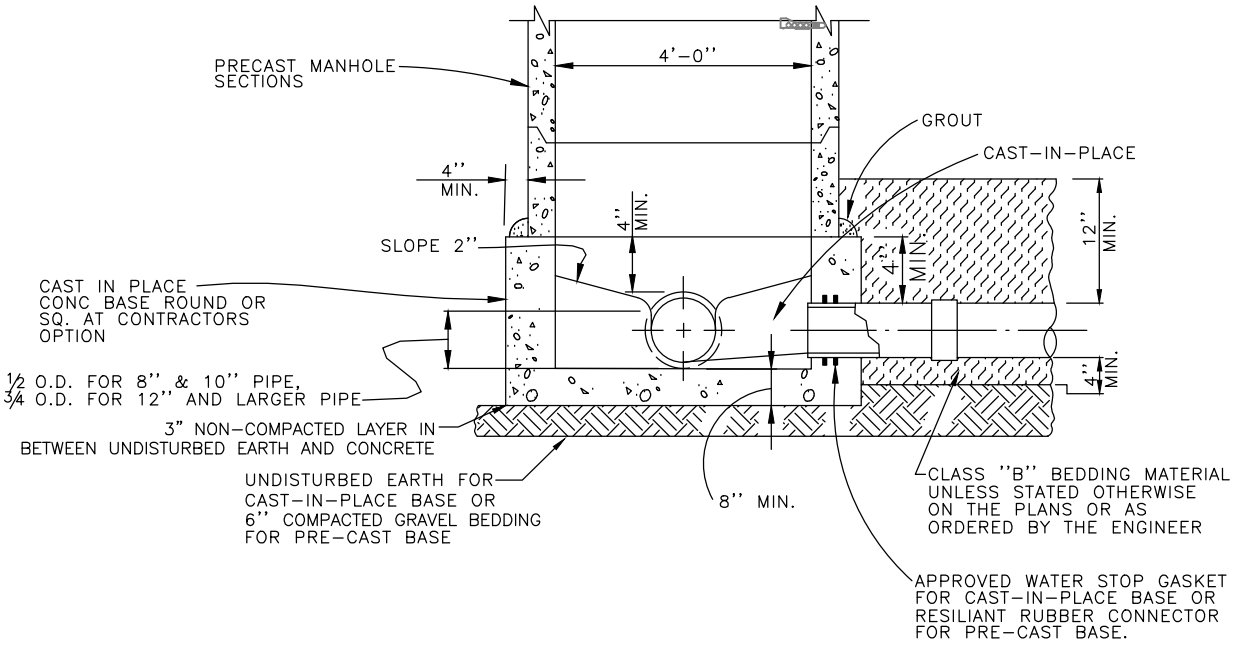
NOTES:

1. CONTRACTOR SHALL COMPLY WITH ALL LOCAL, STATE AND FEDERAL HEALTH AND SAFETY REQUIREMENTS INCLUDING BUT NOT LIMITED TO DEPOSITION OF CUT, SLOPING AND/OR BRACING.

2. SERVICE LINES SHALL BE CONNECTED TO THE SEWER MAIN SO THE FLOWLINE IS AT/OR ABOVE THE SPRINGLINE OF THE PIPE FOR 8" AND 10" SEWER MAINS AND IN THE TOP 1/4 OF THE PIPE FOR 12" AND LARGER SEWER MAINS.

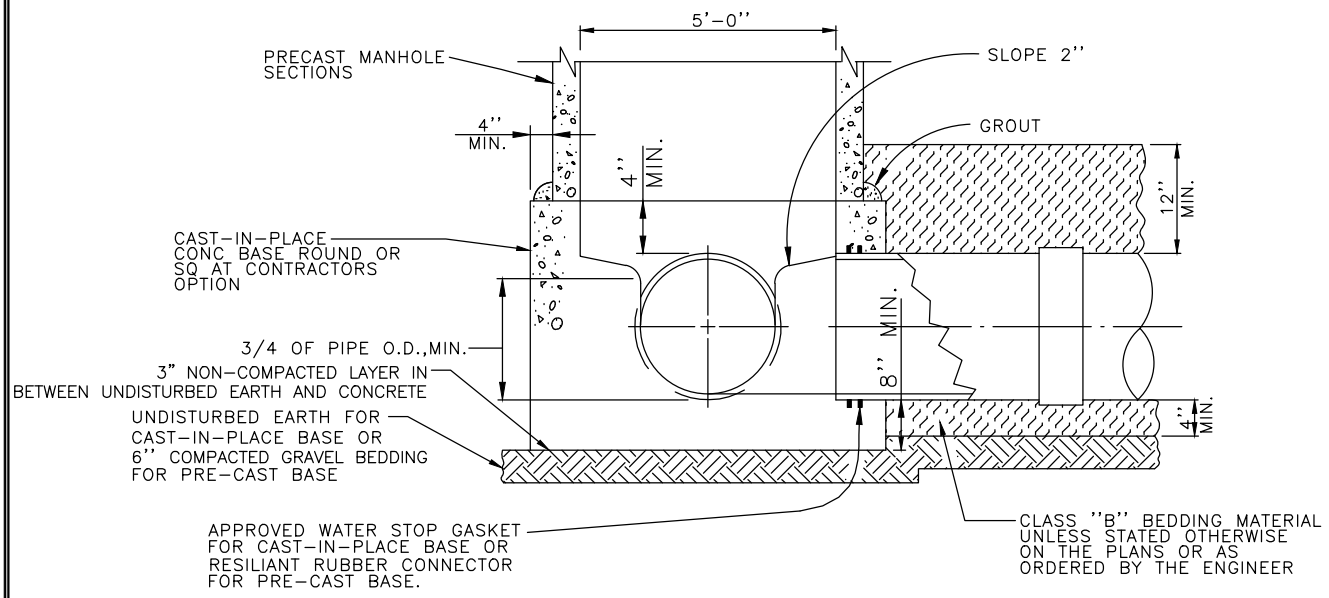
3. THE ENDS OF ALL SERVICE LINES SHALL BE MARKED FOR LOCATION WITH A 2"x4" BOARD OR OTHER SUITABLE MARKER EXTENDING 2 FEET ABOVE AND 3 FEET BELOW GRADE IN ADDITION TO A 3 INCH WIDE GREEN PLASTIC TAPE TIED TO THE END OF THE SERVICE LINE AND EXTENDING 6 INCHES ABOVE THE GROUND SURFACE.

	city of PUEBLO colorado	**SANITARY SEWER TRENCH DETAIL**	SD22
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM
2/13/2023			CHECKED BY: SM
10/17/2022			APPROVED BY: SM
REVISION			



STANDARD 48" BASE SECTION 8" THRU 15" PIPE

NO SCALE



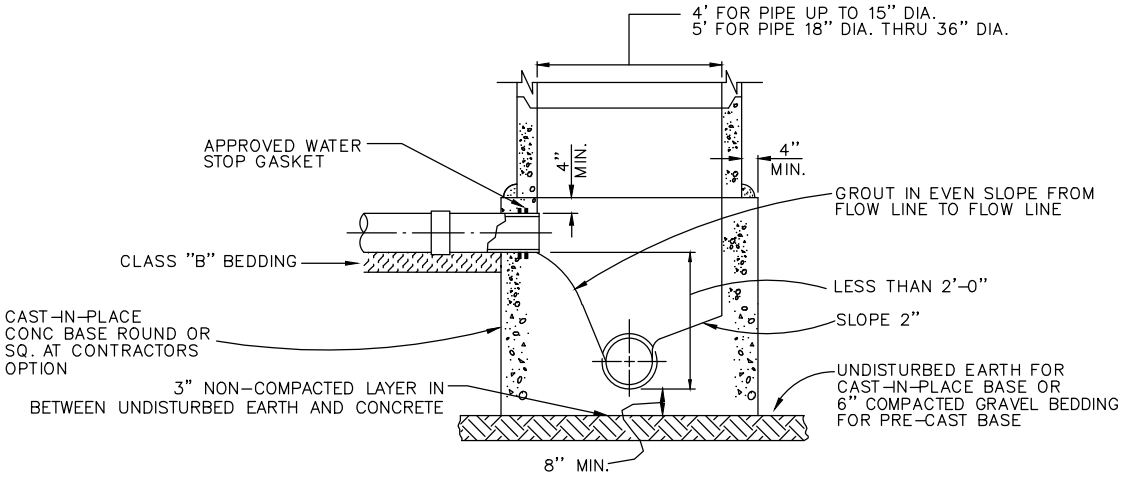
STANDARD 60" BASE SECTION 18" THRU 36" PIPE

NO SCALE

MANHOLE NOTES

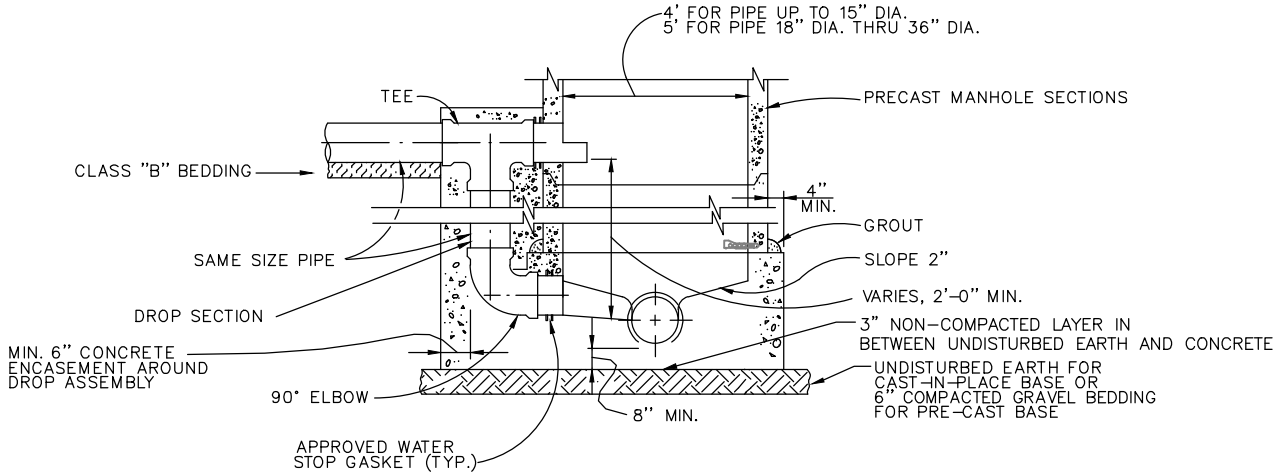
1. USE 24" STANDARD MANHOLE FRAME AND COVER UNLESS OTHERWISE NOTED ON PLANS.
2. IF PRE–CAST MANHOLE BASES ARE USED, THE CONCRETE BENCH/CHANNEL SHALL BE CAST–IN–PLACE, AFTER SEWER PIPE IS SET TO GRADE
3. THE CONCRETE CHANNEL IN ALL MANHOLE BASES SHALL BE CAST WITH A MINIMUM 18'' CENTERLINE RADIUS SWEEP.
4. FOR 72" STANDARD BASE SECTION 42" THRU 48" SEE SD15.
5. MANHOLES FOR PIPES GREATER THAN 48" SHALL BE DESIGNED BY ENGINEER.

2/13/2023 10/17/2022 REVISION	city of PUEBLO colorado	**SANITARY SEWER MANHOLE DETAILS**	SD23
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM CHECKED BY: SM APPROVED BY: SM



MANHOLE BASE SECTION FOR PIPE DROP LESS THAN 2'-0"

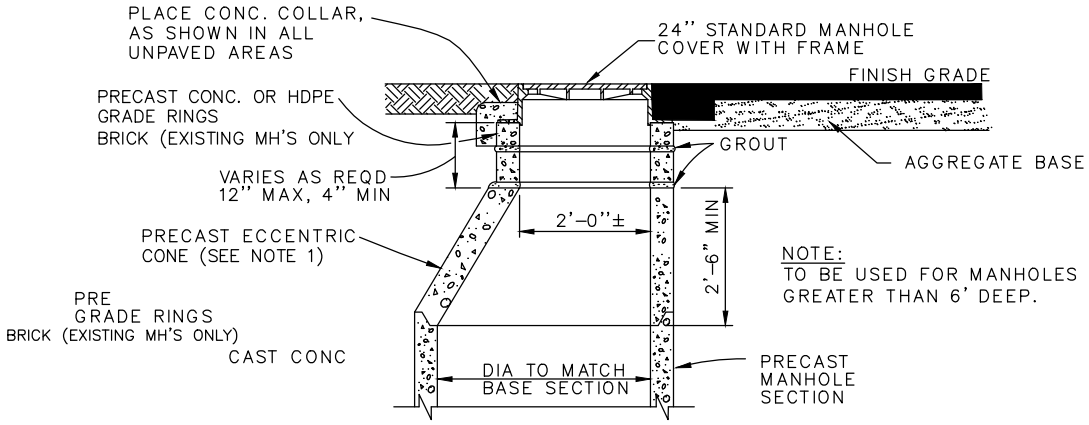
NOT TO SCALE



MANHOLE BASE SECTION WITH DROP ASSEMBLY

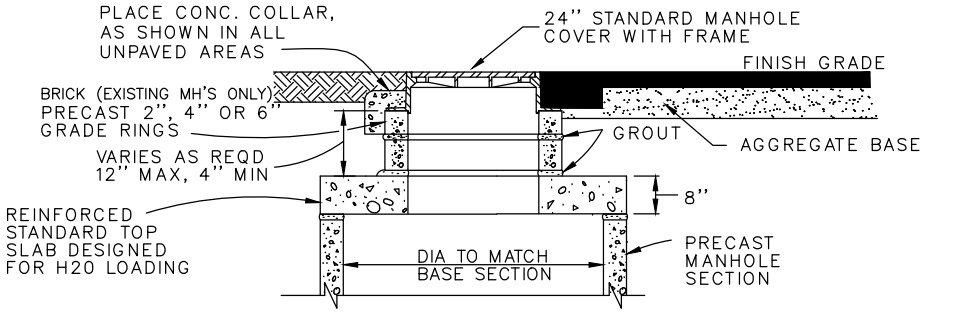
NOT TO SCALE

	city of PUEBLO colorado	**SANITARY SEWER MANHOLE DETAILS**	SD24
2/13/2023		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM
10/17/2022			CHECKED BY: SM
REVISION			APPROVED BY: SM



MANHOLE TOP SECTION WITH RING EXTENSION

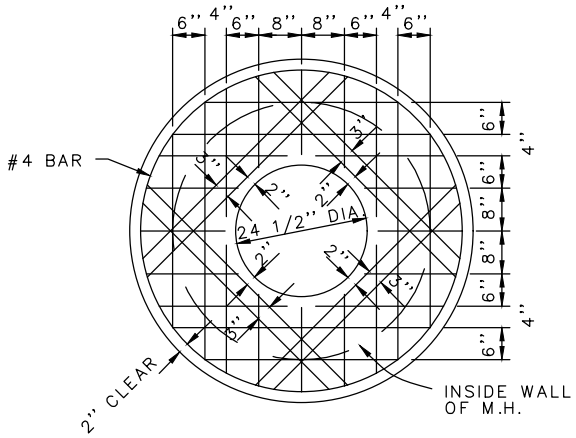
SCALE: 1"-3'-0"



FLAT TOP MANHOLE

SCALE: 1"-3'-0"

NOTE 1. "SITUATE ECCENTRIC CONE SECTION WHERE SLOPE OF THE CONE SECTION IS POINTING TOWARD THE DOWNSTREAM DIRECTION"

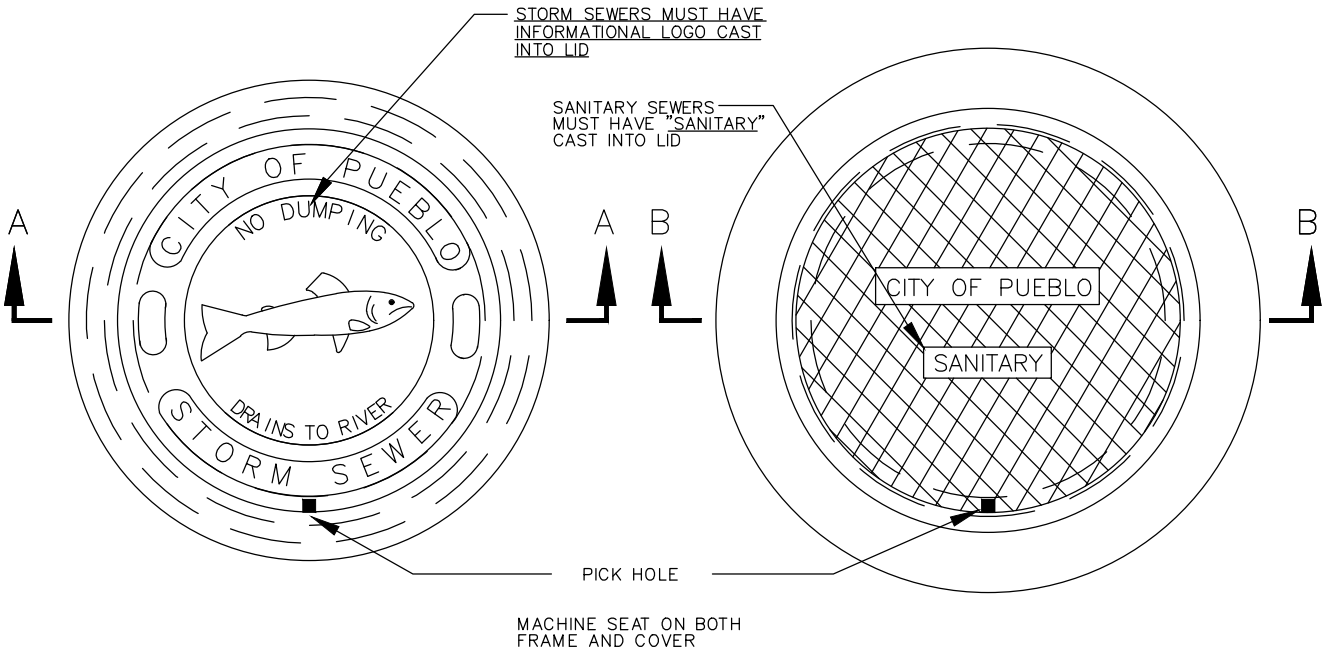


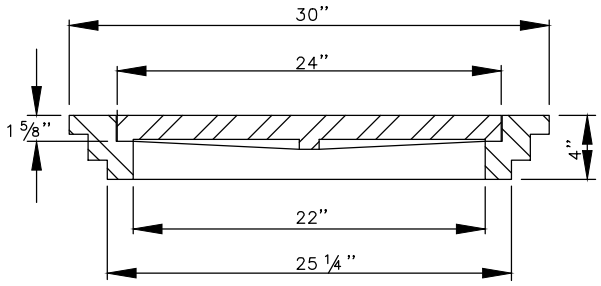
1. DESIGNED FOR H20 LOADING
2. BARS TO BE TIED, NOT WELDED.
3. SLAB TO BE 8" THICK.
4. STEEL TO BE PLACED TOP & BOTTOM WITH 2" CLEAR BTWN. BARS & CONC. SURFACE.
5. ALL BARS TO BE #4.

TOP CONCRETE SLAB FOR FLAT TOP MANHOLE

NOT TO SCALE

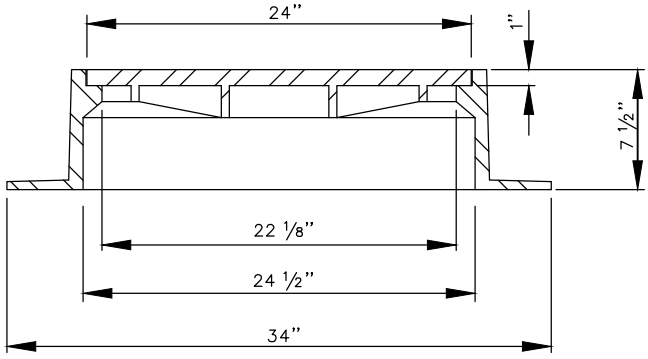
2/13/2023 10/17/2022 REVISION	city of PUEBLO colorado	**SANITARY SEWER MANHOLE DETAILS** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD25 DRAWN BY: JM CHECKED BY: SM APPROVED BY: SM





SECTION A-A
STANDARD MANHOLE RING AND COVER
INLET NEENAH R-6041, DEETER 1157,
EAST JORDAN IRONWORKS 2855
OR APPROVED EQUAL

SCALE 1"=1'-0"



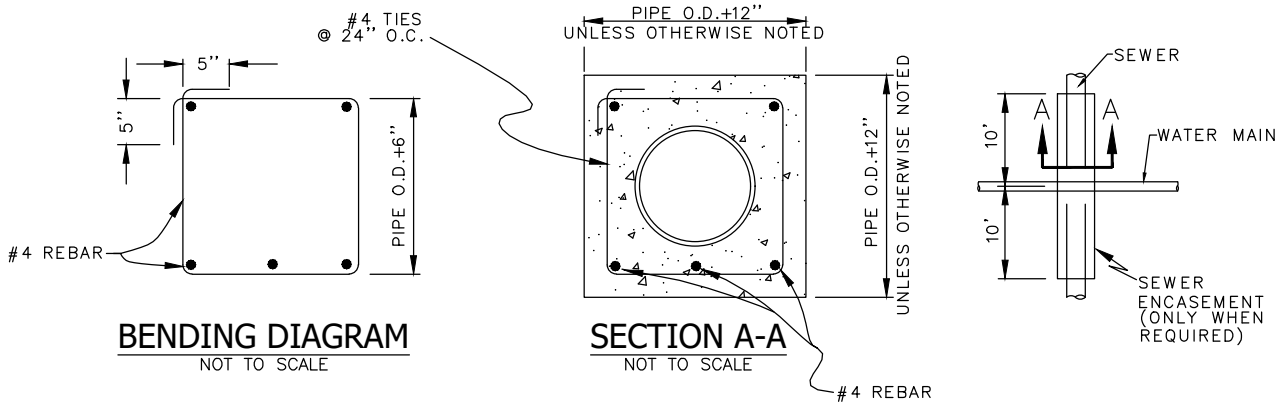
SECTION B-B
STANDARD MANHOLE RING AND COVER
INLET NEENAH R-1706, DEETER 1258,
EAST JORDAN IRONWORKS 2430
OR APPROVED EQUAL

SCALE 1"=1'-0"

MANHOLE NOTES

1. USE 24" STANDARD MANHOLE FRAME AND COVER UNLESS OTHERWISE NOTED ON PLANS.
2. PROVIDE 'BOLT DOWN' COVERS FOR MANHOLE IN IN REMOTE UNIMPROVED AREAS.

10/17/2022 REVISION	city of PUEBLO colorado	**MANHOLE AND INLET RING & COVER DETAILS**	SD26
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR



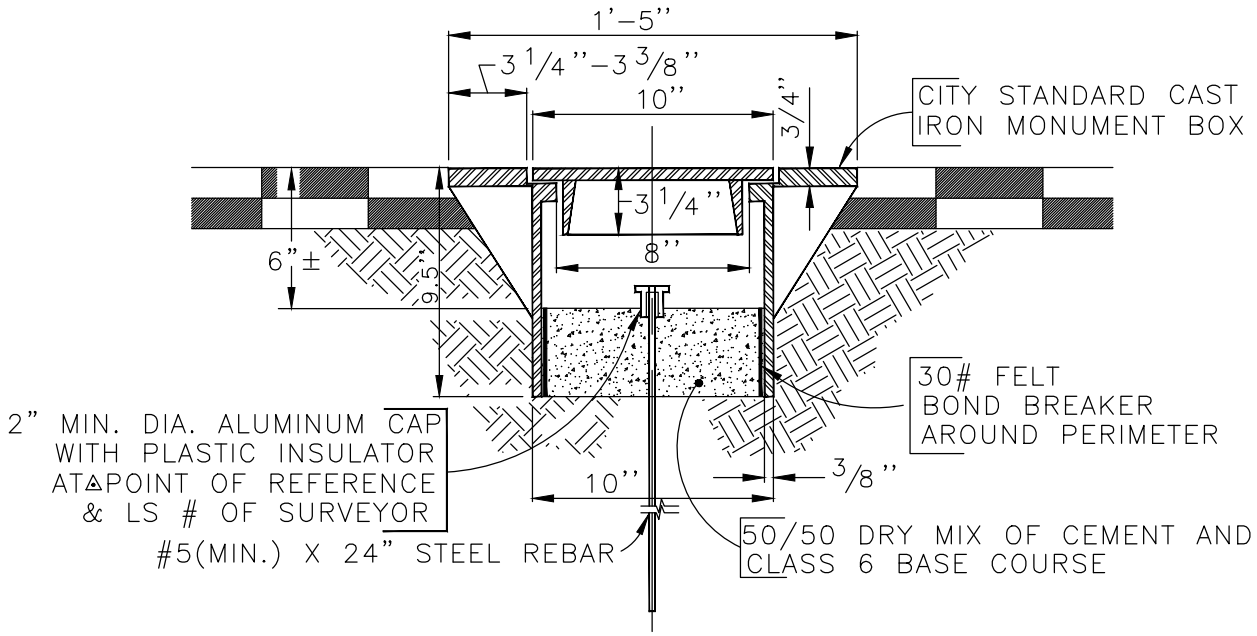
BENDING DIAGRAM
NOT TO SCALE

SECTION A-A
NOT TO SCALE

SEWER ENCASEMENT DETAILS

NOT TO SCALE

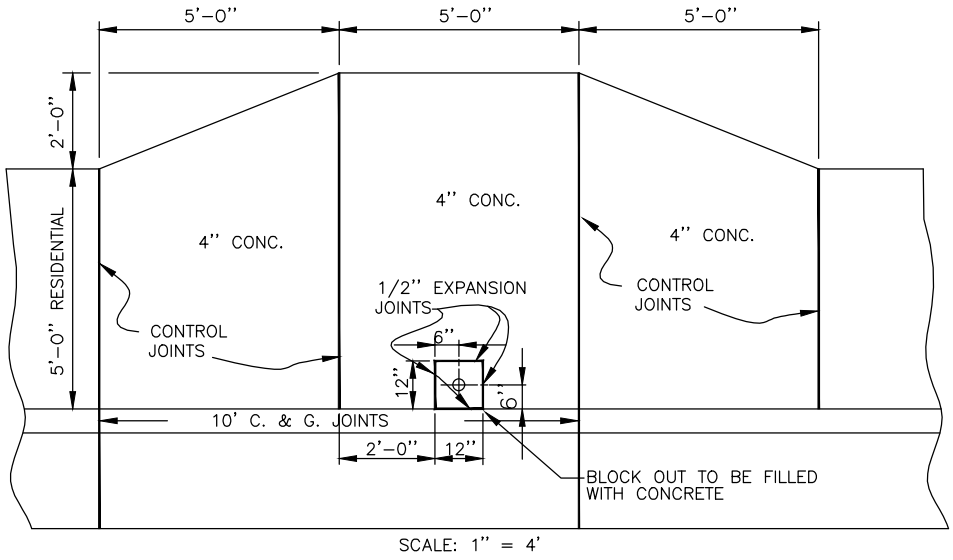
	city of PUEBLO colorado	**SANITARY SEWER ENCASEMENT DETAILS**	SD27
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM CHECKED BY: SM APPROVED BY: SM
2/13/2023			
10/17/2022			
REVISION			



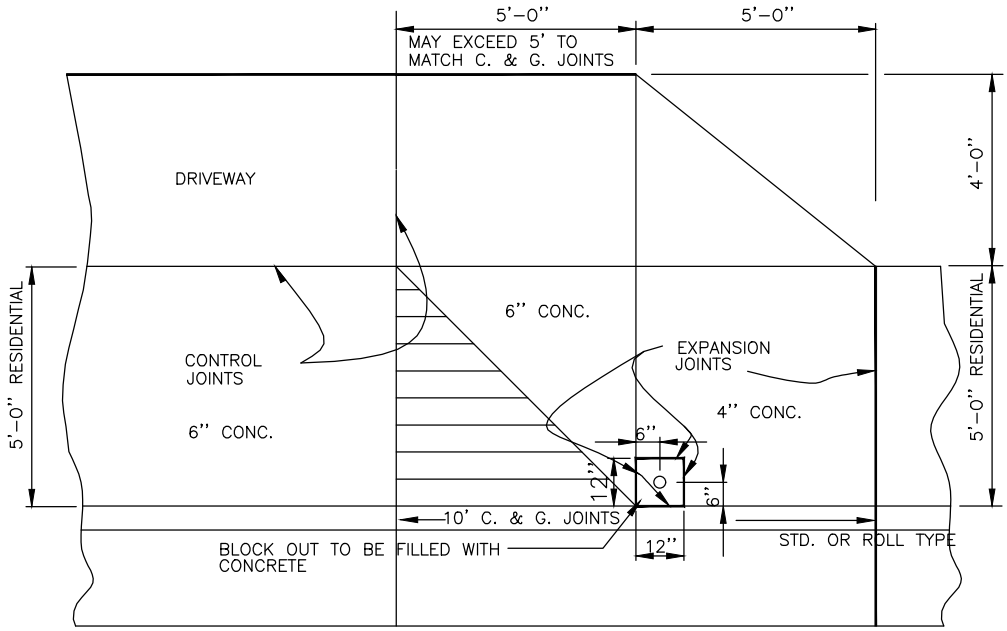
RIGHT-OF-WAY MONUMENTATION STANDARD

NOT TO SCALE

10/17/2022 REVISION	city of PUEBLO colorado	**RIGHT-OF-WAY MONUMENTATION STANDARD** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD28 DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR



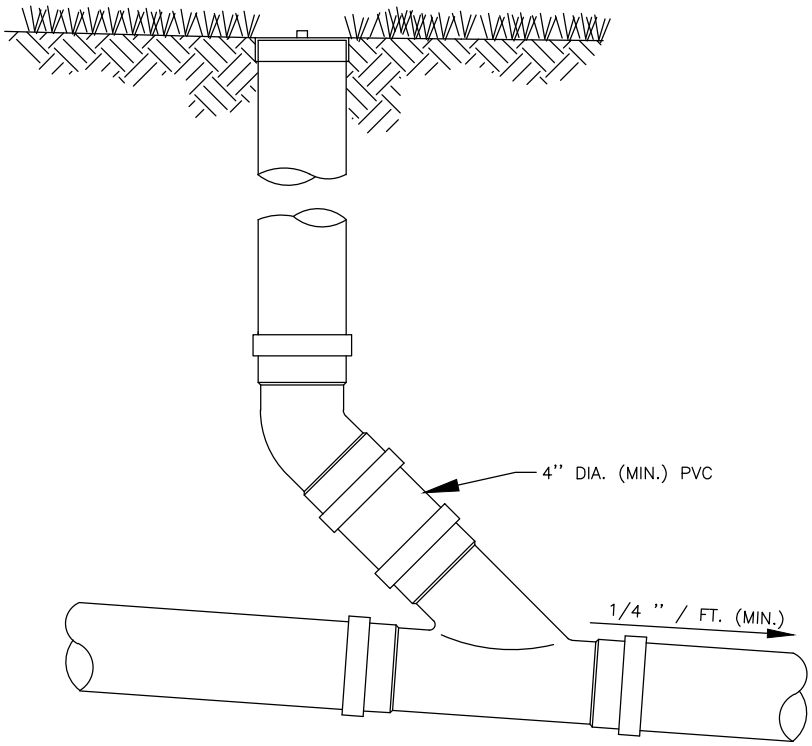
SCALE: 1" = 4'



SCALE: 1" = 4'

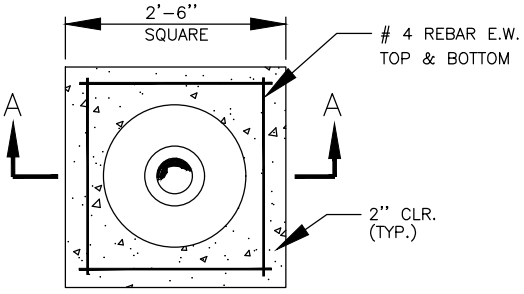
NOTE:
FOR MAIL BOXES LARGER THAN DIMENSIONS SHOWN, DETAIL SHALL BE MODIFIED TO PROVIDE A MINIMUM 3'–6" CLEARANCE TO EDGE OF WALK

10/17/2022 REVISION	city of PUEBLO colorado	**CURB SIDE MAIL BOXES** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD29 DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR



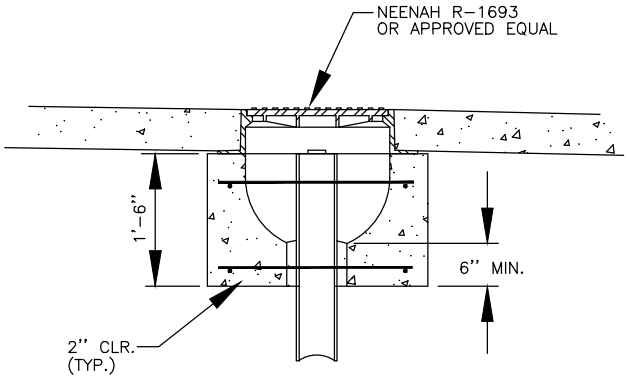
TYPICAL CLEANOUT DETAIL

NOT TO SCALE



COVER DETAIL

NOT TO SCALE



SECTION A-A

NOT TO SCALE

NOTE:

WHEN CLEANOUT IS IN STREET, PARKING OR ANY DRIVEWAY, CONSTRUCT COVER AS SHOWN

10/17/2022 REVISION	city of PUEBLO colorado	**SANITARY SEWER MAIN CLEANOUT**	SD30
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JM CHECKED BY: BQ APPROVED BY: CR

Materials

General

The work covered by this section of the specifications consists of the furnishing of all labor, supplies, equipment and materials and performing all operations in connection with the installation of tracer wire and appurtenances, as shown on the plans, as herein specified and directed by the Engineer to comply with Senate Bill 18-167. The bill requires that all new underground facilities, including laterals up to the structure or building being served, installed on or after August 8, 2018, must be electronically locatable when installed per section 9-1.5-103(10), C.R.S.
All tracer wire and tracer wire products shall be domestically manufactured in the U.S.A.
All tracer wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.

Tracer Wire

- **Open Trench** - Tracer wire shall be #12 AWG copper clad steel, high strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.
- **Directional Drilling/Boring** - Tracer wire shall be #12 AWG copper clad steel, extra high strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.
- **Tracer wire - Pipe Bursting/Slip Lining** - Tracer wire shall be 7 x 7 stranded copper clad steel, extreme strength with 4,700 lb. break load, with minimum 50 ml HDPE insulation thickness.

Connectors

- All mainline tracer wires must be interconnected in intersections, at mainline tees and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector (SnakeBite™ or approved equal). At crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
- **Direct bury wire connectors** - Shall include SnakeBite™ 3-way lockable connectors (or approved equal) and mainline to lateral lug connectors specifically manufactured for use in underground tracer wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion and shall be installed in a manner so as to prevent any uninsulated wire exposure.
- Non-locking friction fit, twist on or taped connectors are prohibited.

Termination/Access

- All tracer wire termination points must utilize an approved tracer wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.
- All grade level/in-ground access boxes shall include a dual terminal switchable lid (SnakePit® LD14G2T-SW or approved equal), be appropriately identified with “sewer” cast into the cap, and color coded per APWA standard for the specific utility being marked.
- A minimum of 2 ft. of excess/slack wire is required in all tracer wire access boxes after meeting final elevation.
- All tracer wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the tracer wire connection and the terminal for the ground rod wire connection.
- Ground wire shall be connected to the identified (or bottom) terminal on all access boxes.
- **Service Laterals on public property** - Tracer wire must terminate with a coil of 6 feet of tracer wire for future extension to the building, located at the edge of the road right-of-way, and out of the roadway.
- **Service Laterals on private property** - Tracer wire must terminate at an approved above-ground tracer wire access box, affixed to the building exterior directly above where the utility enters the building, at an elevation not greater than 5 vertical feet above finished grade, or terminate at an approved grade level/in-ground tracer wire access box, located within 2 linear feet of the building being served by the utility.
- **Long-runs, in excess of 2,500 linear feet** - Tracer wire access must be provided utilizing an approved grade level/in-ground tracer wire access box, located at the edge of the road right-of-way and out of the roadway. The grade level/in-ground tracer wire access box shall be delineated using a minimum 48” polyethylene marker post, color coded per APWA standard for the specific utility being marked or other approved marker by the City of Pueblo.

Grounding

- Tracer wire must be properly grounded at all dead ends/stubs.
- Grounding of tracer wire shall be achieved by use of a drive-in magnesium ground rod with a minimum of 20ft of #12 red HDPE insulated copper clad steel wire connected to anode (minimum 1.5 lb.) specifically manufactured for this purpose and buried at the same elevation as the utility.
- When grounding the tracer wire at dead ends/stubs, the ground rod shall be installed in a direction 180 degrees opposite of the tracer wire, at the maximum possible distance.
- When grounding the tracer wire in areas where the tracer wire is continuous and neither the mainline tracer wire or the ground rod wire will be terminated at/above grade, install ground rod wire directly beneath and in-line with the tracer wire. Do not coil excess wire from ground rod wire. In this installation method, the ground rod wire shall be trimmed to an appropriate length before connecting to tracer wire with a mainline to lateral lug connector.
- Where the ground rod wire will be connected to a tracer wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

Installation

General

- Tracer wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
- Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
- Any damage occurring during installation of the tracer wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.
- Tracer wire shall be installed at the top of the pipe and secured (taped/tied) at 5' intervals.
- Tracer wire must be properly grounded as specified.
- Tracer wire on all service laterals/stubs must terminate at an approved tracer wire access box located directly above the utility, at the edge of the road right-of-way but out of the roadway. (See Tracer wire **Termination/Access**)
- At all mainline dead-ends, tracer wire shall go to ground using an approved connection to a drive-in magnesium ground rod, buried at the same depth as the tracer wire. (See **Grounding**)
- Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end and ground using an approved waterproof connection to a ground rod buried at the same depth as the tracer wire.
- All service lateral tracer wires shall be a single wire, connected to the mainline tracer wire using an approved mainline to lateral lug connector, installed without cutting/splicing the mainline tracer wire.
- In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall be connected using approved splice connectors and shall be properly grounded at the splice location as specified.

Storm & Sanitary Sewer Systems

- All service lateral tracer wires must be properly connected to the mainline tracer wire to ensure full tracing/locating capabilities from a single connection point.
- Lay mainline tracer wire continuously, by-passing around the outside of manholes/structures on the north or east side.
- Tracer wire on all sewer laterals must terminate at the property line with a coil of 6 feet of tracer wire taped directly to the service lateral at the edge of the road right-of-way or at an approved location.
- The City of Pueblo Stormwater Department or Wastewater Department must be contacted to inspect tracer wire installation prior to backfilling any infrastructure that connects to the City's storm sewer or sanitary sewer system.

Prohibited Products and Methods

The following products and methods shall not be allowed or acceptable:

- Uninsulated tracer wire
- Tracer wire insulations other than HDPE
- Tracer wires not domestically manufactured
- Non-locking, friction fit, twist on or taped connectors
- Brass or copper ground rods
- Wire connections utilizing taping or spray-on waterproofing
- Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another
- Tracer wire wrapped around the corresponding utility
- Brass fittings with tracer wire connection lugs
- Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.
- Connecting tracer wire to any conductive utilities

Testing

- All new tracer wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.
- This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.
- Continuity testing in lieu of actual line tracing shall not be accepted.

Products

The following products have been deemed acceptable and appropriate. These products are a guide only to help you choose the correct applications for your tracer wire project.

- **Copper-Clad Steel (CCS) Tracer Wire**
  - **Open Trench** - Copperhead® #12 High Strength part # 1230G-HS or approved equal.
  - **Directional Drilling/Boring** - Copperhead® Extra High Strength part # 1245G-EHS or approved equal.
  - **Pipe Bursting/Slip Lining** - Copperhead® SoloShot Extreme Strength 7 x 7 Stranded part # GPBX- 50 or approved equal.

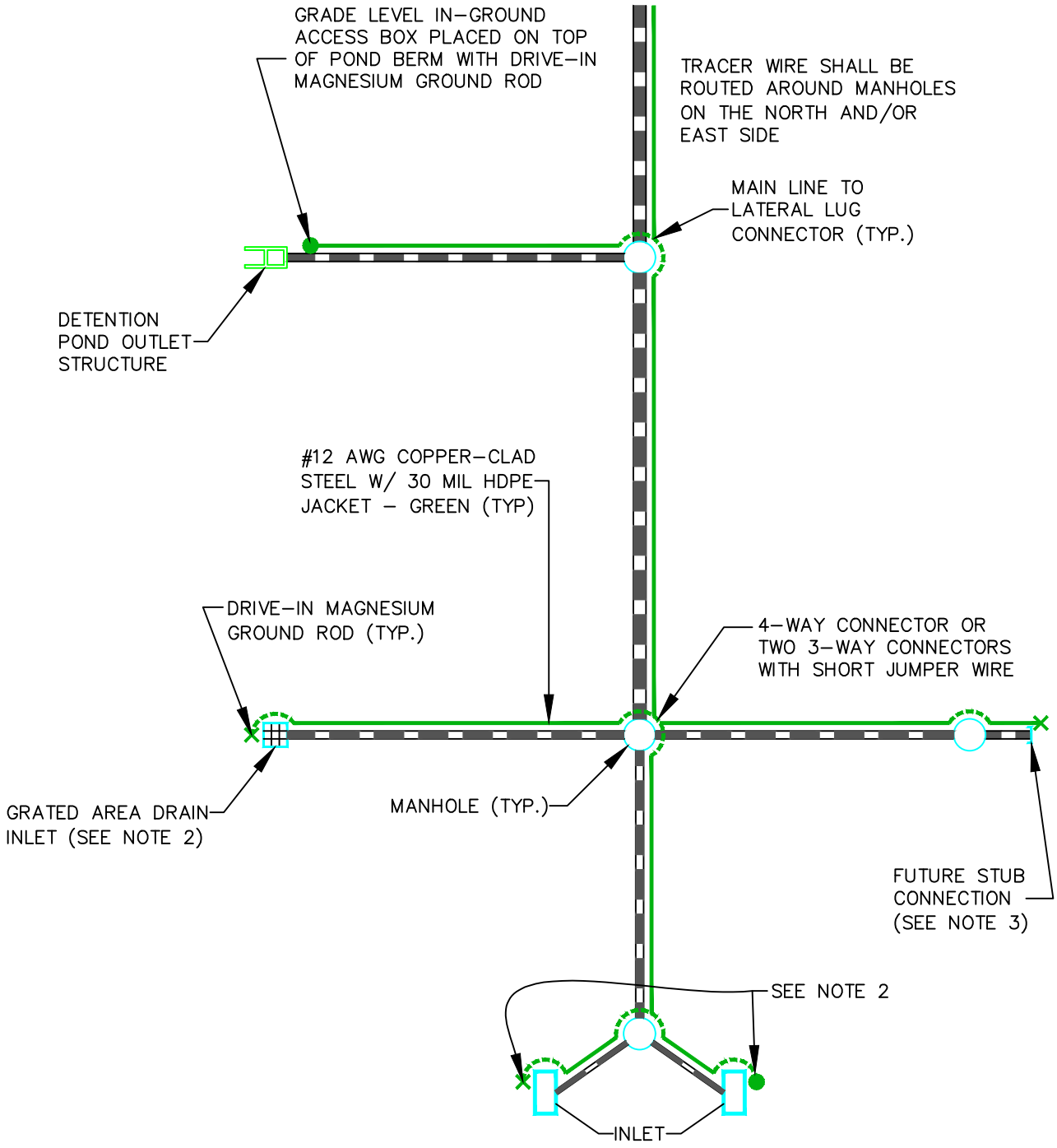
- **Connectors**
  - Copperhead® 3-way locking connector part # LSC1230C or approved equal.
  - DryConn 3-way Direct Bury Lug: Copperhead® Part # 3WB-01 or approved equal.

- **Termination/Access**
  - **Non-Roadway access boxes applications**: Tracer wire access boxes grade level Copperhead® 3-way Direct Bury Lug adjustable lite duty Part # LD14G2T-SW or approved equal.
  - **Concrete / Driveway access box applications**: Tracer wire access boxes grade level Copperhead® Part # CD14G2T-SW or approved equal.

- **Grounding**
  - **Drive in Magnesium Ground Rod**: Copperhead® Part # ANO-12 (1.5 lb.) or approved equal.

Manufacturer Product Options:

Copperhead® products or approved equal.



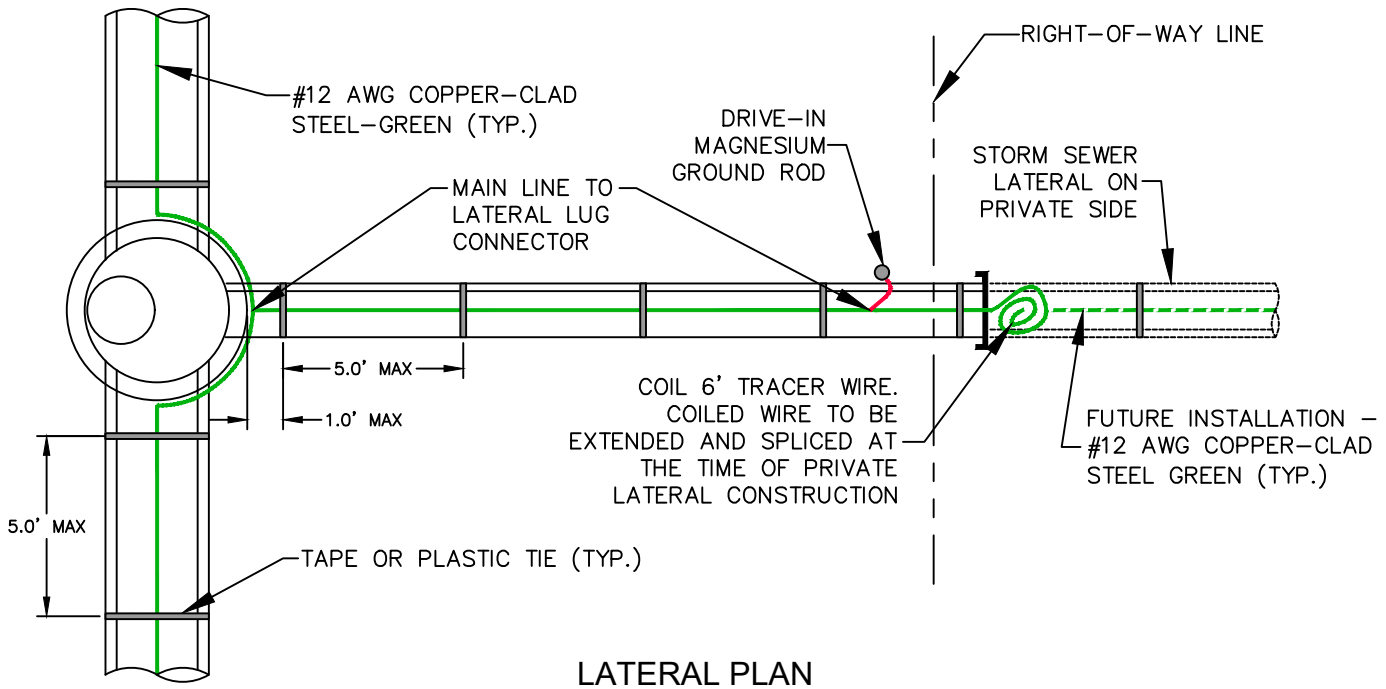
NOTES:

1. WIRE SHOWN AWAY FROM PIPE FOR CLARITY. WIRE SHALL BE INSTALLED ON THE TOP OF THE PIPE. THE WIRE SHALL BE FASTENED TO THE PIPE WITH TAPE OR PLASTIC TIES AT 5' INTERVALS.

2. TRACER WIRE FOR INLETS MAY TERMINATE INSIDE OF INLET BOX BELOW THE ACCESS (SEE DETAIL SHEET 6 OF 8) OR A GRADE LEVEL IN-GROUND ACCESS BOX MUST BE USED (OPTION REQUIRES CITY APPROVAL IN PAVED AREAS). DRIVE-IN MAGNESIUM GROUND ROD MUST BE USED FOR EITHER OPTION.

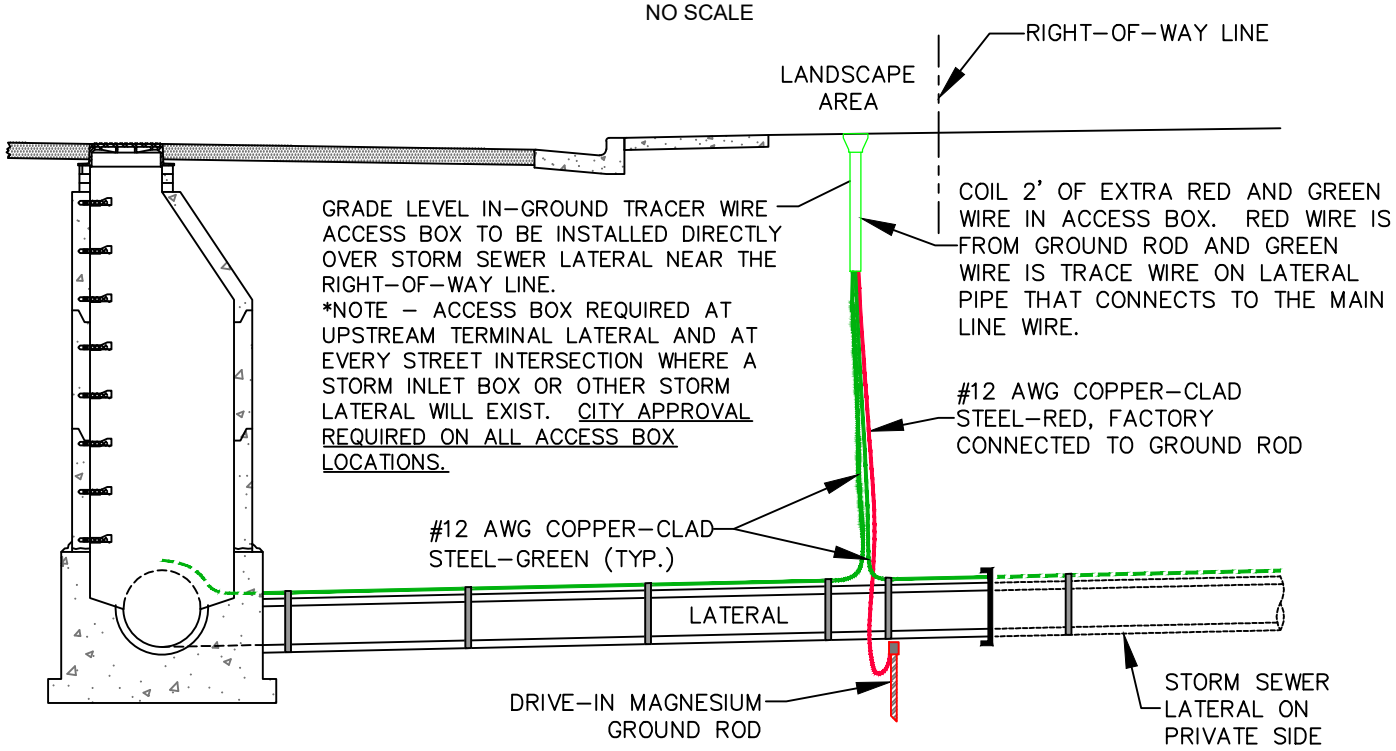
3. AT ALL FUTURE STUB CONNECTIONS, A MINIMUM OF 6 FEET OF TRACER WIRE SHALL BE EXTENDED BEYOND THE END OF THE PIPE, COILED AND SECURED FOR FUTURE CONNECTIONS. THE END OF THE TRACER WIRE SHALL BE SPLICED TO THE WIRE OF A DRIVE-IN MAGNESIUM GROUND ROD AND IS TO BE BURIED AT THE SAME ELEVATIONS AS THE SEWER MAIN.

REVISION	city of PUEBLO colorado	**TRACER WIRE SAMPLE PLAN STORM SEWER**	SD34
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JH CHECKED BY: SM APPROVED BY: JH



LATERAL PLAN

NO SCALE



LATERAL PROFILE

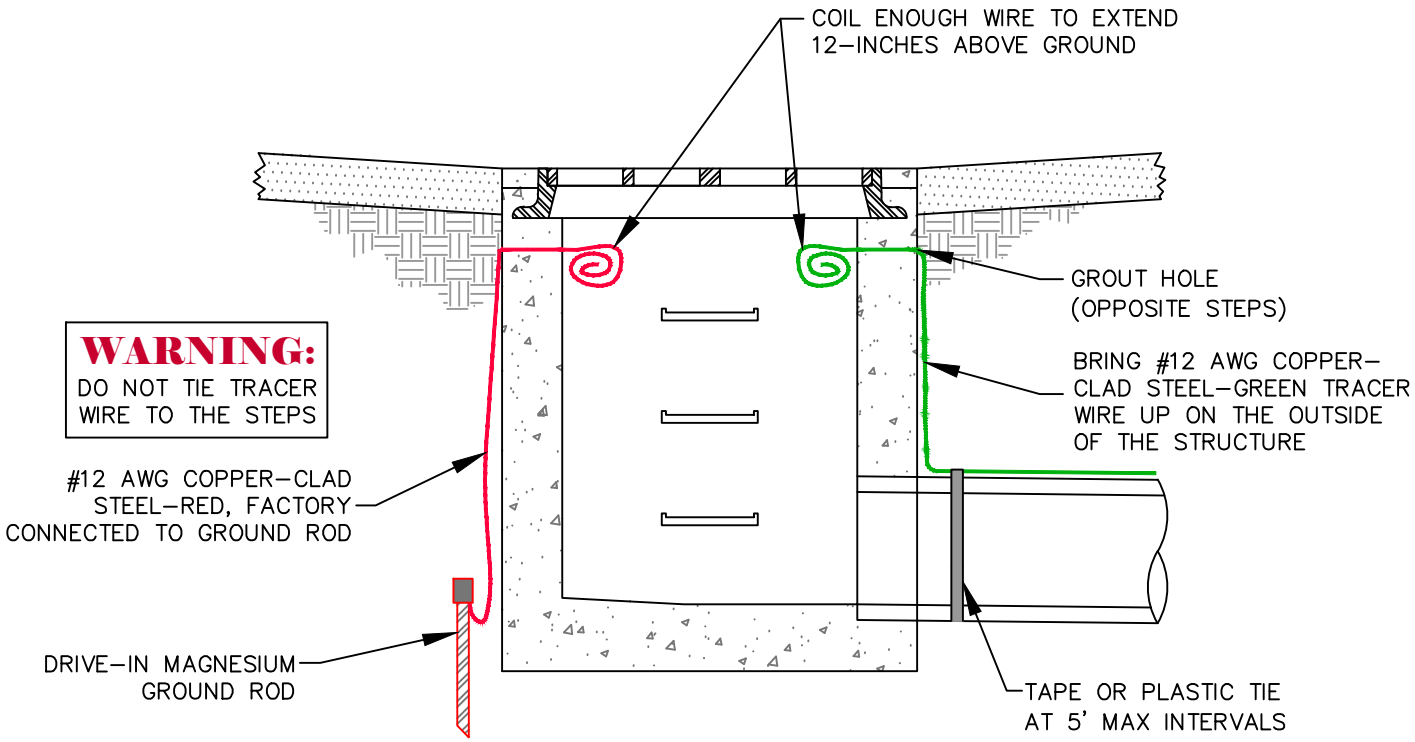
NO SCALE

NOTES:

1. WIRE SHOWN AWAY FROM PIPE FOR CLARITY. WIRE SHALL BE INSTALLED IMMEDIATELY ADJACENT TO THE SERVICE PIPE. THE WIRE SHALL BE FASTENED TO THE PIPE WITH TAPE OR PLASTIC TIES AT 5' INTERVALS.

2. TRACER WIRE NOT REQUIRED FOR REHABILITATION PROJECTS.

REVISION		TRACER WIRE LATERAL DETAIL STORM SEWER	SD35
	city of PUEBLO colorado	PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JH CHECKED BY: SM APPROVED BY: JH

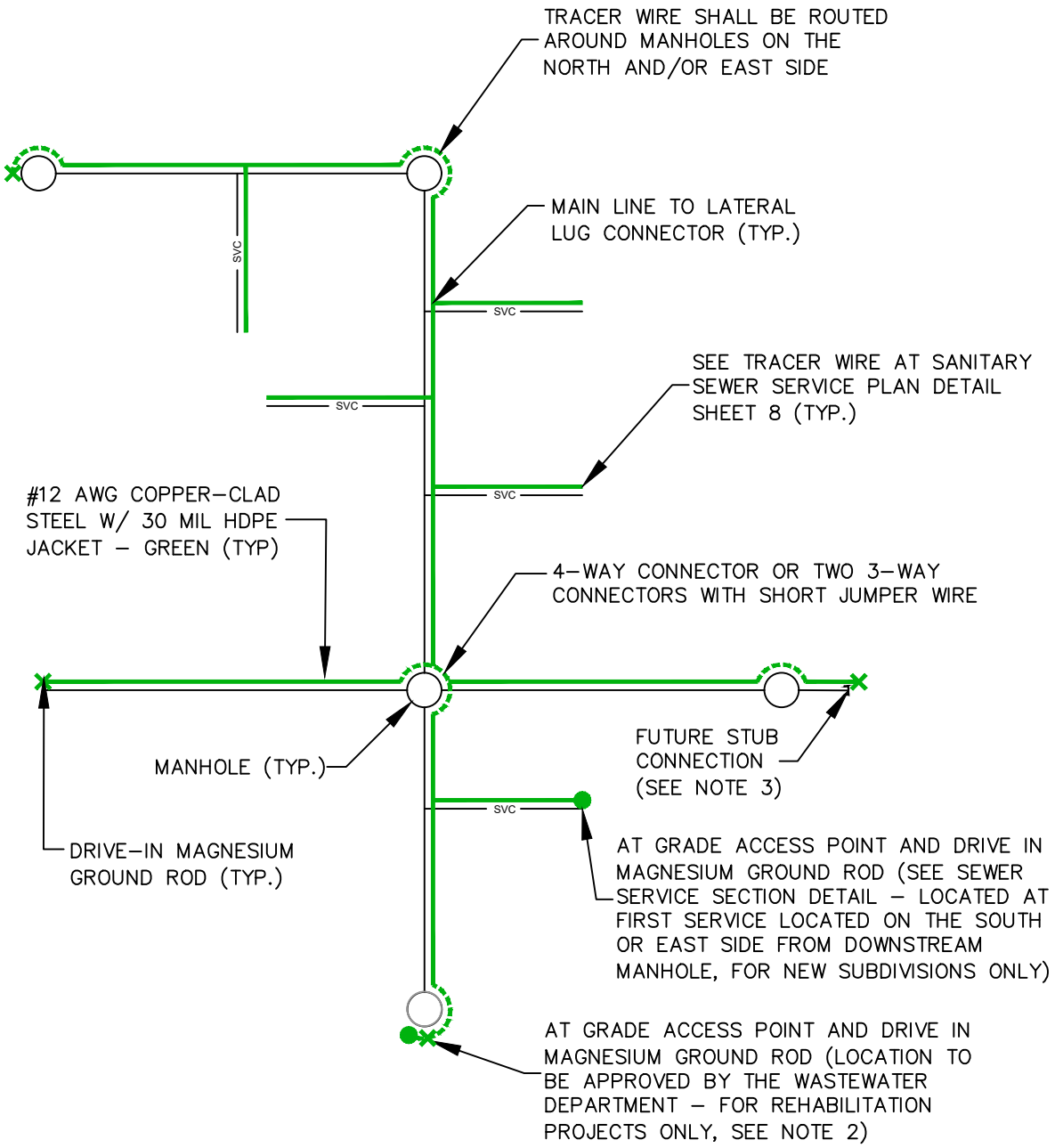


NOTE:
THIS OPTION IS RECOMMENDED FOR INLETS IN A PARKING LOT WHERE A LEVEL IN–GROUND TRACER WIRE ACCESS BOX HAS POTENTIAL TO BE COVERED BY ASPHALT OVERLAY. THIS OPTION REQUIRES CITY OF PUEBLO STORMWATER APPROVAL AND MAY BE SUBJECT TO ADDITIONAL REQUIREMENTS.

INLET OR MANHOLE LOCATED IN A PAVED SURFACE

NO SCALE

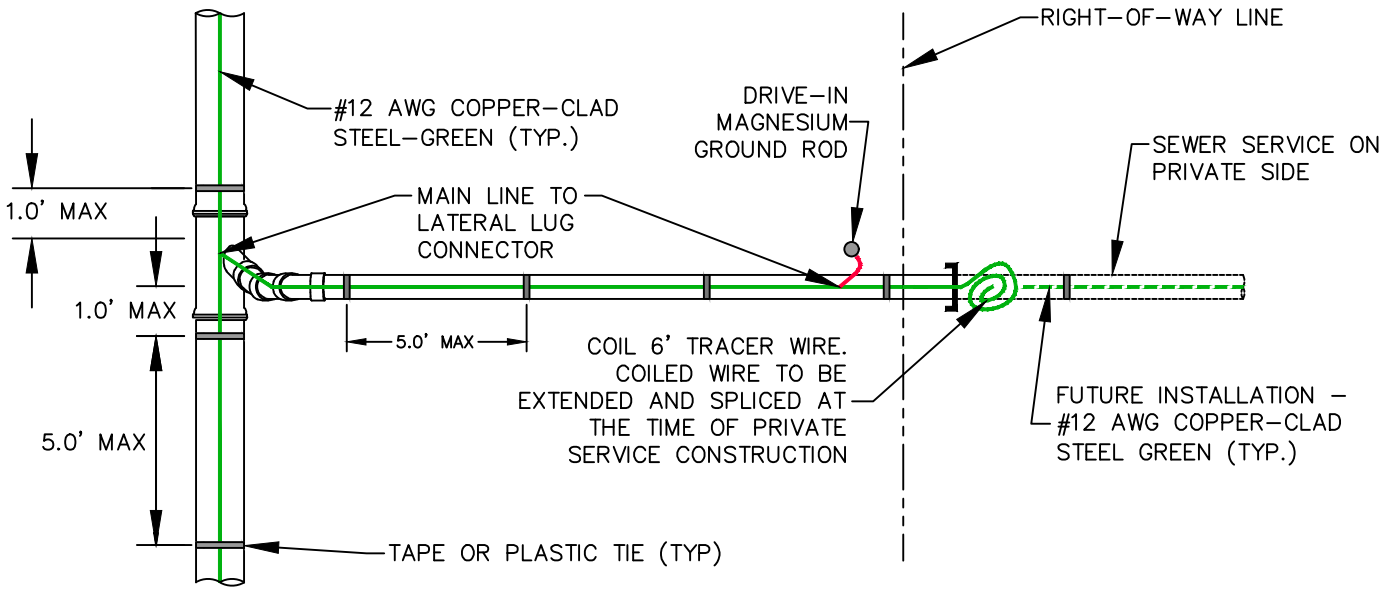
REVISION	city of PUEBLO colorado	**TRACER WIRE DETAILS STORM SEWER** PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SD36 DRAWN BY: JH CHECKED BY: SM APPROVED BY: JH



NOTES:

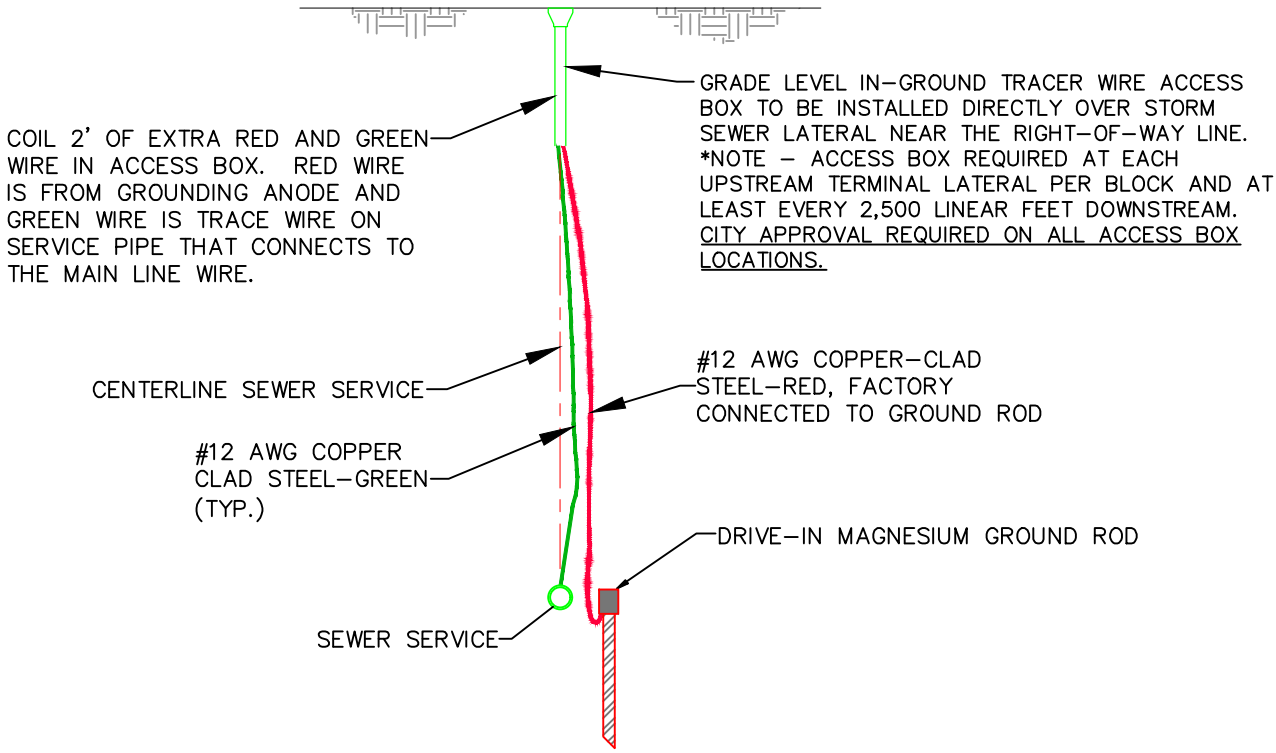
1. WIRE SHOWN AWAY FROM PIPE FOR CLARITY. WIRE SHALL BE INSTALLED ON THE TOP OF THE PIPE. THE WIRE SHALL BE FASTENED TO THE PIPE WITH TAPE OR PLASTIC TIES AT 5' INTERVALS.
2. REHABILITATION PROJECTS SHALL HAVE A DRIVE-IN MAGNESIUM GROUND ROD INSTALLED ON THE UPSTREAM AND DOWNSTREAM MANHOLES AS WELL AS A GRADE LEVEL IN-GROUND ACCESS BOX INSTALLED AT THE DOWNSTREAM MANHOLE (ACCESS BOX TYPE AND LOCATION TO BE APPROVED BY WASTEWATER DEPARTMENT).
3. AT ALL FUTURE STUB CONNECTIONS, A MINIMUM OF 6 FEET OF TRACER WIRE SHALL BE EXTENDED BEYOND THE END OF THE PIPE, COILED AND SECURED FOR FUTURE CONNECTIONS. THE END OF THE TRACER WIRE SHALL BE SPLICED TO THE WIRE OF A DRIVE-IN MAGNESIUM GROUND ROD AND IS TO BE BURIED AT THE SAME ELEVATIONS AS THE SEWER MAIN.

REVISION	city of PUEBLO colorado	**TRACER WIRE SAMPLE PLAN SANITARY SEWER**	SD37
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JH CHECKED BY: SM APPROVED BY: JH



SEWER SERVICE PLAN

NO SCALE



SEWER SERVICE SECTION

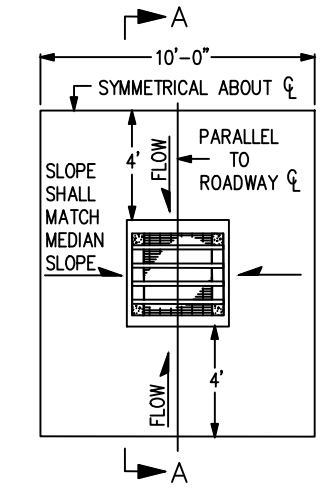
NO SCALE

NOTES:

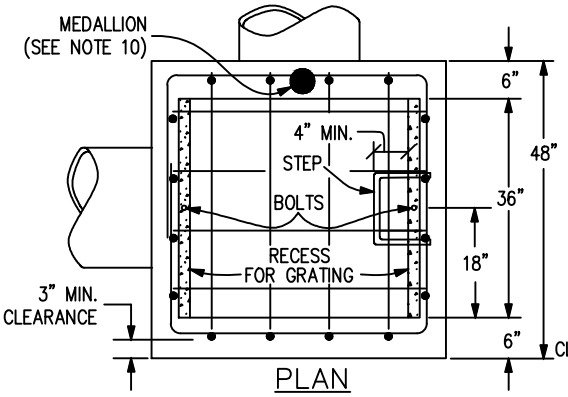
1. WIRE SHOWN AWAY FROM PIPE FOR CLARITY. WIRE SHALL BE INSTALLED IMMEDIATELY ADJACENT TO THE SERVICE PIPE. THE WIRE SHALL BE FASTENED TO THE PIPE WITH TAPE OR PLASTIC TIES AT 5' INTERVALS.

2. TRACER WIRE NOT REQUIRED FOR REHABILITATION PROJECTS.

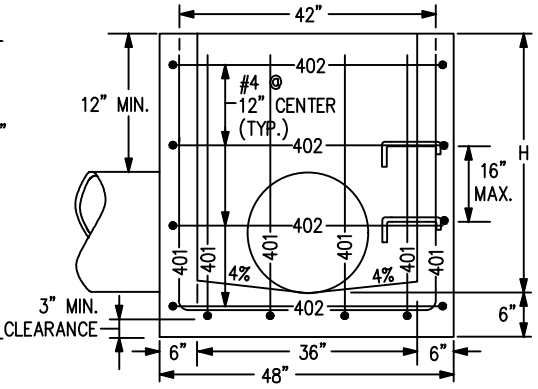
REVISION	city of PUEBLO colorado	TRACER WIRE DETAILS SANITARY SEWER SERVICE	SD38
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: JH CHECKED BY: SM APPROVED BY: JH



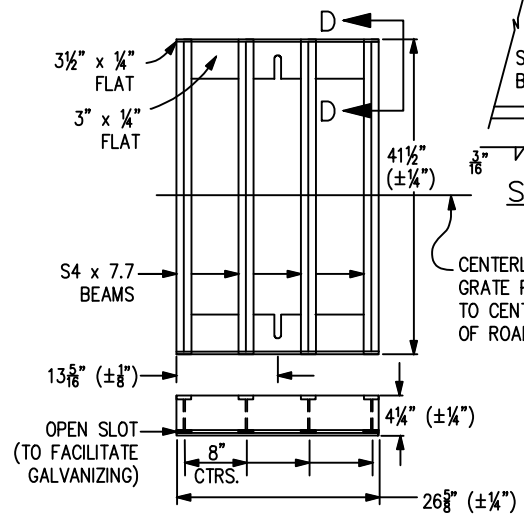
INLET WITH DITCH PAVING



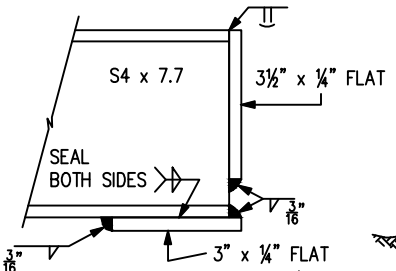
PLAN



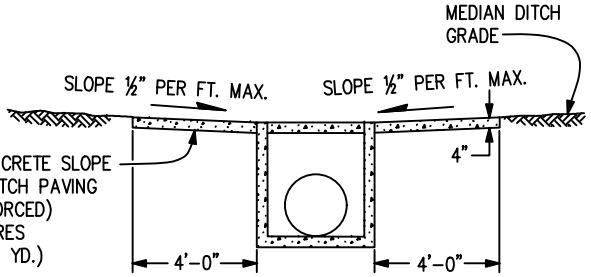
ELEVATION
CONCRETE INLET



STANDARD INLET GRATE



SECTION D–D



SECTION A–A

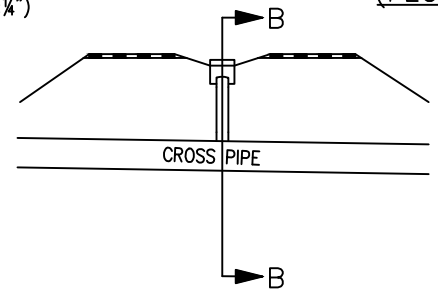
*CONCRETE SLOPE AND DITCH PAVING WILL BE REQUIRED WHEN SHOWN ON THE PLANS.

INLET AT BOTTOM OF VERTICAL CURVE
(FLOW FROM TWO DIRECTIONS)

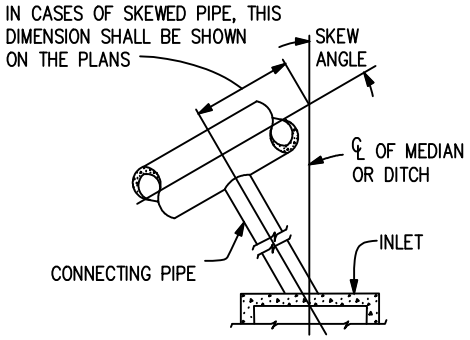
STEEL GRATE QUANTITIES

NO. PIECES	DESCRIPTION	LENGTH	LBS PER FT.	WEIGHT (LBS.)
4	S4 x 7.7 BEAM	41"	7.90	106
2	3½" x ¼" FLAT	26 5/8"	2.98	13
2	3" x ¼" FLAT	26 5/8"	2.55	12

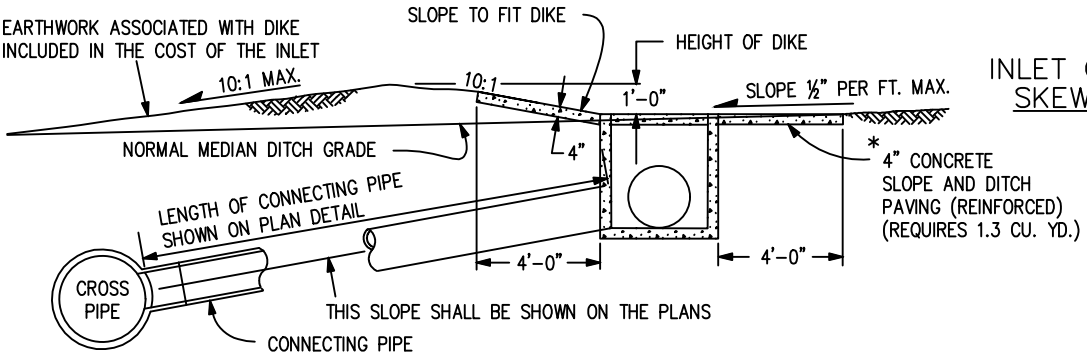
TOTAL LBS. – 131



SECTION VIEW



INLET CONNECTED TO A
SKEWED CROSS PIPE



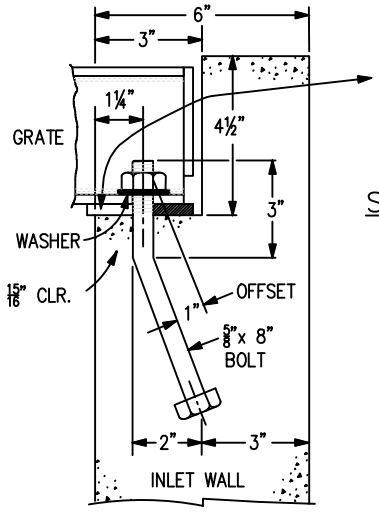
SECTION B–B

INLET CONNECTED
TO A CROSS PIPE

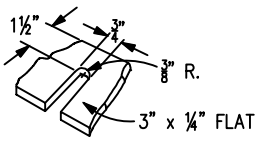
SECTION A–A

INLET ON GRADE
(FLOW FROM ONE DIRECTION)

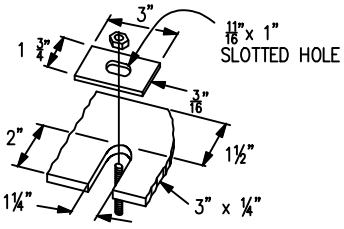
09/03/2024	city of PUEBLO colorado	INLET, TYPE C (1 OF 2)	SW1.1
01/01/2023		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH
REVISIONS			



GRATE INSTALLATION DETAIL



SLOT DETAIL



ALTERNATE SLOT AND HOLD DOWN PLATE DETAIL

QUANTITIES FOR ONE INLET

H	CONCRETE (CU. YDS.)	STEEL (LBS.)	NO. STEPS REQ'D.
2'-6"	1.0	76	0
3'-0"	1.1	81	0
3'-6"	1.2	97	0
4'-0"	1.3	102	1
4'-6"	1.5	117	2
5'-0"	1.6	123	2
5'-6"	1.7	138	2
6'-0"	1.9	143	3
6'-6"	2.0	159	3
7'-0"	2.1	164	3
7'-6"	2.2	180	4
8'-0"	2.4	185	4
8'-6"	2.5	200	4
9'-0"	2.6	206	5
9'-6"	2.8	221	5
10'-0"	2.9	236	6
11'-6"	3.3	252	6

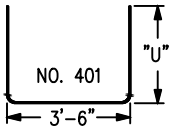
▼ PIPE INSIDE DIAMETER SHALL BE 30 IN. OR LESS. CONCRETE AND STEEL QUANTITIES ARE FOR ONE ENTIRE INLET BEFORE DEDUCTION FOR VOLUME OCCUPIED BY PIPE. WEIGHT OF STEEL INCLUDES A RING FOR THE MAXIMUM PIPE DIAMETER.

GENERAL NOTES

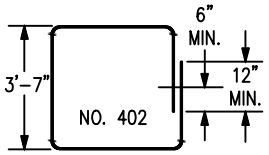
1. INLET TYPE C IS NOT HS-20 RATED AND SHALL NOT BE PLACED IN PAVED ROADWAYS. THIS INLET SHALL BE USED ONLY OUTSIDE PAVED ROADWAYS.
2. CONCRETE SHALL BE CLASS B. INLET MAY BE CAST-IN-PLACE OR PRECAST.
3. REINFORCING BARS SHALL BE GRADE 60, EPOXY COATED, AND DEFORMED #4, AND SHALL HAVE A MIN. 2 INCH CLEARANCE. CUT OR BEND AROUND PIPES AS REQUIRED.
4. CONCRETE SLOPE AND DITCH PAVING SHALL BE IN ACCORDANCE WITH SECTION 507. REINFORCEMENT FOR CONCRETE SLOPE PAVING SHALL BE 6 X 6 – W1.4 X W1.4 OR 6 X 6 – W2.1 X W2.1.
5. STRUCTURAL STEEL FOR GRATES AND GRATE INSTALLATION HARDWARE SHALL BE GALVANIZED, AND SHALL BE IN ACCORDANCE WITH SUBSECTION 712.06.
6. THE STANDARD INLET GRATES SHALL BE USED ON ALL TYPE C INLETS UNLESS CLOSE MESH INLET GRATES ARE SPECIFIED ON THE PLANS.
7. CLOSE MESH GRATES ARE RECOMMENDED WHERE FOOT TRAFFIC OR BICYCLE ROUTES ARE IN CLOSE PROXIMITY TO GRATE. THIS GRATE IS NOT ADA COMPLIANT OR BICYCLE FRIENDLY AND SHALL NOT BE PLACED DIRECTLY IN SIDEWALKS, CROSSWALKS OR BIKE PATHS.
8. STEPS SHALL BE PROVIDED WHEN INLET DIMENSION "H" IS EQUAL TO OR GREATER THAN 3 FEET – 6 INCHES AND SHALL CONFORM TO AASHTO M 199.
9. SEE STANDARD PLAN M-604-11, FOR REINFORCEMENT AROUND THE PIPE OPENING.
10. ALL INLETS SHALL HAVE A 4 INCH DIA. METAL MEDALLION WITH A "NO DUMPING DRAINS TO STREAM" MESSAGE ON IT. THE MEDALLION SHALL HAVE A FISH SYMBOL WITH A BLUE BACKGROUND. IT SHALL BE FIRMLY ATTACHED TO THE TOP OF THE INLET WITH A PERMANENT FASTENER.

BAR LIST FOR H = 2 FT.–6 IN. AND BENDING DIAGRAM

MARK	NO. REQ'D.	HEIGHT	LENGTH
401	2	2'-2½"	8'-0"
401	6	2'-7"	8'-8"
402	4	"U"	15'-4"

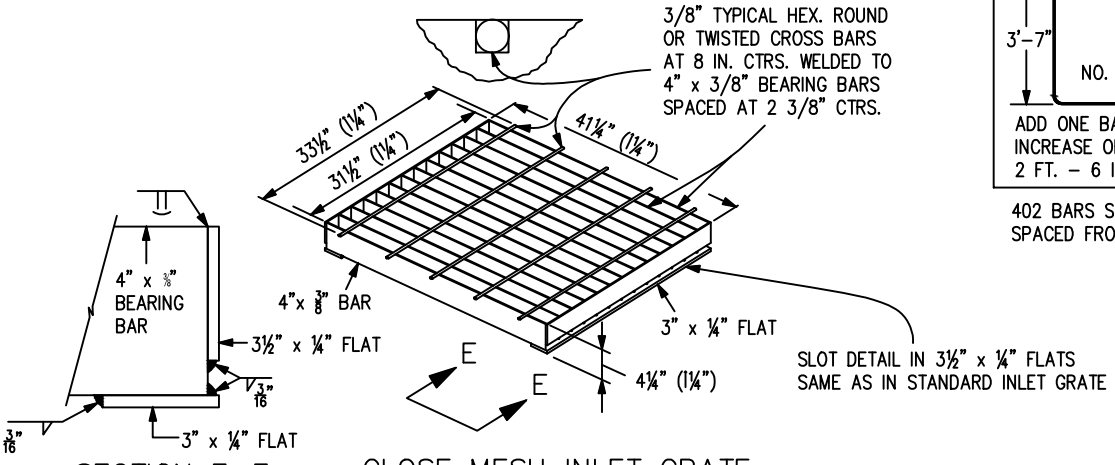


"U" INCREASE DIMENSION 6 IN. FOR EACH 6 IN. INCREASE OF "H" ABOVE 2 FT.–6 IN.



ADD ONE BAR FOR EACH FT. INCREASE OF "H" ABOVE 2 FT. – 6 IN.

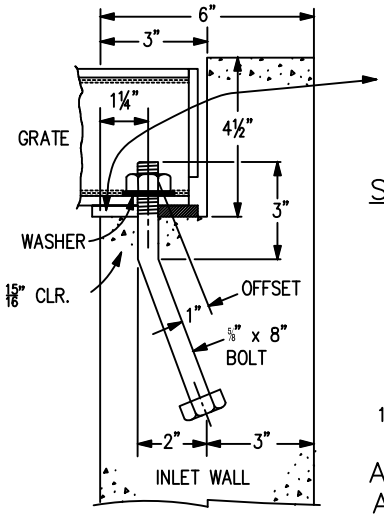
402 BARS SHALL BE EQUALLY SPACED FROM EACH OTHER.

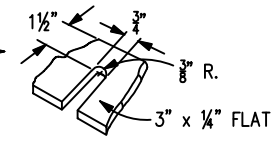


SECTION E–E

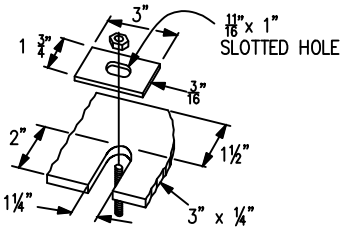
CLOSE MESH INLET GRATE

	city of PUEBLO colorado	INLET, TYPE C (2 OF 2)	SW1.2
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION	DRAWN BY: NLS
01/01/2023		211 EAST "D" ST. PUEBLO, CO 81003	CHECKED BY: JS
REVISIONS		(719) 553-2295 PHONE	APPROVED BY: JH

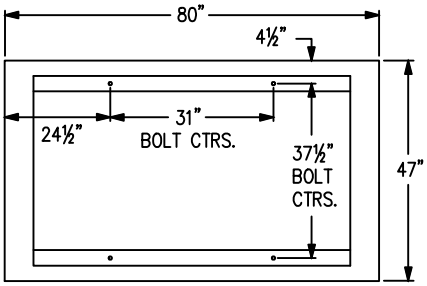




SLOT DETAIL

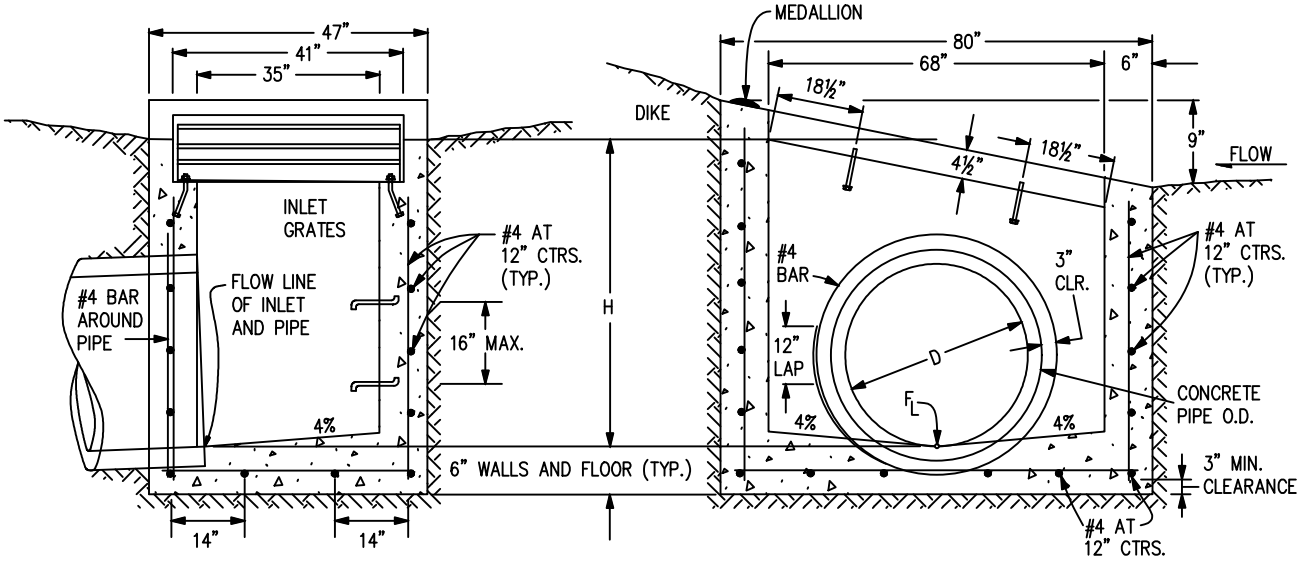


ALTERNATE SLOT AND HOLD DOWN PLATE DETAIL



PLAN VIEW
(SHOWING ANCHOR BOLT LAYOUT)

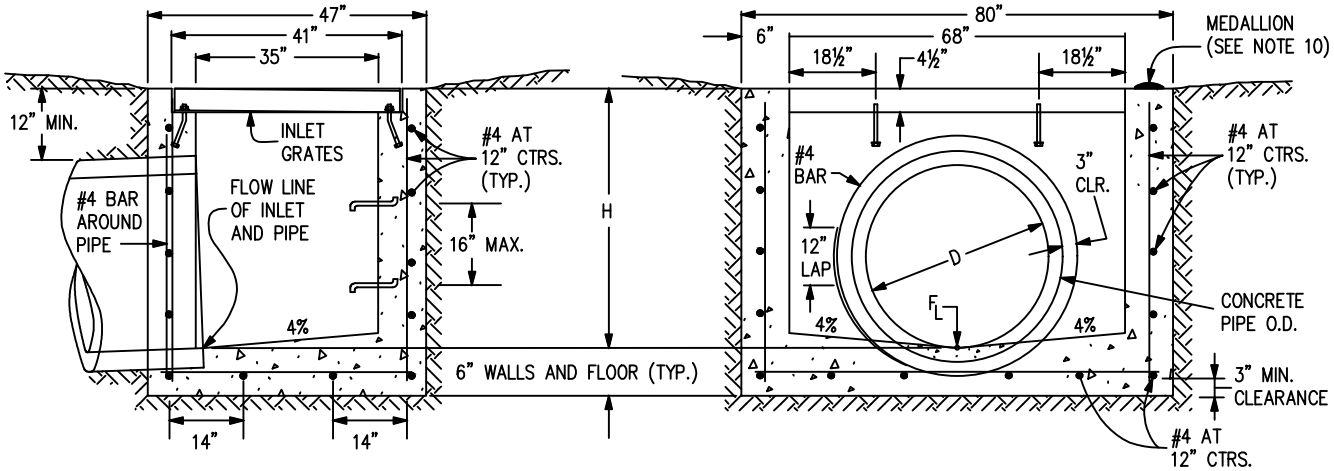
GRATE INSTALLATION DETAIL



TRANSVERSE CROSS SECTION

LONGITUDINAL CROSS SECTION

SLOPING GRATE INSTALLATION



TRANSVERSE CROSS SECTION

LONGITUDINAL CROSS SECTION

LEVEL GRATE INSTALLATION

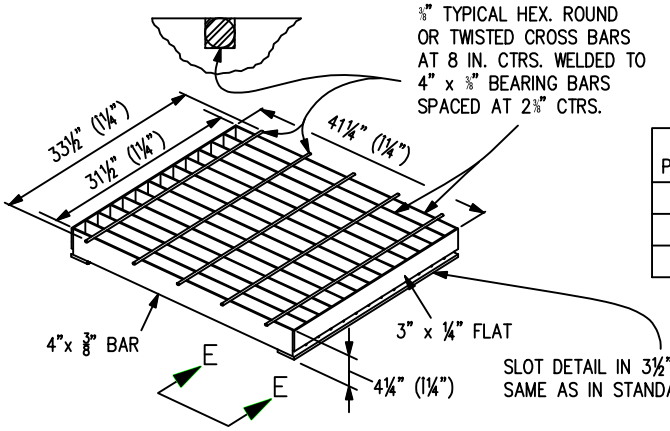
09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	INLET, TYPE D (1 OF 2) PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SW2.1 DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH

GENERAL NOTES

1. INLET TYPE D IS NOT HS–20 RATED AND SHALL NOT BE PLACED IN PAVED ROADWAYS. THIS INLET SHALL BE USED ONLY OUTSIDE PAVED ROADWAYS.
2. CONCRETE SHALL BE CLASS B. INLET MAY BE CAST–IN–PLACE OR PRECAST.
3. SEE PLANS FOR SIZE AND LOCATION OF PIPE.
4. STRUCTURAL STEEL FOR GRATES AND GRATE INSTALLATION HARDWARE SHALL BE GALVANIZED AND SHALL BE IN ACCORDANCE WITH SUBSECTION 712.06.
5. STANDARD INLET GRATES SHALL BE USED ON ALL TYPE D INLETS UNLESS CLOSE MESH GRATES ARE SPECIFIED ON THE PLANS.
6. CLOSE MESH GRATES ARE RECOMMENDED WHERE FOOT TRAFFIC OR BICYCLE ROUTES ARE IN CLOSE PROXIMITY TO GRATE. THIS GRATE IS NOT ADA COMPLIANT OR BICYCLE FRIENDLY AND SHALL NOT BE PLACED DIRECTLY IN SIDEWALKS, CROSSWALKS OR BIKE PATHS.
7. STEPS SHALL BE PROVIDED WHEN INLET DIMENSION "H" IS EQUAL TO OR GREATER THAN 3 FEET–6 INCHES AND SHALL CONFORM WITH AASHTO M 199.
8. REINFORCING BARS SHALL BE GRADE 60, EPOXY COATED, AND DEFORMED #4, AND SHALL HAVE A 2 INCH MIN. CLEARANCE. CUT OR BEND BARS AROUND PIPE AS REQUIRED.
9. ALL INLETS SHALL HAVE A 4 INCH DIA. METAL MEDALLION WITH A "NO DUMPING DRAINS TO STREAM" MESSAGE ON IT. THE MEDALLION SHALL HAVE A FISH SYMBOL WITH A BLUE BACKGROUND. IT SHALL BE FIRMLY ATTACHED TO THE INLET'S SURFACE WITH A PERMANENT FASTENER.

"H" FT.	CONCRETE CU. YDS. ▼	STEEL LBS. ▼	CIRCULAR PIPE RANGE INSIDE DIA., IN. – "D"
3.0	1.5	127	18
3.5	1.7	149	18–24
4.0	1.9	157	18–30
4.5	2.0	179	18–36
5.0	2.2	187	18–42
5.5	2.4	208	18–42
6.0	2.6	215	18–42
6.5	2.8	236	18–42
7.0	2.9	243	18–42
7.5	3.1	264	18–42
8.0	3.3	271	18–42
8.5	3.5	292	18–42
9.0	3.6	299	18–42
9.5	3.8	320	18–42
10.0	4.0	327	18–42

▼ CONCRETE AND STEEL QUANTITIES ARE FOR ONE ENTIRE INLET BEFORE DEDUCTION FOR VOLUME OCCUPIED BY PIPE. WEIGHT OF STEEL INCLUDES A RING FOR THE MAXIMUM PIPE DIAMETER.



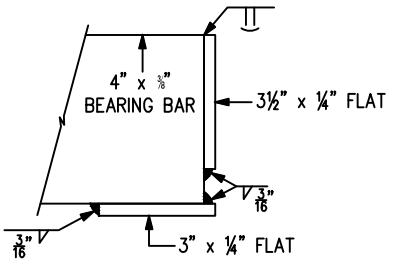
CLOSE MESH GRATE

TWO STEEL GRATE PER INLET QUANTITIES

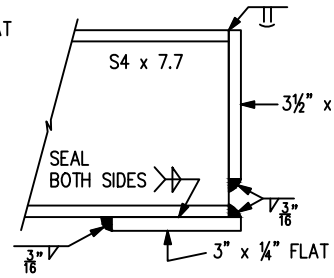
NO. PIECES	DESCRIPTION	LENGTH	LBS PER FT.	WEIGHT (LBS.)
8	S4 x 7.7 BEAM	40"	7.70	206
4	3½" x ¼" FLAT	26⅝"	2.98	26
4	3" x ¼" FLAT	26⅝"	2.55	24

TOTAL LBS. – 256

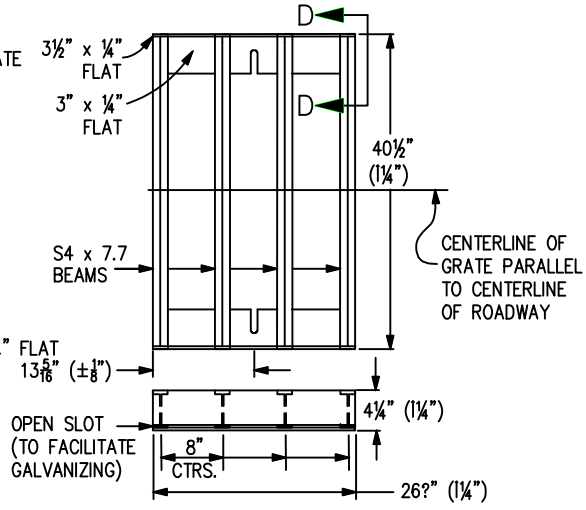
OUTLET PIPE INSIDE DIA. FT. – "D"	MIN. "H" FT.
1.5	3.0
2.0	3.5
2.5	4.0
3.0	4.5
3.5	5.0



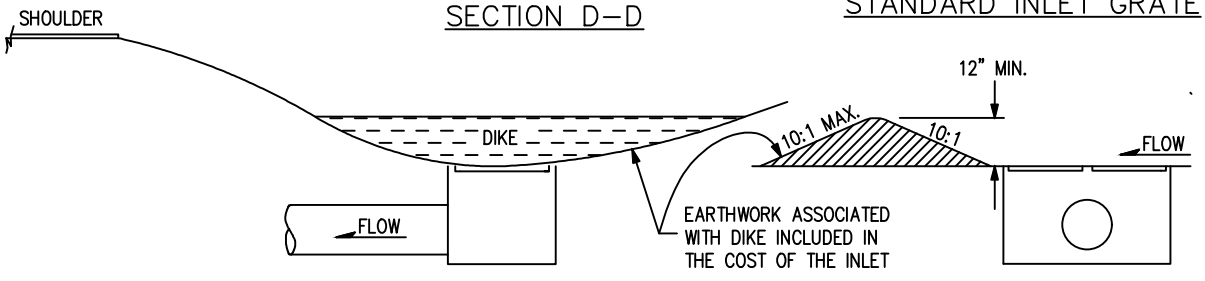
SECTION E–E



SECTION D–D



STANDARD INLET GRATE



TRANSVERSE VIEW

LONGITUDINAL VIEW

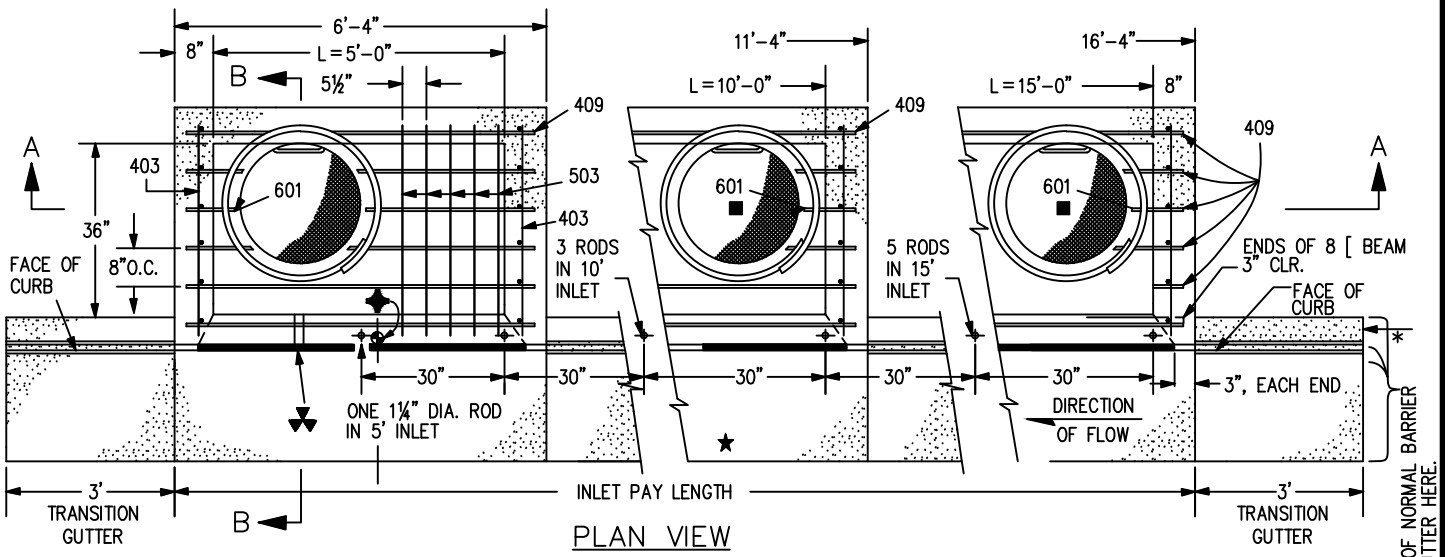
DIKE

09/03/2024	city of PUEBLO colorado	INLET, TYPE D (2 OF 2)	SW2.2
01/01/2023		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH
REVISIONS			

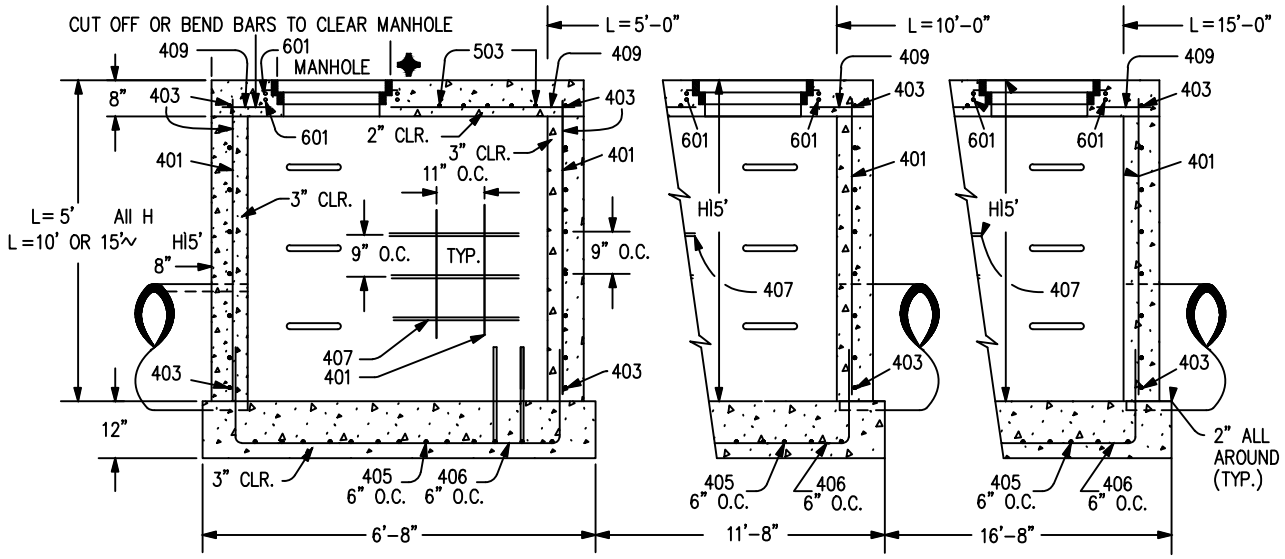
★ FOR LENGTH (L) 10 FT. OR MORE, PROVIDE MAINTENANCE ACCESS AT BOTH ENDS WITH AN ADDITIONAL MANHOLE RING AND COVER. CUT REINFORCEMENT BAR ACCORDINGLY.

✦ STATION POINT AT MIDPOINT OF INLET ALONG FLOWLINE

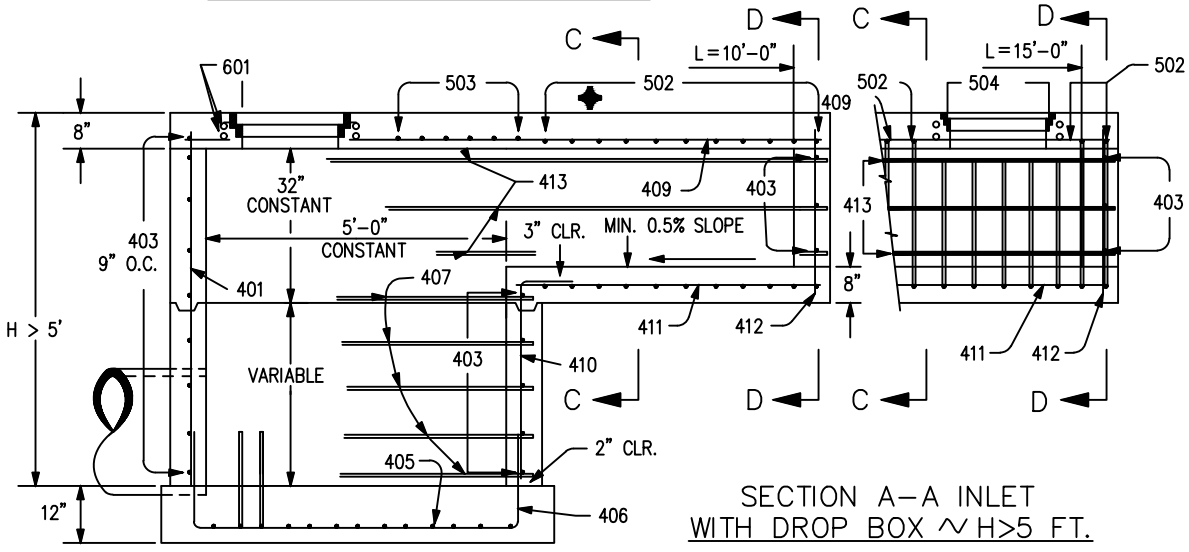
* WHEN A TYPE R INLET IS USED WITH MOUNTABLE CURB AND GUTTER, 5 FT. TRANSITION SHALL BE CONSTRUCTED. TRANSITION SHALL BE PAID FOR AS CURB AND GUTTER.



PLAN VIEW



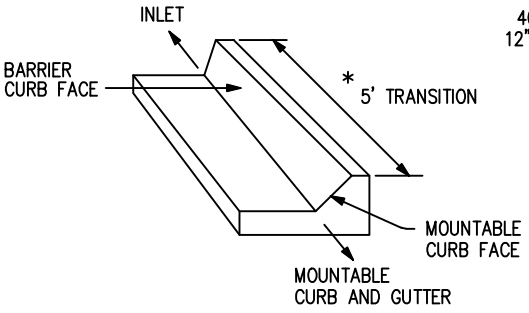
SECTION A–A REGULAR INLET



SECTION A–A INLET WITH DROP BOX ~ H>5 FT.

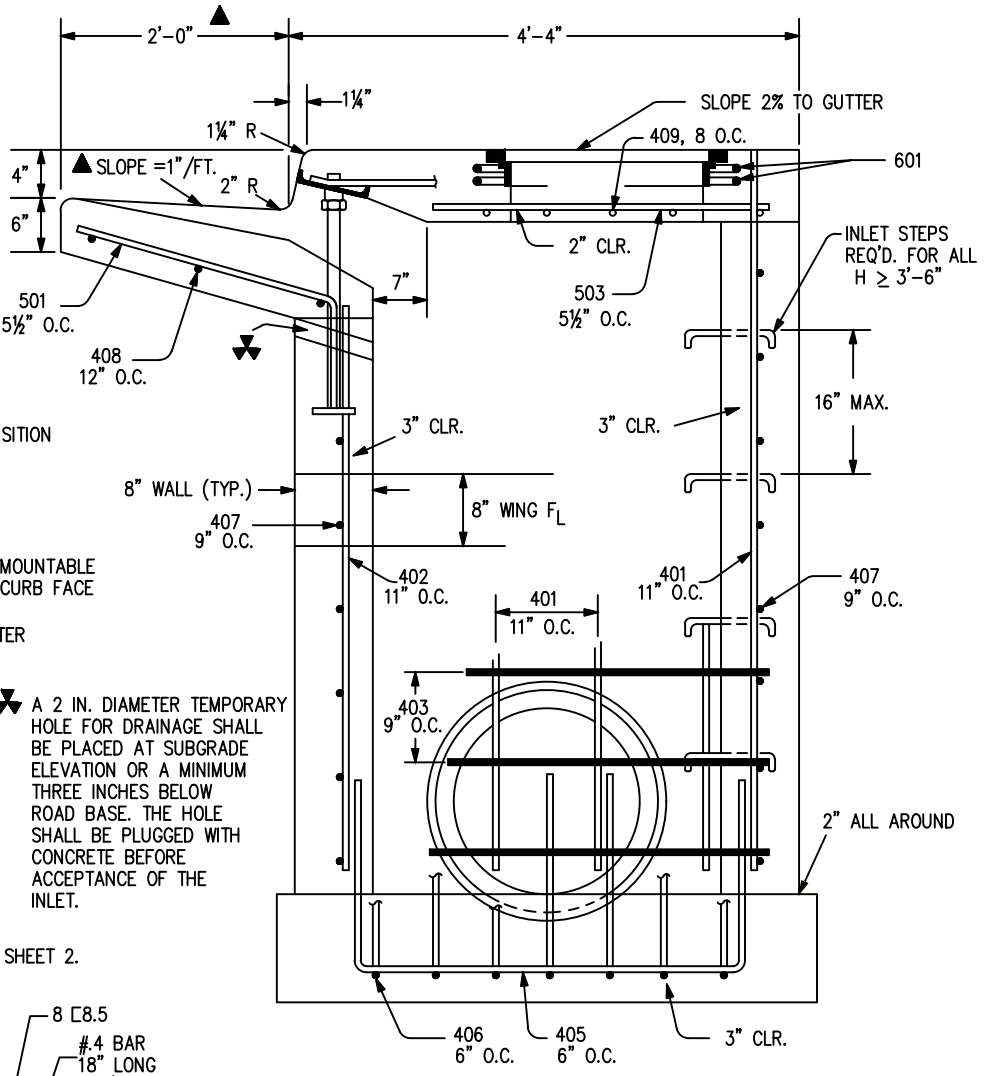
09/03/2024	city of PUEBLO colorado	INLET, TYPE R (1 OF 4)	SW3.1
01/01/2023		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH
REVISIONS			

▲ – FOR A 1'–0" PAN SLOPE 2" PER FT.



TRANSITION CURB

* WHEN A TYPE R INLET IS USED WITH MOUNTABLE CURB AND GUTTER, 5 FT. TRANSITION SHALL BE CONSTRUCTED. TRANSITION SHALL BE PAID FOR AS CURB AND GUTTER.

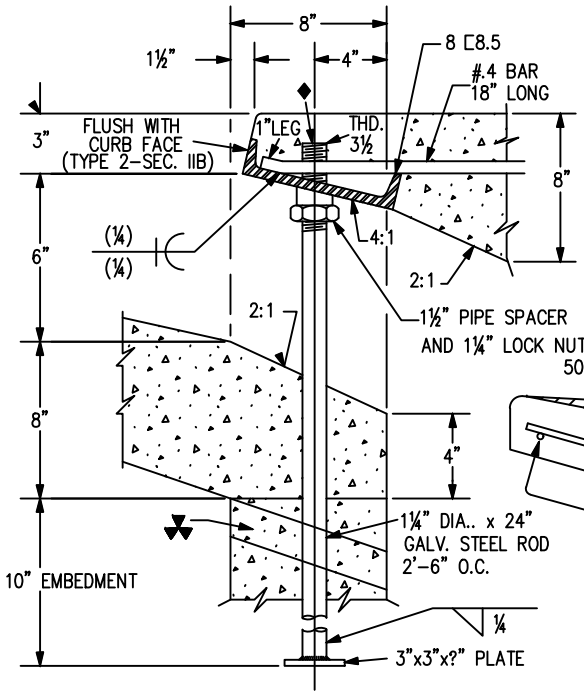


SECTION B–B
END VIEW

▲▲ A 2 IN. DIAMETER TEMPORARY HOLE FOR DRAINAGE SHALL BE PLACED AT SUBGRADE ELEVATION OR A MINIMUM THREE INCHES BELOW ROAD BASE. THE HOLE SHALL BE PLUGGED WITH CONCRETE BEFORE ACCEPTANCE OF THE INLET.

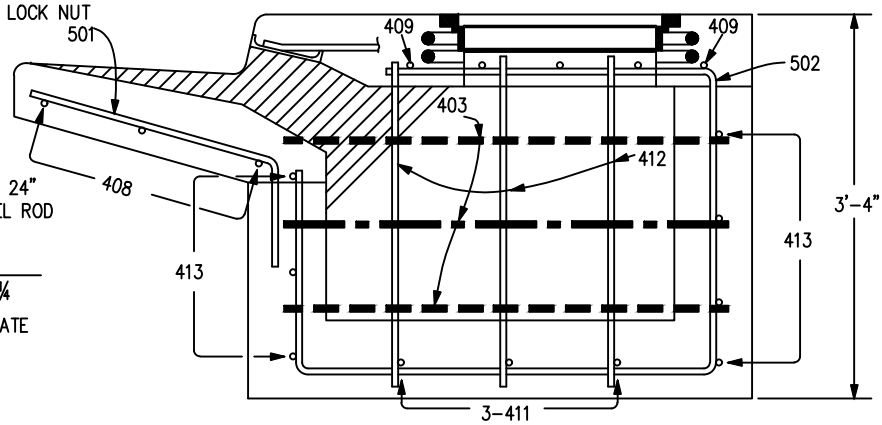
NOTE: MANHOLE RING AND COVER, STATION POINT AND OUTFLOW PIPE SHALL BE LOCATED AT THE SAME END OF THE INLET.

SEE CHANNEL LAYOUT ON SHEET 2.



CURB FACE ASSEMBLY

◆PLACE ENTIRE ASSEMBLY BEFORE POURING CONCRETE.



SECTIONS C–C & D–D
(DOTTED BARS ARE IN SECTION D–D)

09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	INLET, TYPE R (2 OF 4)	SW3.2
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH

MARK	BAR # OR SIZE	O.C. SPACING	TYPE	ALL INLETS		INLETS: H ≤ 5 FT.				INLETS: H > 5 FT.			
				L = 5 FT.		L = 10 FT.		L = 15 FT.		L = 10 FT.		L = 15 FT.	
				NO. REQ'D.	LENGTH	NO. REQ'D.	LENGTH	NO. REQ'D.	LENGTH	NO. REQ'D.	LENGTH	NO. REQ'D.	LENGTH
401	4	11"	II	15	*	21	*	26	*	11	*	11	*
402	4	11"	II	7	*	13	*	18	*	7	*	7	*
403	4	9"	II	*	4'-0"	*	4'-0"	*	4'-0"	*	4'-0"	*	4'-0"
405	4	6"	VI	11	6'-10"	21	6'-10"	31	6'-10"	11	6'-10"	11	6'-10"
406	4	6"	VIII	7	8'-10"	7	13'-10"	7	18'-10"	7	8'-10"	7	8'-10"
407	4	9"	II	*	5'-10"	*	10'-10"	*	15'-10"	*	5'-10"	*	5'-10"
408	4	12"	II	3	6'-10"	3	11'-10"	3	16'-0"	3	11'-10"	3	16'-0"
409	4	8"	II	6	5'-10"	6	10'-10"	6	15'-10"	6	10'-10"	6	15'-10"
410	4	11"	VII							3		3	*
411	4	11"	II							3	5'-2"	3	10-2"
412	4	11"	II							3	2'-9"	3	2'-9"
413	4	9"	II							7	10'-10"	7	15'-10"
501	5	5½"	IV	11	3'-4"	22	3'-4"	33	3'-4"	22	3'-4"	33	3'-4"
502	5	5½"	III							11	11'-5"	17	11'-5"
503	5	5½"	II	5	3'-6"	16	3'-6"	27	3'-6"	6	3'-6"	6	3'-6"
504	5	5½"	IX									5	8'-4"
601	6	2½"	V	2	8'-10"	2	8'-10"	2	8'-10"	2	8'-10"	4	8'-10"
■8[8.5				1	5'-10"	1	10'-10"	1	15'-10"	1	10'-10"	1	15'-10"
				2 BARS, 1 RODS	——	4 BARS, 3 RODS	——	8 BARS, 5 RODS	——	4 BARS, 3 RODS	——	8 BARS, 5 RODS	——
						REGULAR INLETS				DROP BOX INLETS			

* VARIABLE REFER TO TABLE TWO.

■ INCLUDE #4, 18 IN. BARS (SEE CHANNEL LAYOUT).

TABLE ONE ~ BAR LIST FOR CURB INLETS, TYPE "R"

"H"	LENGTH			NO. REQ'D. REGULAR		NO. REQ'D. DROP BOX		L = 5 FT.		L = 10 FT.		L = 15 FT.	
	401	402	410	403	407	403	407	CONC. CU. YDS.	STEEL LBS.	CONC. CU. YDS.	STEEL LBS.	CONC. CU. YDS.	STEEL LBS.
3'-0"	2'-8"	1'-8"		10	7			3.2	285	5.3	497	7.4	706
3'-6"	3'-2"	2'-2"		10	7			3.4	305	5.7	528	7.9	747
4'-0"	3'-8"	2'-8"		12	9			3.7	326	6.0	559	8.4	786
4'-6"	4'-2"	3'-2"		12	9			3.9	334	6.4	571	8.8	803
5'-0"	4'-8"	3'-8"		14	11			4.1	354	6.7	602	9.3	844
5'-6"	5'-2"	4'-2"	3'-5"	16	13	15	6	4.4	375	6.0	607	7.4	850
6'-0"	5'-8"	4'-8"	3'-11"	16	13	16	6	4.6	382	6.2	616	7.6	860
6'-6"	6'-2"	5'-2"	4'-5"	18	15	18	8	4.8	402	6.4	637	7.8	880
7'-0"	6'-8"	5'-8"	4'-11"	20	17	19	10	5.0	423	6.6	654	8.0	897
7'-6"	7'-2"	6-2"	5'-5"	20	17	20	10	5.3	430	6.9	664	8.3	907
8'-0"	7'-8"	6'-8"	5'-11"	22	19	22	12	5.5	451	7.1	684	8.5	927
8'-6"	8'-2"	7'-2"	6'-5"	24	21	23	14	5.7	471	7.3	702	8.7	944
9'-0"	8'-8"	7'-8"	6'-11"	24	21	24	14	6.0	479	7.6	711	9.0	954
9'-6"	9'-2"	8'-2"	7'-5"	26	23	26	16	6.2	499	7.8	732	9.2	974
10'-0"	9'-8"	8'-8"	7'-11"	28	25	27	18	6.4	520	8.0	749	9.4	992
10'-6"	10'-2"	9'-2"	8'-5"	28	25	28	18	6.7	527	8.3	759	9.7	1001
11'-0"	10'-8"	9'-8"	8'-11"	30	27	30	20	6.9	547	8.5	779	9.9	1022

NOTES: FOR L= 5 FT., L= 10 FT., AND L= 15 FT.
REGULAR INLETS: TOTAL QUANTITIES NEEDED ARE OUTSIDE THE HEAVY BLACK LINE.
DROP BOX INLETS: TOTAL QUANTITIES NEEDED ARE INSIDE THE HEAVY BLACK LINE.

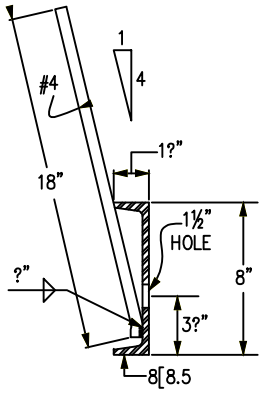
STEEL WEIGHTS DO NOT INCLUDE STRUCTURAL STEEL CHANNEL.

TABLE TWO ~ BARS AND QUANTITIES VARIABLE WITH "H"

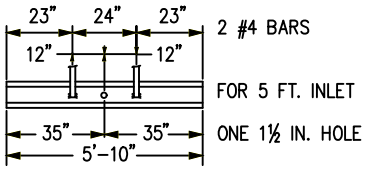
09/03/2024	city of PUEBLO colorado	INLET, TYPE R (3 OF 4)	SW3.3
01/01/2023		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH
REVISIONS			

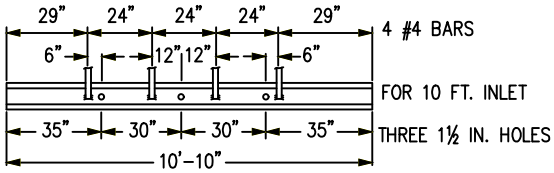
GENERAL NOTES

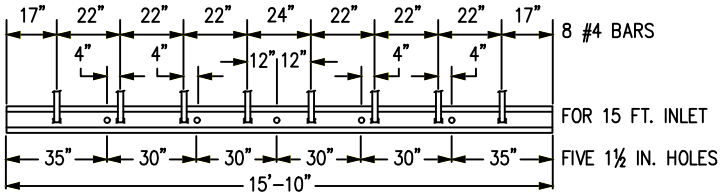
1. CONCRETE SHALL BE CLASS B. INLET MAY BE CAST-IN-PLACE OR PRECAST.
2. CONCRETE WALLS SHALL BE FORMED ON BOTH SIDES AND SHALL BE 8 INCHES THICK.
3. INLET STEPS SHALL BE IN CONFORMANCE WITH AASHTO M 199.
4. CURB FACE ASSEMBLY SHALL BE GALVANIZED AFTER WELDING.
5. EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED ¾OF A INCH. CURB AND GUTTER CORNERS SHALL BE FINISHED TO MATCH THE EXISTING CURB AND GUTTER BEYOND THE TRANSITION GUTTER.
6. REINFORCING BARS SHALL BE DEFORMED AND SHALL HAVE A 2 INCH MINIMUM CLEARANCE. ALL REINFORCING BARS SHALL BE GRADE 60 AND EPOXY COATED.
7. DIMENSIONS AND WEIGHTS OF TYPICAL MANHOLE RING AND COVER ARE NOMINAL.
8. MATERIAL FOR MANHOLE RINGS AND COVERS SHALL BE GRAY OR DUCTILE CAST IRON IN ACCORDANCE WITH SUBSECTION 712.06.
9. SINCE PIPE ENTRIES INTO THE INLET ARE VARIABLE, THE DIMENSIONS SHOWN ARE TYPICAL. ACTUAL DIMENSIONS AND QUANTITIES FOR CONCRETE AND REINFORCEMENT SHALL BE AS REQUIRED IN THE WORK. QUANTITIES INCLUDE VOLUMES OCCUPIED BY PIPES.
10. ALL MANHOLE COVERS SHALL BE CAST WITH A "NO DUMPING DRAINS TO STREAM" MESSAGE AND A FISH SYMBOL. THE SURFACE OF THE MANHOLE COVER SHALL HAVE A NON-SLIP PATTERN.
11. STRUCTURAL STEEL SHALL BE GALVANIZED AND SHALL BE IN ACCORDANCE WITH SUBSECTION 712.06.



SECTION AT HOLE (TYP.)

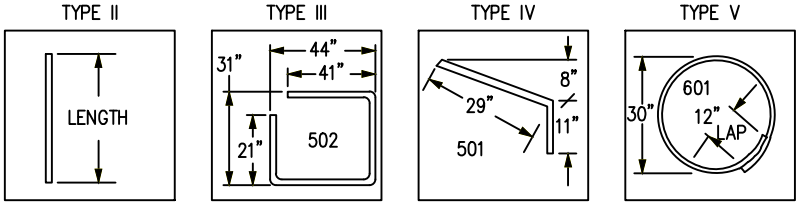


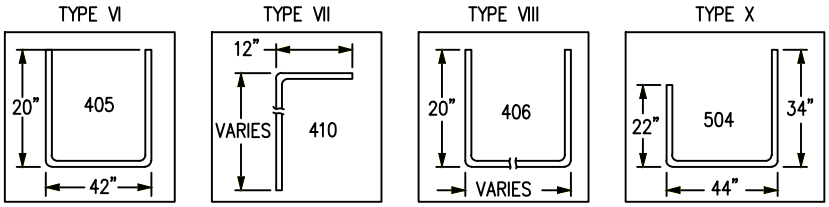




CHANNEL LAYOUT DETAILS

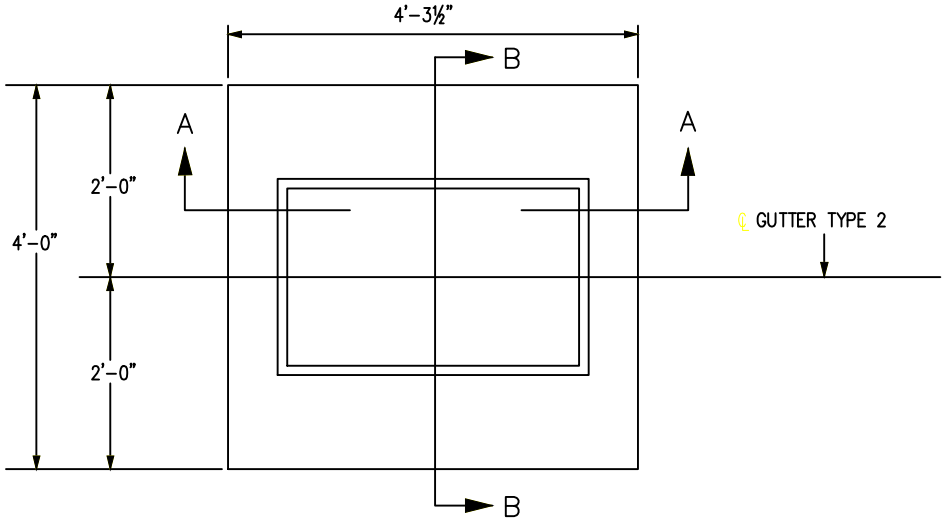
SEE CURB FACE ASSEMBLY ON SHEET 1.





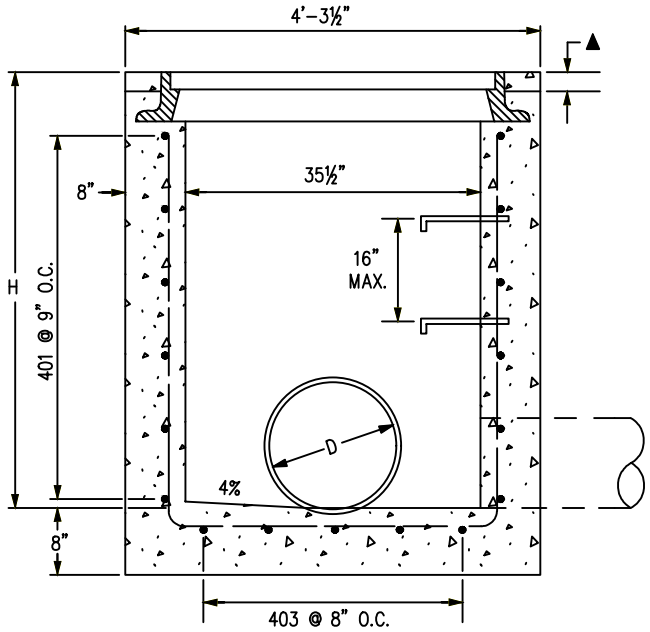
BAR BENDING DIAGRAMS ~ (DIMENSIONS ARE OUT-TO-OUT OF BAR)

	city of PUEBLO colorado	INLET, TYPE R (4 OF 4)	SW3.4
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION	DRAWN BY: NLS
01/01/2023		211 EAST "D" ST. PUEBLO, CO 81003	CHECKED BY: JS
REVISIONS		(719) 553-2295 PHONE	APPROVED BY: JH

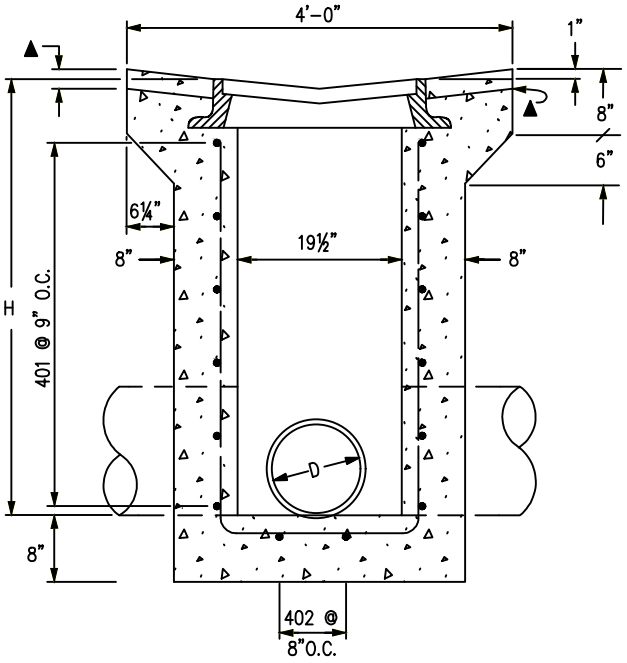


▲ WHEN HMA MATERIAL IS TO EXTEND TO THE EDGE OF THE GRATING FRAME, CONCRETE MAY BE DEPRESSED.

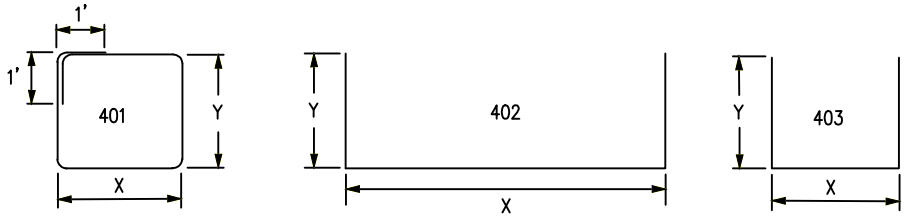
PLAN VIEW
TYPE 13 INLET FOR GUTTER TYPE 2



SECTION A-A
D MAX = 30 IN. FOR H > 4 FT.

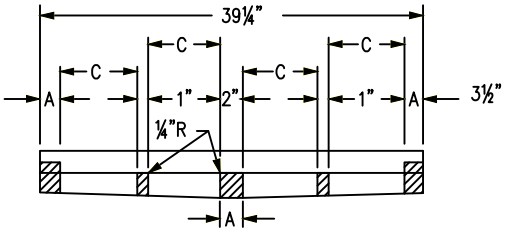


SECTION B-B
D MAX = 18 IN. FOR ALL H

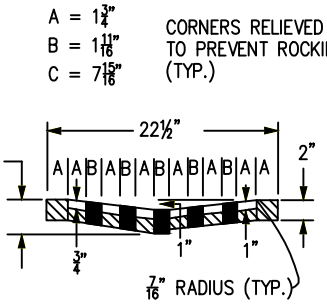


BENDING DIAGRAMS
ALL DIMENSIONS ARE OUT-TO-OUT OF BAR.

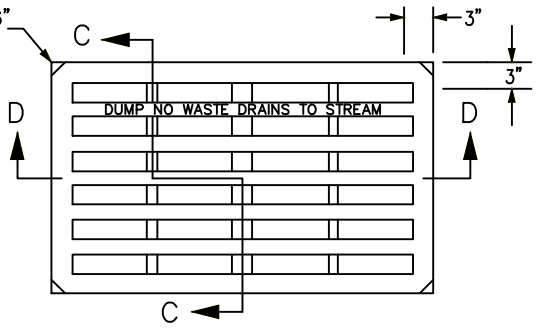
09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	INLET, TYPE 13 (1 OF 2)	SW4.1
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH



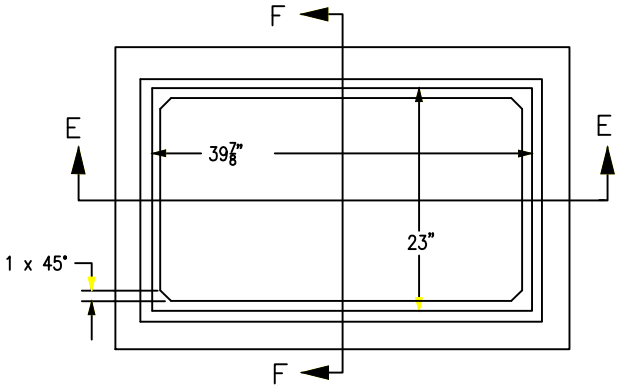
SECTION D–D



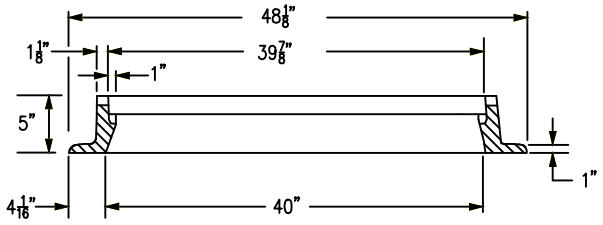
SECTION C–C



NO. 13 GRATE

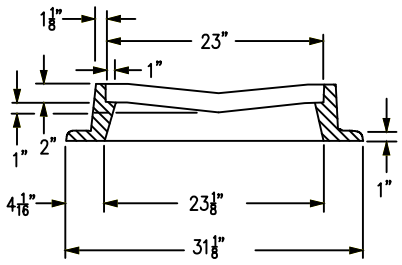


NO. 13 GRATING & FRAMES



SECTION E–E

APPROXIMATE WEIGHT =590 LBS.



SECTION F–F

H	CONCRETE	REINFORCING STEEL	NO. OF 401 BARS REQ'D.	MAXIMUM PIPE I.D.	
				SEC. A–A	SEC. B–B
	CU. YDS.	θ LB.		IN.	IN.
3'–0"	1.3	72	4	18	18
3'–6"	1.5	76	4	24	18
4'–0"	1.6	90	5	30	18
4'–6"	1.8	104	6	30	18
5'–0"	1.9	109	6	30	18
5'–6"	2.1	122	7	30	18
6'–0"	2.2	136	8	30	18
6'–6"	2.4	141	8	30	18
7'–0"	2.5	154	9	30	18
7'–6"	2.7	168	10	30	18
8'–0"	2.8	173	10	30	18
8'–6"	3.0	187	11	30	18
9'–0"	3.1	200	12	30	18
9'–6"	3.3	205	12	30	18
10'–0"	3.4	219	13	30	18

θ INCLUDES 1% FOR OVERRUN.
NOTE: CONCRETE QUANTITIES INCLUDE VOLUME OCCUPIED BY PIPE.

QUANTITIES FOR ONE INLET

GENERAL NOTES

1. CONCRETE SHALL BE CLASS B. INLET MAY BE CAST–IN–PLACE OR PRECAST.
2. CAST–IN–PLACE CONCRETE WALLS SHALL BE FORMED ON BOTH SIDES.
3. EXPOSED CONCRETE CORNERS SHALL BE CHAMFERED 3/4" OF A INCH.
4. REINFORCING BARS SHALL BE DEFORMED #4 AND SHALL HAVE A 2 INCH MINIMUM CLEARANCE. ALL REINFORCING BARS SHALL BE GRADE 60 AND EPOXY COATED.
5. STEPS SHALL BE PROVIDED WHEN INLET DIMENSION "H" IS EQUAL TO OR GREATER THAN 3 FEET–6 INCHES AND SHALL CONFORM TO AASHTO M 199.
6. ALL GRATES AND FRAMES SHALL BE GRAY OR DUCTILE CAST IRON IN ACCORDANCE WITH SUBSECTION 712.06. GRATES AND FRAMES SHALL BE DESIGNED TO WITHSTAND HS 20 LOADING.
7. STATION POINT IS AT THE CENTER OF THE INLET.
8. GRATE SHALL HAVE "DUMP NO WASTE DRAINS TO STREAM" MESSAGE CAST ON SURFACE.

MARK	NO. REQ'D.	DIMENSIONS		LENGTH
		X	Y	
401	4	3'–6"	2'–2"	13'–4"
402	2	3'–4½"	* 2'–6½"	8'–5½"
403	5	2'–½"	* 2'–7"	7'–2½"

* ADD 6 IN. TO THIS DIMENSION FOR EACH 6 IN. INCREASE OF "H" OVER 3 FT.–0 IN.

BAR LIST FOR H = 3 FT.–0 IN.

09/03/2024
01/01/2023
REVISIONS

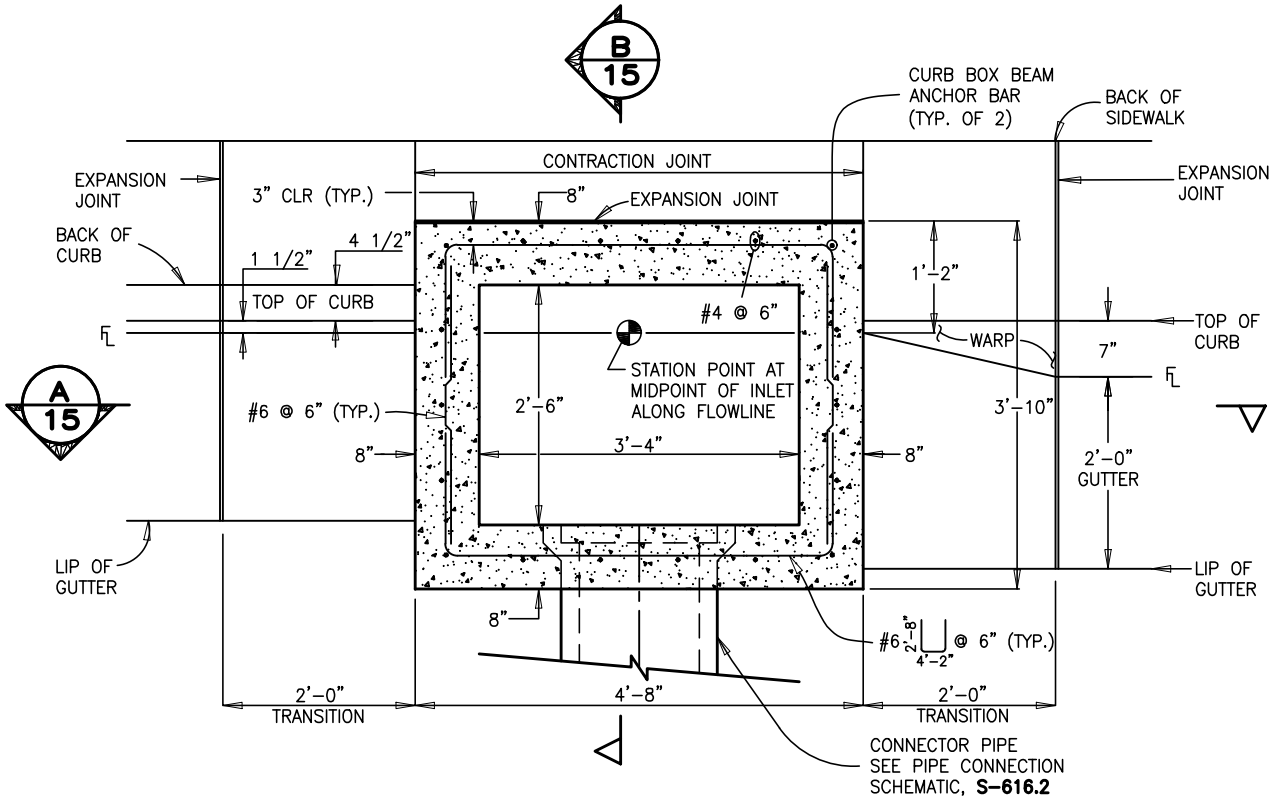
city of PUEBLO colorado

INLET, TYPE 13 (2 OF 2)

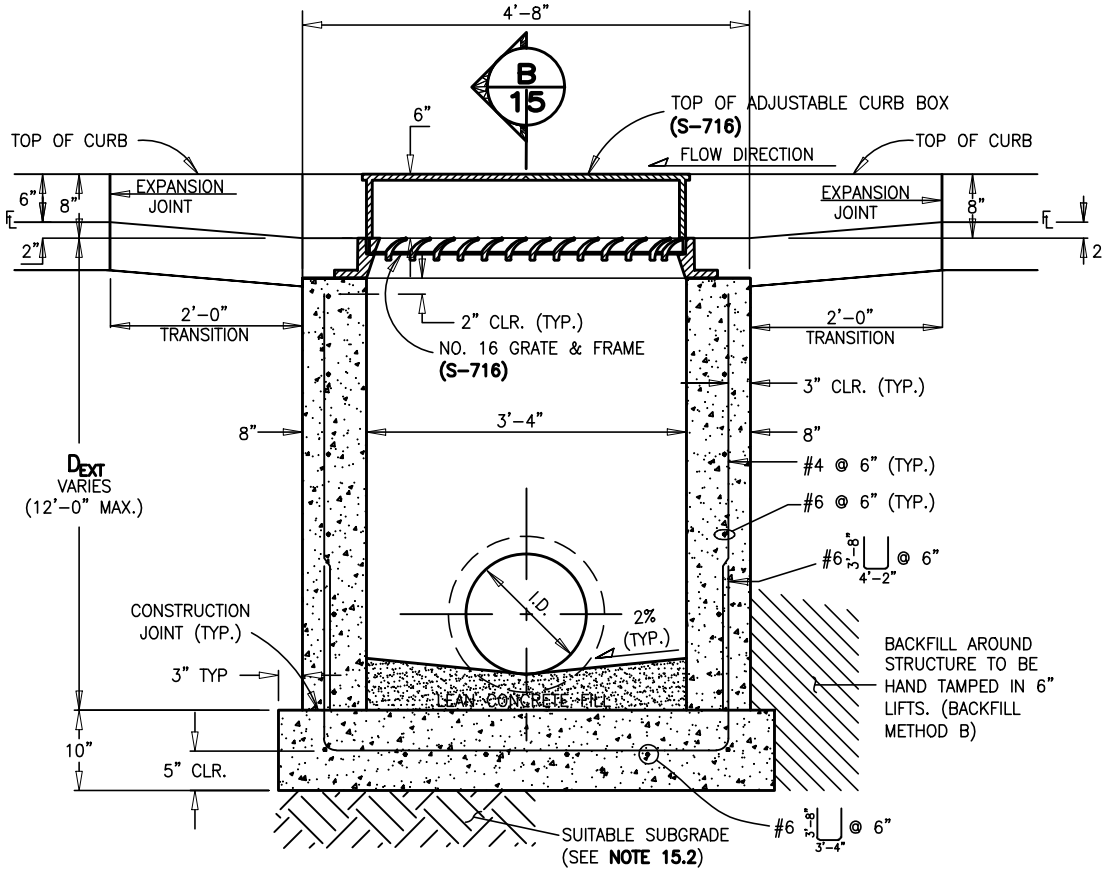
PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION
211 EAST "D" ST. PUEBLO, CO 81003
(719) 553-2295 PHONE

SW4.2

DRAWN BY: NLS
CHECKED BY: JS
APPROVED BY: JH

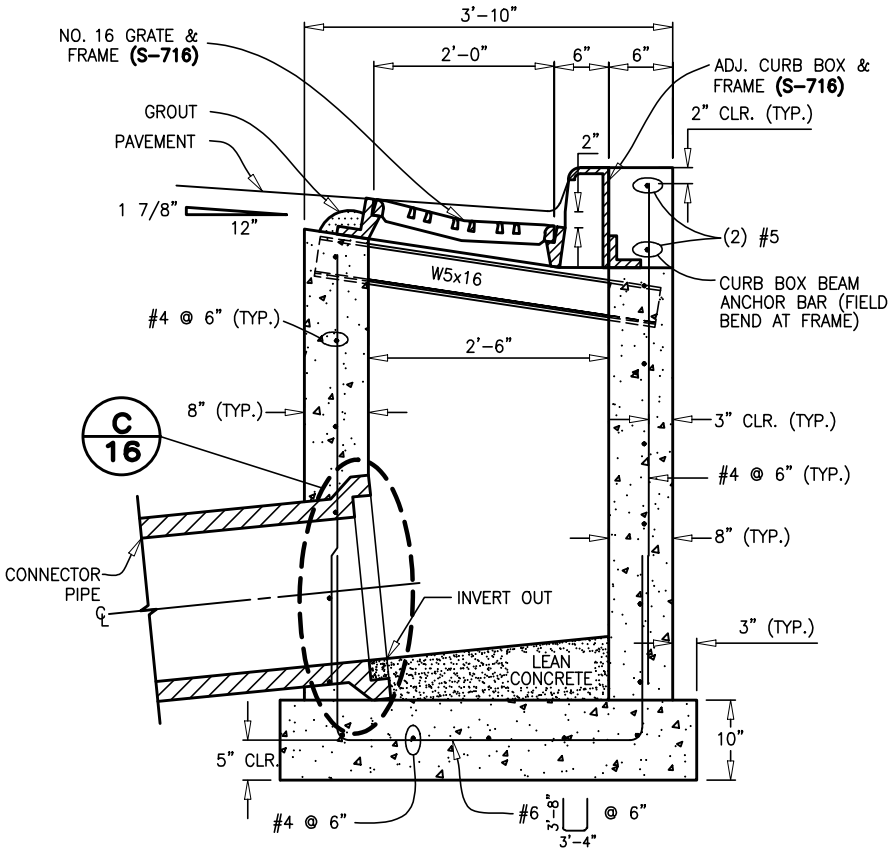


PLAN
NO SCALE



A SECTION
NO SCALE

09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	INLET, TYPE 16 (1 OF 6)	SW5.1
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH

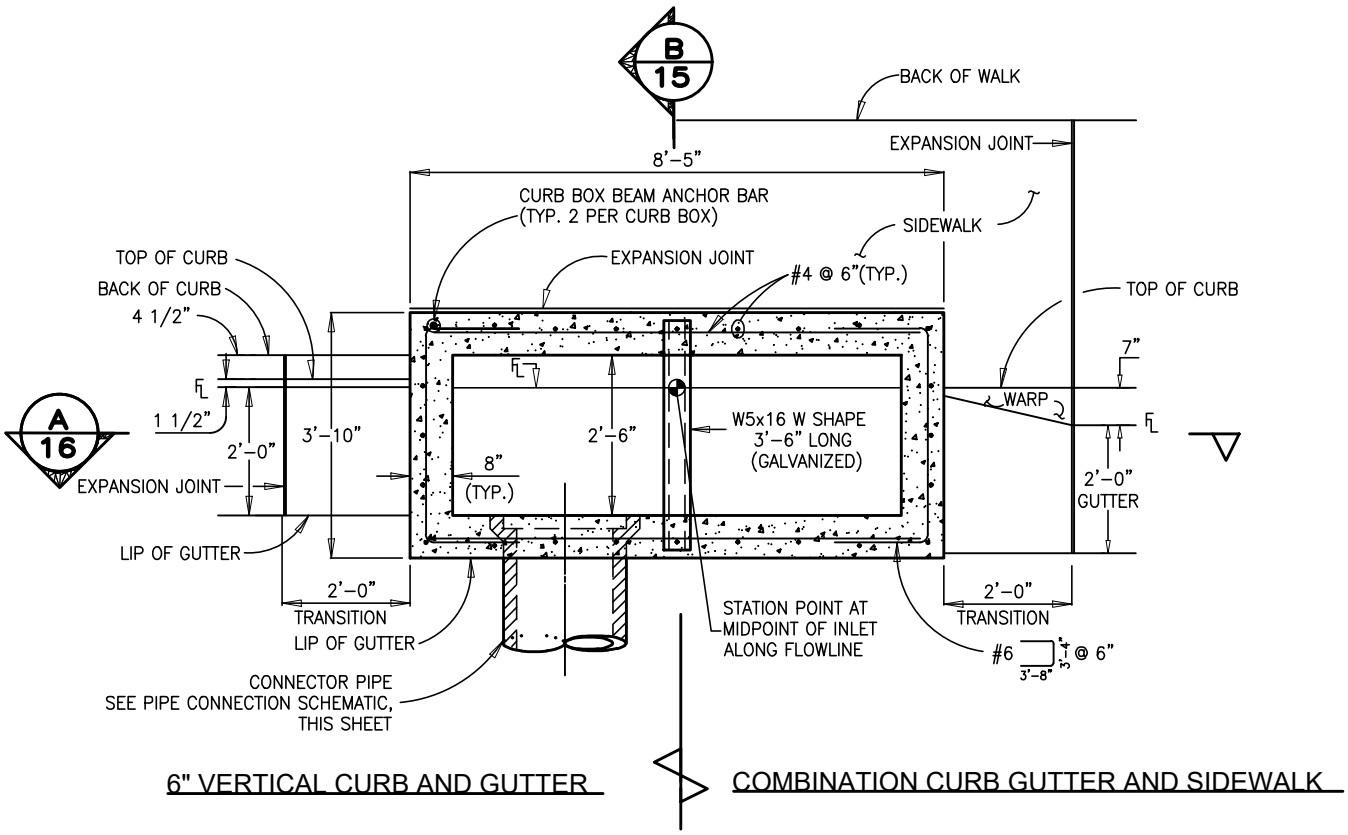


B SECTION (TYPICAL, ALL SIZES)
NO SCALE

SINGLE NUMBER 16 INLET NOTES:

1. FOR PAYMENT PURPOSES, INLET STRUCTURES SHALL ALSO INCLUDE 2'–0" CURB & GUTTER TRANSITION SECTION AT EACH END OF INLET PLUS SIDEWALK SECTIONS WHERE REQUIRED BEHIND INLET STRUCTURE AND TRANSITION SECTIONS.
2. SUB–GRADE SHALL BE 6–12" OF CLASS B BEDDING COMPACTED PER COP STANDARD CONSTRUCTION SPECIFICATIONS, ON SUITABLE, UNDISTURBED MATERIAL. IF SUBGRADE IS UNSUITABLE, THE SUBGRADE SHALL BE OVEREXCAVATED AND STABILIZED WITH CLASS B BEDDING PER COP STANDARD CONSTRUCTION SPECIFICATIONS.
3. FLOOR SLOPE MAY BE POURED MONOLITHIC WITH BASE.
4. Sc = SLOPE OF CONNECTOR = 2% MIN.
5. UNLESS OTHERWISE SPECIFIED ON THE DRAWINGS OR OTHERWISE APPROVED, ALL NO. 16 INLETS SHALL BE CONSTRUCTED WITH AN ADJUSTABLE CAST IRON CURB BOX (S–716).
6. DESIGN CONDITIONS FOR INLET ALLOWS DEPTHS OF 12'–0" (MAX). FOR INLETS MORE THAN 12'–0" FEET IN DEPTH, SHOP DRAWINGS AND DESIGN ANALYSIS SHALL BE SUBMITTED FOR APPROVAL.
7. ALL REINFORCING STEEL SHALL BE ASTM, A–615, GRADE 60 DEFORMED BARS. DIAMETER OF BEND MEASURED ON THE INSIDE OF THE BAR SHALL BE A MINIMUM OF 6 BAR DIAMETER.
8. ALL SHALL CONFORM TO AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, 8TH EDITION, 2017.
9. NO FORMWORK SHALL WORK REMAIN INSIDE STRUCTURE WHEN COMPLETE.
10. CONCRETE MIX FOR GUTTER AND ANY ADDED STREET PANELS SHALL MEET CLASS 2 REQUIREMENTS FOR SULFATE RESISTANCE IN ACCORDANCE WITH CDOT STANDARD 601.04 ON STREETS WHERE MAGNESIUM CHLORIDE CHEMICAL DEICERS ARE APPLIED. REFER TO COP STANDARD CONSTRUCTION SPECIFICATIONS FOR REQUIREMENTS FOR SULFATE RESISTANCE IN CONCRETE EXPOSED TO EARTH.
11. SPLICING OF REINFORCING STEEL SHALL BE PERMITTED ONLY WHERE DETAILED IN DRAWINGS.
12. INLET WALLS SHALL BE FORMED BOTH INSIDE AND OUTSIDE CASTING OF SIDEWALLS AGAINST EARTH IS NOT PERMITTED.
13. LEAN CONCRETE FILL TO BE F'C = 2000 PSI. INLET STRUCTURE, LID, STREET CURB AND GUTTER, AND PAVEMENT TO BE F'C = 4,500 PSI, MAX W/CM = 0 45 AND AIR ENTRAINED 5% TO 8% F'C = 28 DAY COMPRESSIVE STRENGTH REQUIREMENT FOR MIX DESIGN, FIELD ACCEPTANCE.
14. FOR THROUGH STRUCTURES, BENCHES MUST COME TO TOP OF PIPE.
15. NO CORNER PENETRATIONS ON STRUCTURE.
16. SEE COP STANDARD CONSTRUCTION SPECIFICATIONS STORM INLETS SECTION FOR MORE INFORMATION. USE OF THIS DETAIL WITHOUT SPECIFICATIONS SHALL BE CONSIDERED NON–COMPLIANT.
17. SEE SW5.4 FOR REBAR PLACEMENT AT WALL PENETRATION DETAIL.

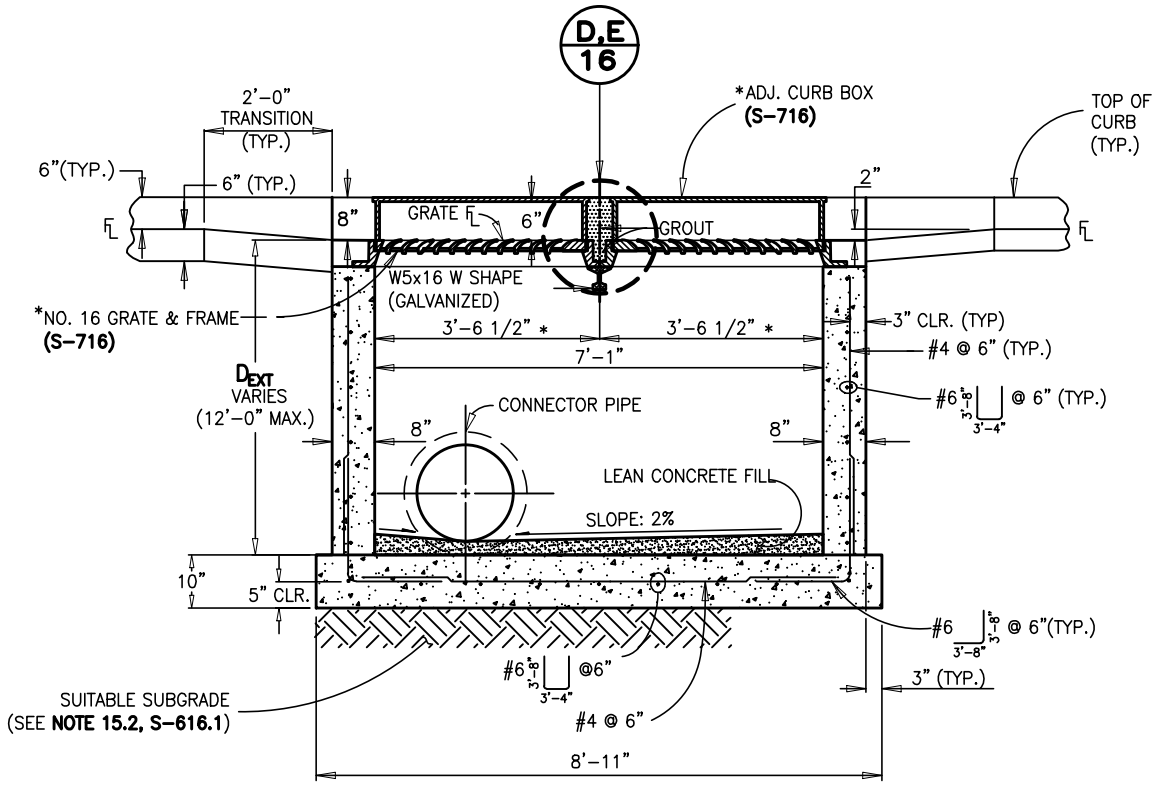
09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	INLET, TYPE 16 (2 OF 6)	SW5.2
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH



6" VERTICAL CURB AND GUTTER

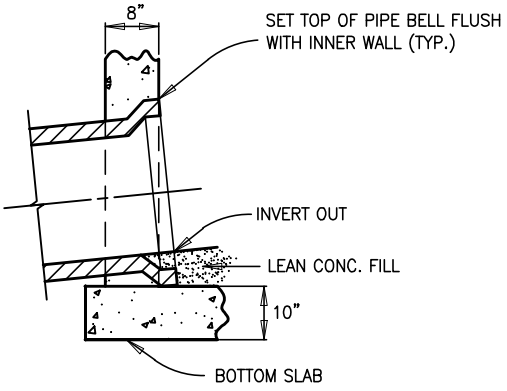
COMBINATION CURB GUTTER AND SIDEWALK

PLAN
NO SCALE

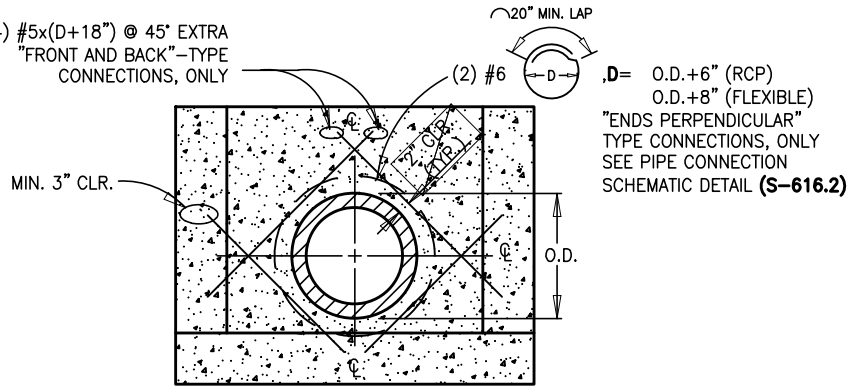


A SECTION
NO SCALE

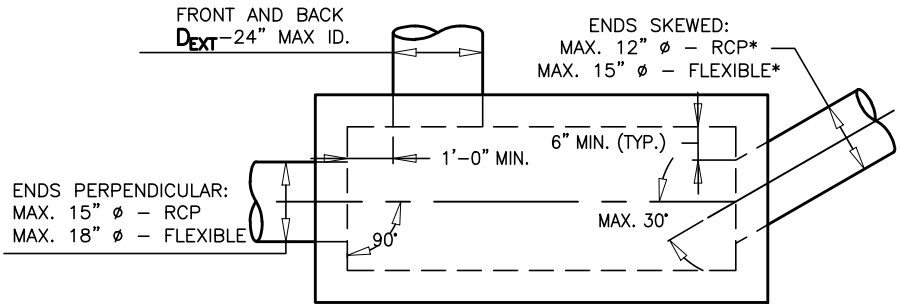
09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	INLET, TYPE 16 (3 OF 6)	SW5.3
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH



C DETAIL - CONNECTOR OUTLET
NO SCALE



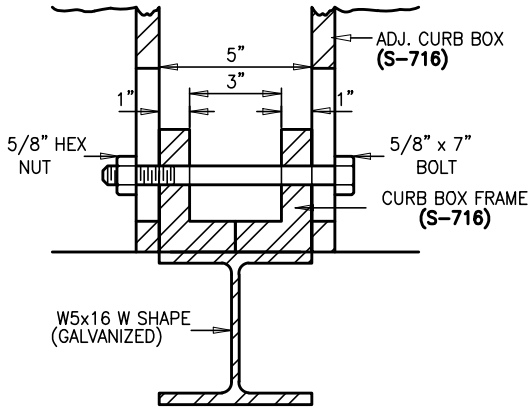
DETAIL - REBAR PLACEMENT AROUND CONNECTOR PIPE
NO SCALE



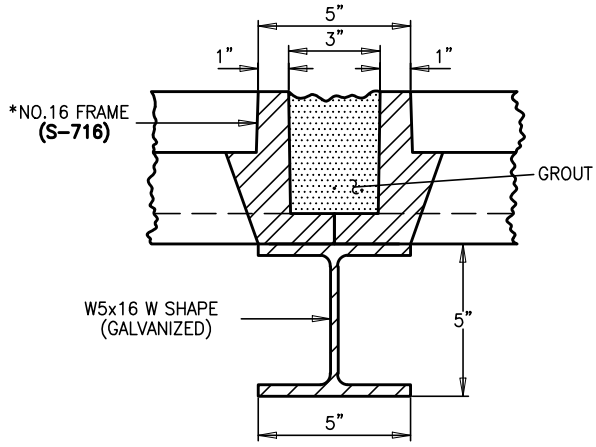
*ANGLED CONNECTIONS REQUIRE CITY APPROVAL.

PIPE CONNECTION SCHEMATIC (NO. 16 INLET)

THIS DIAGRAM IS PROVIDED FOR GENERAL GUIDANCE ONLY. THE DESIGNER IS RESPONSIBLE FOR VERIFYING PROJECT SPECIFIC GEOMETRY.



D DETAIL - PLACEMENT OF ADJ. CURB BOX ON SUPPORT RAIL (TYP.)
NO SCALE



E DETAIL - FRAME PLACEMENT ON SUPPORT RAIL (TYP.)
NO SCALE

DOUBLE NUMBER 16 INLET NOTES:

16.1 SEE DETAIL SPECIFICATIONS SECTION 11.05 STORM INLETS FOR MORE INFORMATION. USE OF THIS DETAIL WITHOUT SPECIFICATIONS SHALL BE CONSIDERED NON–COMPLIANT.

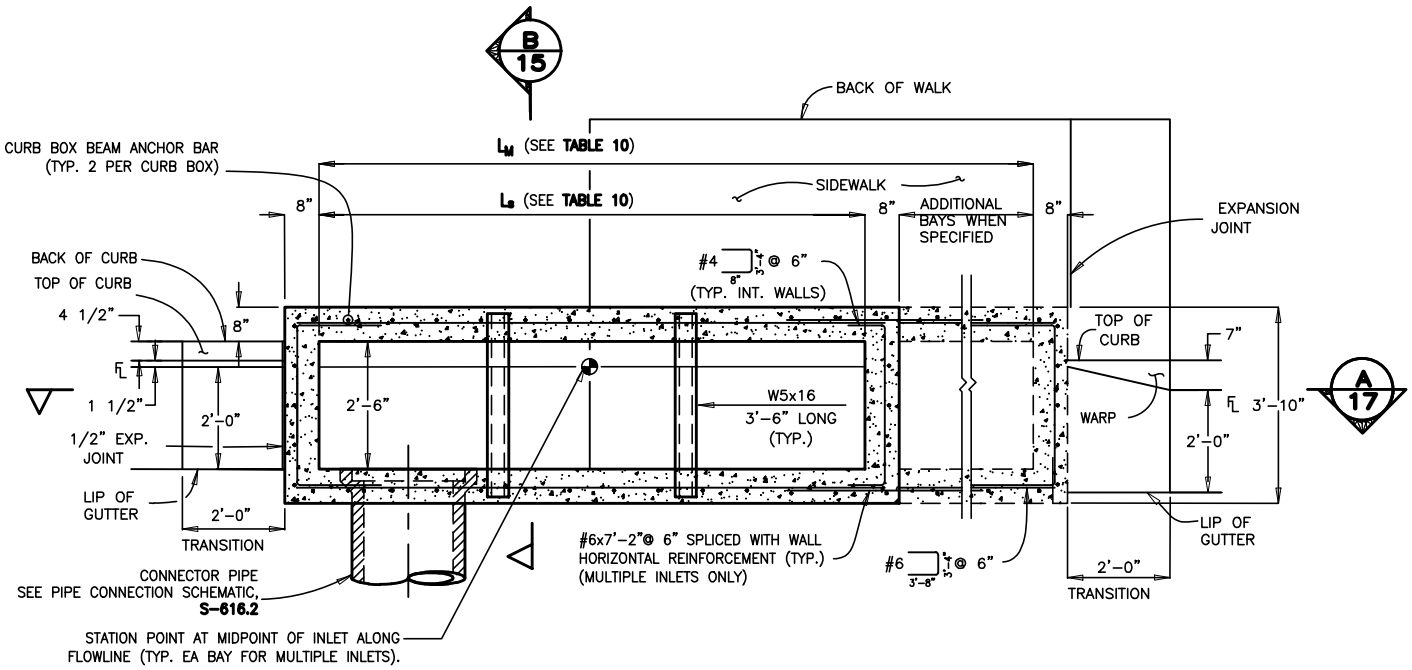
16.2 SEE GENERAL NOTES ON **S–616.1.**

16.3 EXPANSION JOINT MATERIAL SHALL BE PLACED FULL DEPTH OF THE CURB AND GUTTER, SIDEWALK, CONCRETE PAVEMENT, AS APPLICABLE. THE TOP PORTION OF THE JOINT SHALL BE SEALED WITH SILICONE SEALANT.

16.4 SEE **S–616.1** FOR REBAR PLACEMENT AT WALL PENETRATION DETAIL.

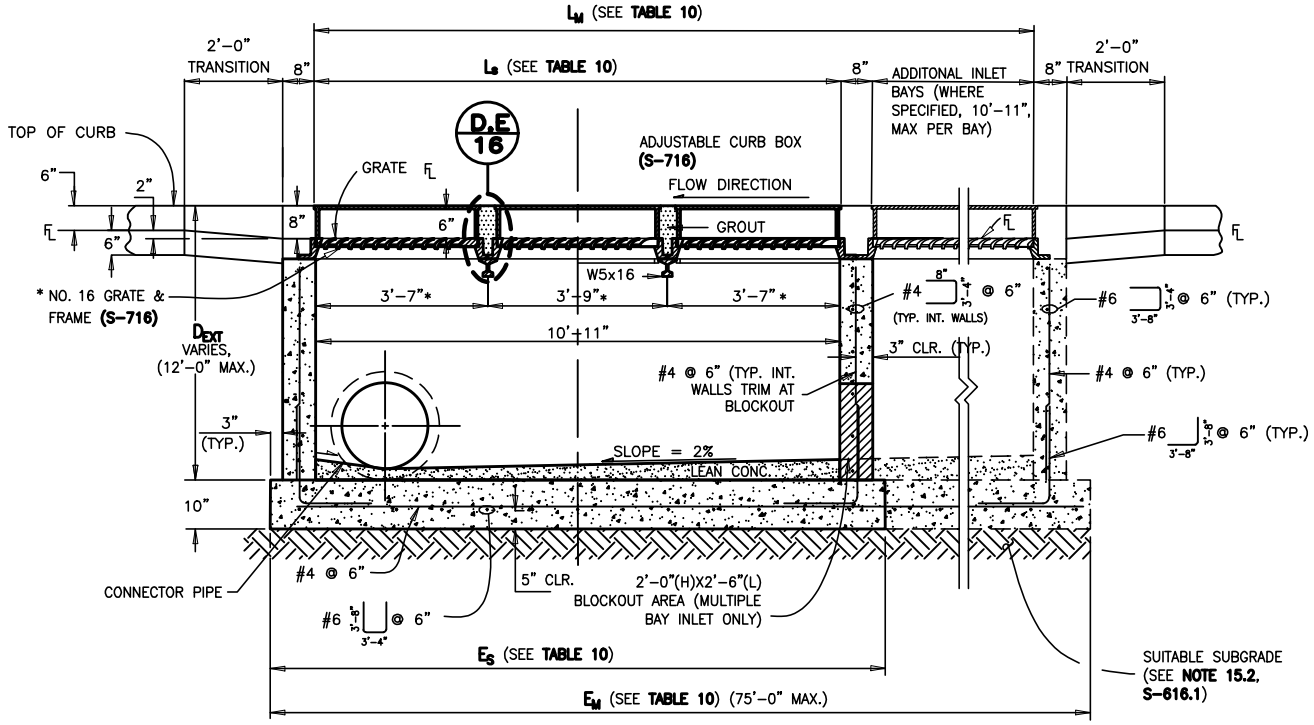
* STANDARD DETAIL **S–716** APPLIES TO ALL OF THE GRATE & FRAME GEOMETRIC DIMENSIONS FOR THE DOUBLE NUMBER 16 INLET EXCEPT FOR THE FRAME LENGTH. FRAME FRAME LENGTH SHOULD BE MANUFACTURED FOR THE DIMENSIONS CALLED OUT ON THIS SHEET.

09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	INLET, TYPE 16 (4 OF 6) PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SW5.4 DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH



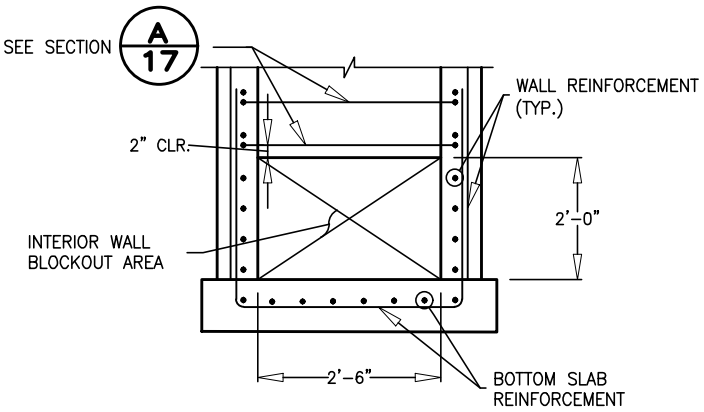
6" VERTICAL CURB AND GUTTER — COMBINATION CURB GUTTER AND SIDEWALK

PLAN
NO SCALE



A SECTION
NO SCALE

09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	INLET, TYPE 16 (5 OF 6)	SW5.5
		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH



DETAIL - TYPICAL INTERIOR WALL BLOCK-OUT

NO SCALE

TRIPLE NUMBER 16 INLET NOTES:

17.1 SEE WCPM STANDARD CONSTRUCTION SPECIFICATIONS SECTION 11.05 STORM INLETS FOR MORE INFORMATION. USE OF THIS DETAIL WITHOUT SPECIFICATIONS SHALL BE CONSIDERED NON-COMPLIANT.

17.2 SEE GENERAL NOTES ON **S-616.1**

17.3 EXPANSION JOINT MATERIAL SHALL BE PLACED FULL DEPTH OF THE CURB AND GUTTER, SIDEWALK, CONCRETE PAVEMENT, AS APPLICABLE. THE TOP PORTION OF THE JOINT SHALL BE SEALED WITH SILICONE SEALANT.

17.4 SEE **S-616.2** FOR REBAR PLACEMENT AROUND CONNECTOR PIPE.

* STANDARD DETAIL **S-716** APPLIES TO ALL OF THE GRATE & FRAME GEOMETRIC DIMENSIONS FOR THE TRIPLE NUMBER 16 INLET EXCEPT FOR THE FRAME LENGTH. FRAME LENGTH SHOULD BE MANUFACTURED FOR THE DIMENSIONS CALLED OUT ON THIS SHEET.

TABLE 10. NO. 16 TOTAL INLET LENGTH

INLET CONFIGURATION	L_S OR L_M INLET LENGTH	▨ E_S OR E_M TOTAL BOTTOM SLAB LENGTH
TRIPLE NO. 16	10'-11"	12'-9"
NO. 16 3-3-2 (EXAMPLE CONFIGURATION)	10'-11", 10'-11", 7'-1"	32'-1"
NO. 16 __-__-__ (CONFIGURATION TEMPLATE)	L_S, L_S, L_S	=3"+8"+L_S+8"+L_S+8"+L_S+8"+3"

▨ MAX. BOTTOM SLAB LENGTH = 75'-0"

REVISIONS
09/03/2024
01/01/2023

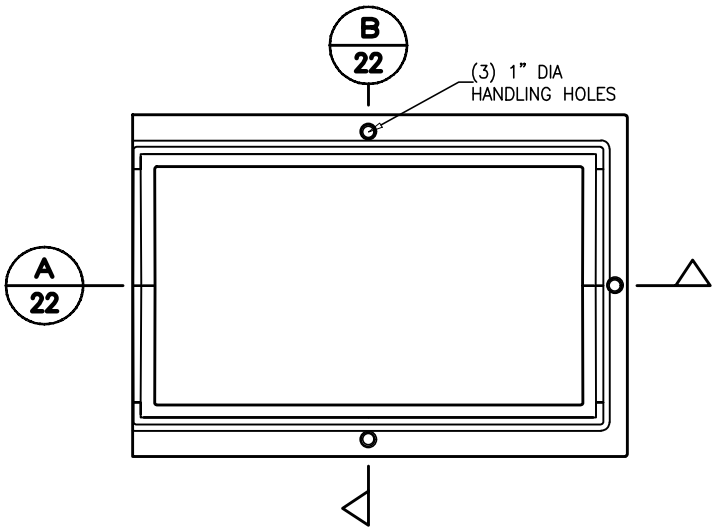
city of PUEBLO colorado

INLET, TYPE 16 (6 OF 6)

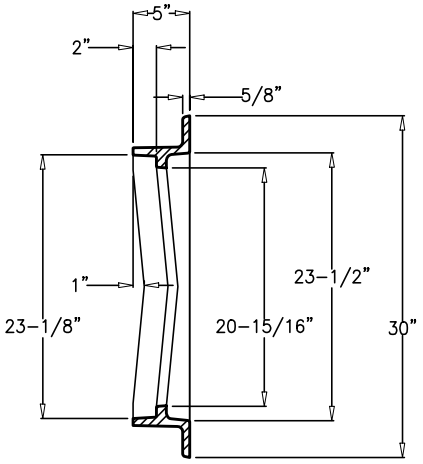
PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION
211 EAST "D" ST. PUEBLO, CO 81003
(719) 553-2295 PHONE

SW5.6

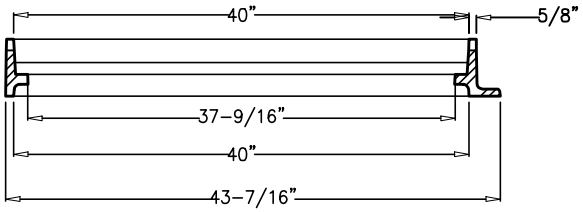
DRAWN BY: NLS
CHECKED BY: JS
APPROVED BY: JH



FRAME TOP VIEW

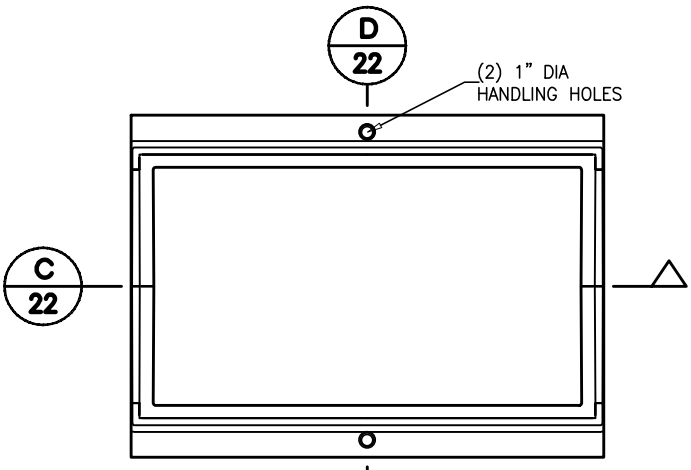


B FRAME SECTION

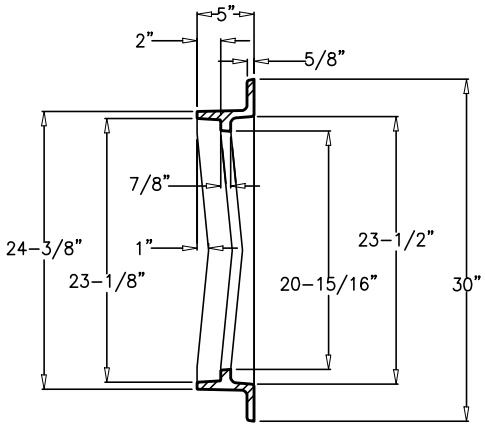


A FRAME SECTION

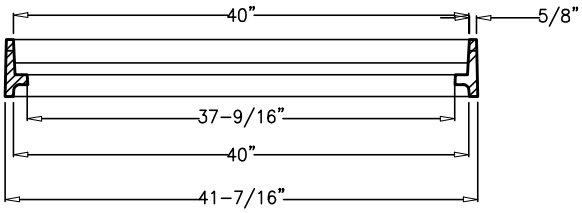
NO. 16 INLET FRAME - RIGHT OR LEFT
NO SCALE



FRAME TOP VIEW



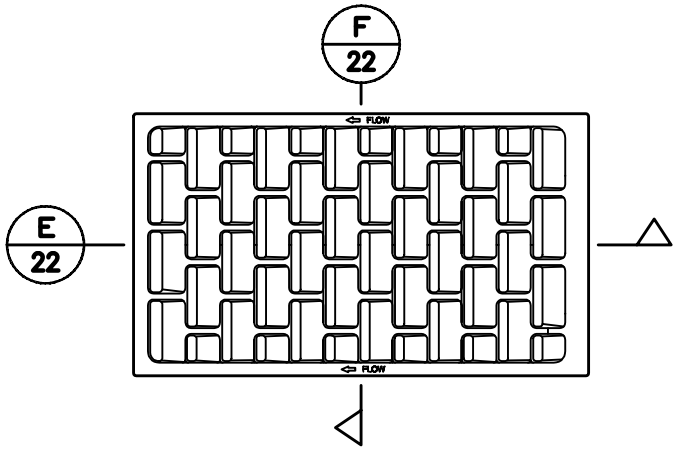
D FRAME SECTION



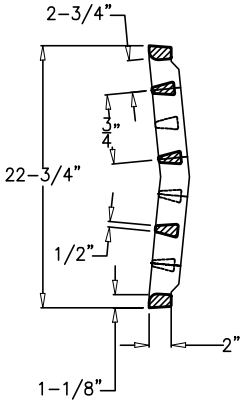
C FRAME SECTION

NO. 16 INLET FRAME - CENTER
NO SCALE

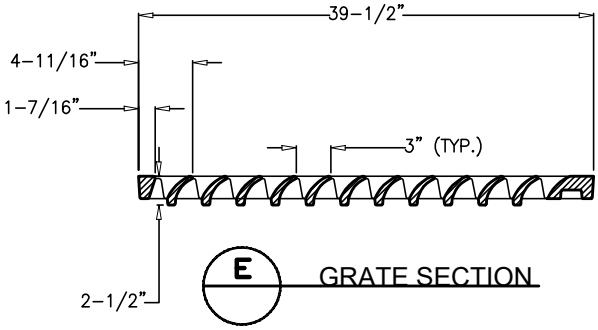
09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	GRATE & FRAME - ADJUSTABLE CURB BOX (1 OF 2) PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SW6.1 DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH



GRATE TOP VIEW



F GRATE SECTION

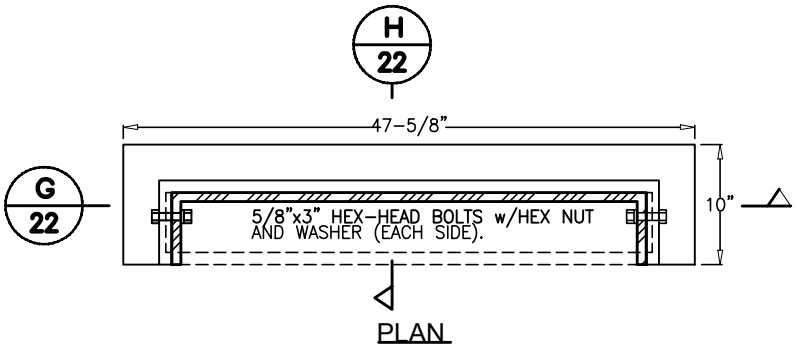


E GRATE SECTION

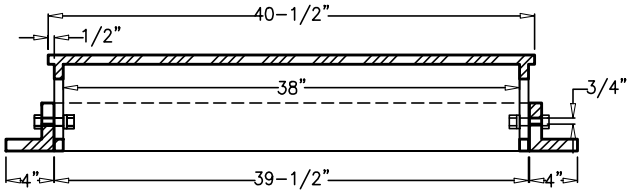
NO. 16 INLET GRATE
NO SCALE

GRATE & FRAME NOTES:

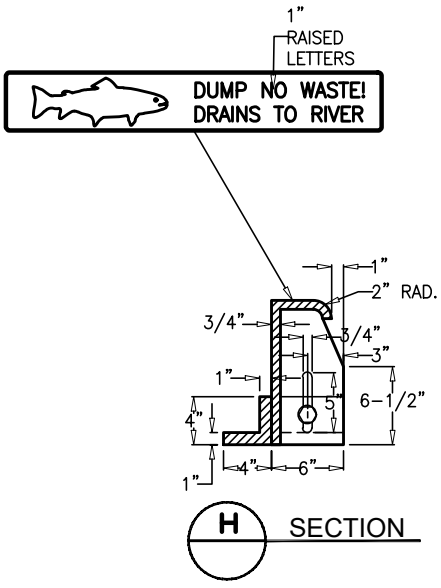
1. CAST IRON SHALL CONFORM TO ASTM A48 (CLASS 35B, MINIMUM).
2. CASTINGS SHALL COMPLY WITH FEDERAL SPECIFICATION RR-F-621D FOR CASTING PROOF LOADING (HEAVY DUTY).
3. ALL CASTINGS REQUIRE INDIVIDUAL APPROVAL/CERTIFICATION FROM THIS DIVISION.
4. CASTINGS SHALL NOT BE DIPPED OR PAINTED PRIOR TO FINAL INSPECTION, ONCE INDIVIDUAL CASTINGS ARE CHECKED, AND APPROVED BY THE DIVISION FOR PROJECT USAGE, THEY SHALL BE COATED WITH AN APPROVED MATERIAL.



PLAN



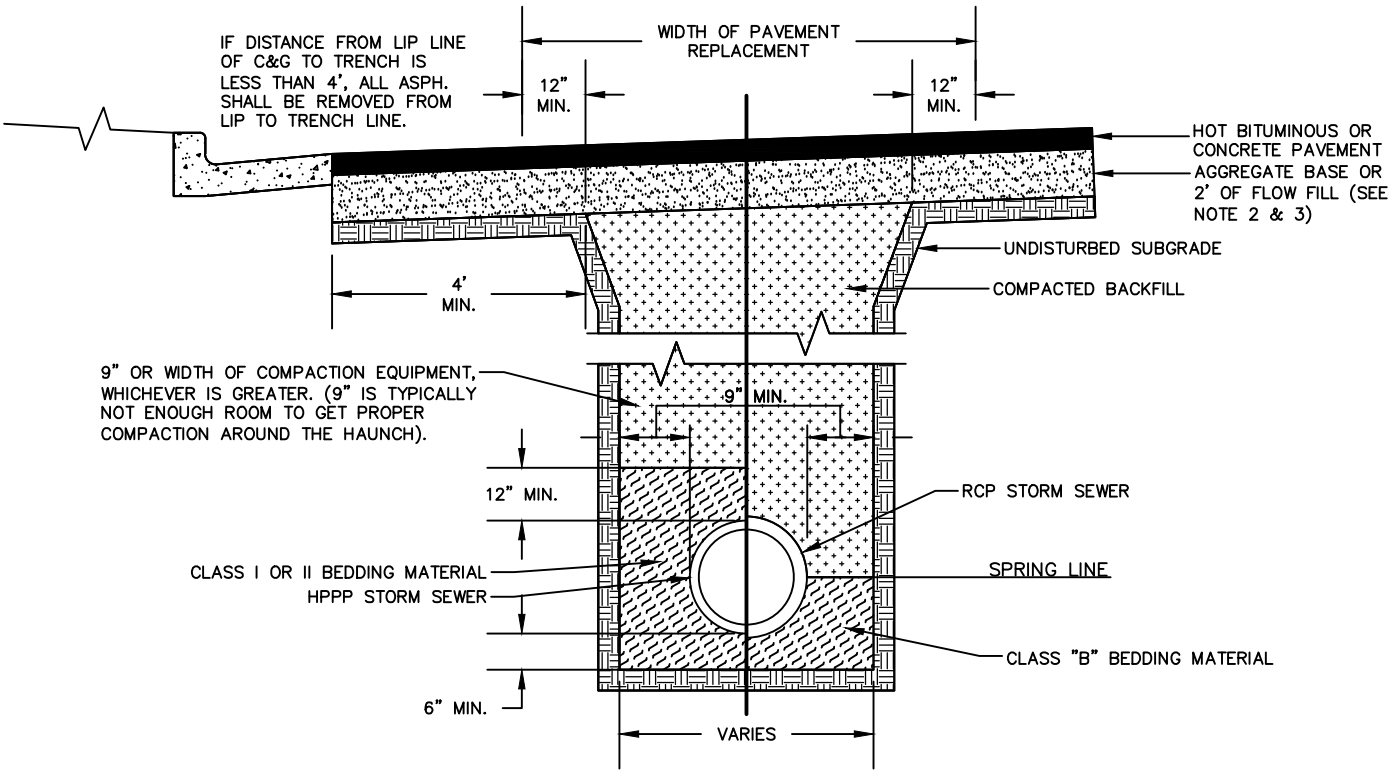
G SECTION



H SECTION

ADJUSTABLE CURB BOX
(MINIMUM CURB OPENING AREA = 150 in2)
NO SCALE

09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	GRATE & FRAME - ADJUSTABLE CURB BOX (2 OF 2) PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SW6.2 DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH



TRENCH DETAIL FOR STORM SEWER
SCALE 1" = 3'-0"

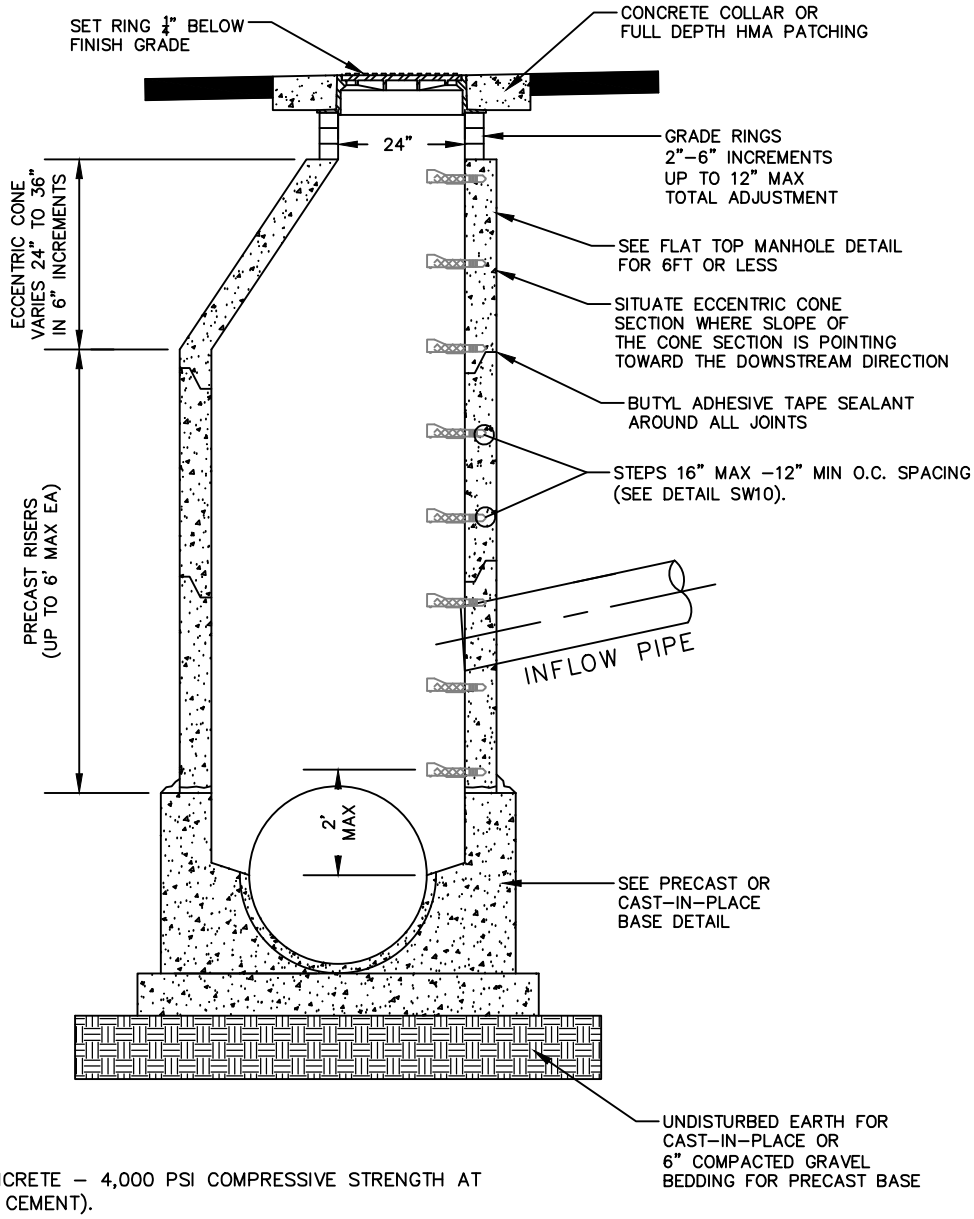
1. ALL TRENCHES SHALL BE ADEQUATELY SUPPORTED AND THE SAFETY OF WORKERS PROVIDED FOR AS REQUIRED BY THE MOST RECENT OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) "SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION".

2. NEW STREETS SHALL COMPLY WITH THE CITY OF PUEBLO'S PAVEMENT DESIGN CRITERIA FOR PAVEMENT AND AGGREGATE THICKNESS FOR EACH ROADWAY CLASSIFICATION (TABLE 3-1).

3. EXISTING STREETS SHALL COMPLY THE CITY OF PUEBLO'S PAVEMENT DESIGN CRITERIA FOR PAVEMENT THICKNESS (TABLE 3-1) OR BE EQUAL TO EXISTING PAVEMENT THICKNESS WHICH EVER IS GREATER. 2 FOOT OF FLOWABLE FILL SHALL BE USED IN LIEU OF AGGREGATE BASE.

4. ON ALL STORM SEWER INSTALLATION, COMPACTION TESTS SHALL BE MADE BY AN APPROVED INDEPENDENT TESTING LABORATORY AND SHALL IDENTIFY THE LOCATION AND DEPTH OF THE TEST, THE DATE OF THE TEST, THE MAXIMUM STANDARD PROCTOR DENSITY AND OPTIMUM MOISTURE CONTENT OF THE SOIL AND GIVE THE PERCENT OF COMPACTION AND MOISTURE CONTENT OF THE BACKFILL MATERIAL AT THE TEST LOCATION. COMPACTION TESTS SHALL BE MADE AT A DEPTH OF THREE FEET (3') ABOVE THE TOP OF THE PIPE AND AT TWO FOOT INTERVALS IN DEPTH, UP TO AND INCLUDING THE SURFACE. TESTING SHALL BE DONE AT A MINIMUM OF ONE LOCATION FOR EVERY 250 FEET OF MAIN LINE TRENCH OR FRACTION THEREOF AND AT EVERY MANHOLE OR SIMILAR STRUCTURE. AN ADDITIONAL COMPACTION TEST IS REQUIRED FOR EACH INLET AND LATERAL AND MAY BE TAKEN ALONG THE PIPE OR AR THE INLET AT THE DISCRETION OF THE CITY. SEE 12.3.12 FOR FURTHER GUIDANCE & REQUIREMENTS.

	city of PUEBLO colorado	STORM SEWER TRENCH	SW7
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION	DRAWN BY: NLS
01/01/2023		211 EAST "D" ST. PUEBLO, CO 81003	CHECKED BY: JS
REVISIONS		(719) 553-2295 PHONE	APPROVED BY: JH



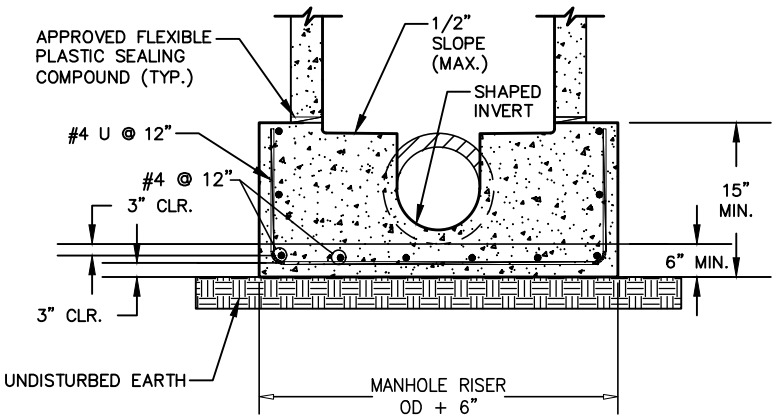
NOTES:

1. DESIGN CRITERIA: CONCRETE – 4,000 PSI COMPRESSIVE STRENGTH AT 28 DAYS (TYPE II–V CEMENT).
2. PROVIDE ECCENTRIC CONES FOR ALL MANHOLES GREATER THAN SIX FEET (6') DEEP, AND FLAT TOPS FOR MANHOLES SIX FEET (6') OR LESS.
3. FOR PIPE INVERT ELEVATIONS SEE PLAN AND PROFILE SHEETS.
4. STEPS SHALL BE REQUIRED WHEN THE MANHOLE DEPTH EXCEEDS 3 FT 6 IN. SEE CITY OF PUEBLO MANHOLE/INLET STEP DETAIL FOR STEP SPECIFICATIONS.
5. MANHOLE STEPS SHALL NOT BE INSTALLED OVER THE FLOW CHANNEL.
6. FOR DEPTHS GREATER THAN 20' (RIM TO INVERT) SHOP DRAWINGS, CALCULATIONS OF WALLS, TOP AND BOTTOM SLABS SHALL BE SUBMITTED.
7. DESIGN ENGINEER OR PROJECT ENGINEER MAY INCREASE MANHOLE SIZE FOR SPECIAL DESIGN CONSIDERATIONS.
8. ALL JOINTS IN THE MANHOLE BARREL, CONE, GRADE ADJUSTMENT RINGS, AND FLAT TOP SECTIONS SHALL BE SEALED WITH A PREFORMED FLEXIBLE PLASTIC SEALING COMPOUND CONFORMING TO FEDERAL SPECIFICATION SS–S–00210 (GSA–FS6).
9. ALL PIPE PENETRATIONS SHALL BE AN APPROVED FLEXIBLE CONNECTION, MECHANICAL SEAL, WATER STOP, OR NON–SHRINK GROUT TO REDUCE INFILTRATION AND EXFILTRATION. WHEN GROUTING IS NECESSARY AT A WATER STOP CONNECTION, NON–SHRINK GROUT SHALL SHALL BE USED.

STORM DRAIN DIAMETER (INCHES)	MANHOLE DIAMTER (FEET)
15 TO 18	4
>18 TO <42	5
42 TO 54	6
LARGER THAN 54	APPROPRIATE MANHOLE SIZE FROM CDOT STANDARD PLAN NO. M–604–20

MANHOLE DROP REQUIREMENT	
HORIZONTAL DEFLECTION ANGLE OF SEWER PIPE AT MANHOLE	MINIMUM DROP(FT)
0°	0.10
0° & 45°	0.20
45°TO 90°	0.30

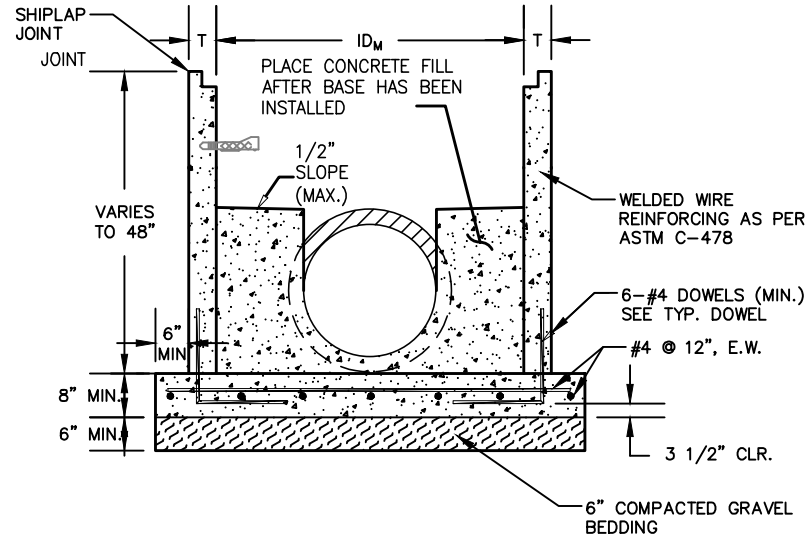
	city of PUEBLO colorado	STORM MANHOLE	SW8
09/03/2024		PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION	DRAWN BY: NLS
01/01/2023		211 EAST "D" ST. PUEBLO, CO 81003	CHECKED BY: JS
REVISIONS		(719) 553-2295 PHONE	APPROVED BY: JH



CAST–IN–PLACE MANHOLE BASE NOTES:

1. GROUTED FLOW CHANNELS AND INVERTS MAY BE FORMED BY SHAPING WITH LEAN CONCRETE (f'c=2,000 PSI MIN.), ALL OTHER CONCRETE SHALL BE MIN f'c=4,000 PSI.
2. REINFORCING IS REQUIRED FOR ALL MANHOLE BASES.
3. SLOPE MANHOLE BENCH 1/2" MAXIMUM TOWARD FLOW CHANNEL.
4. ALL MANHOLES TO BE PLACED ON SUITABLE SUBGRADE MATERIAL. IF SUBGRADE CONDITIONS WARRANT, UNSUITABLE FOUNDATION MATERIAL SHALL BE OVEREXCAVATED, & SELECT SUBGRADE WILL BE PLACED.
5. CONCRETE TO CONCRETE DONE WITHOUT THE PLASTIC SEALING COMPOUND FOR STORM SEWER WILL BE AT THE DISCRETION OF THE CITY.
6. ALL PRECAST RISER SECTIONS, CONES, GRADE RINGS, ETC. SHALL CONFORM TO THE LATEST REVISION OF ASTM C–478, STANDARD SPECIFICATIONS FOR CIRCULAR PRECAST REINFORCED CONCRETE MANHOLE SECTIONS.
7. NO MODIFICATIONS TO A CAST–IN–PLACE MANHOLE WILL BE ACCEPTED ONCE CAST.

CAST–IN–PLACE MANHOLE BASE
NO SCALE

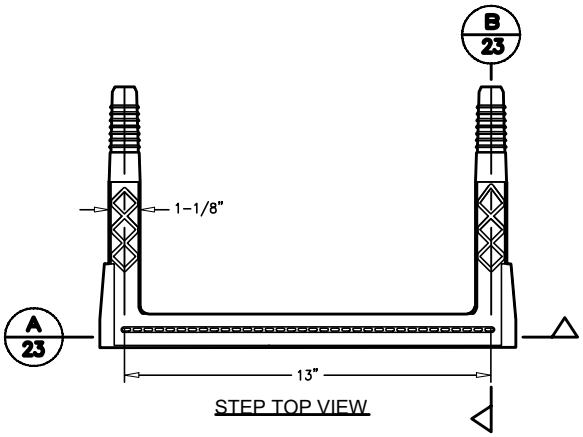


PRECAST MANHOLE BASE NOTES:

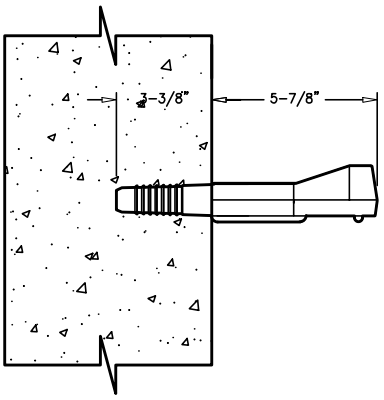
1. THE BASE SLAB SHALL BE POURED MONOLITHICALLY WITH BOTTOM RISER SECTION.
2. PRECAST MANHOLE BASES SHALL FIT THE CONDITIONS AND LOCATIONS FOR WHICH THEY ARE INTENDED WITHOUT ANY FIELD MODIFICATIONS. ANY MANHOLE BASE WHICH REQUIRES FIELD CUTTING OR MODIFICATION IN ORDER TO FIT THE LOCATIONS INTENDED SHALL BE REJECTED BY THE CITY AND REMOVED AT NO COST TO THE CITY.
3. PRECAST MANHOLES CANNOT BE SHIPPED PRIOR TO 5 DAYS POST CASTING, AND CANNOT BE INSTALLED PRIOR TO 7 DAYS POST CASTING.

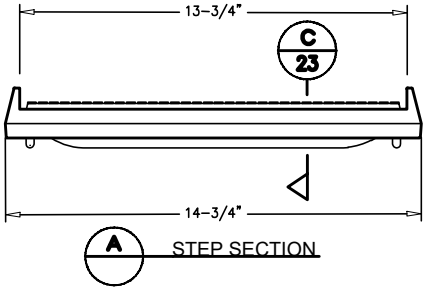
PRECAST MANHOLE BASE
NO SCALE

09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	STORM MANHOLE BASES PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SW9 DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH

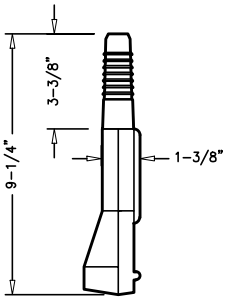


STEP TOP VIEW

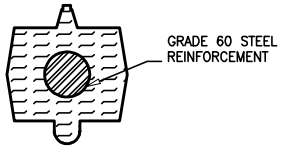




STEP SECTION



B STEP SECTION

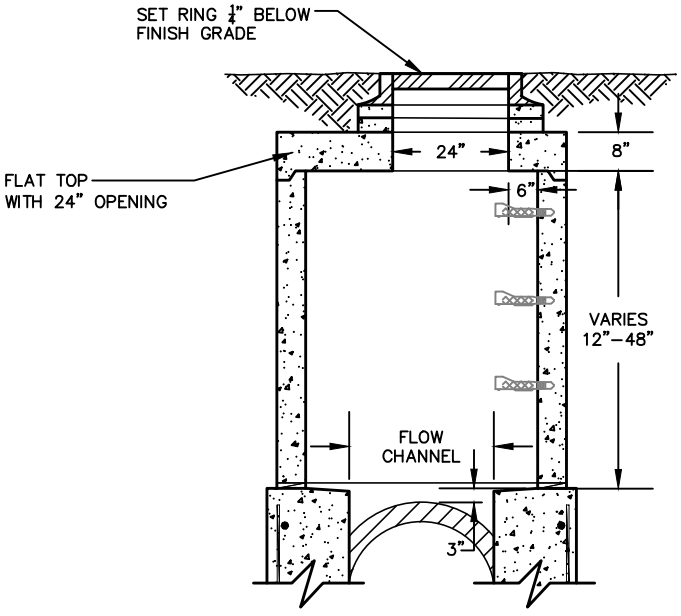


C STEP CROSS-SECTION

NOTES:

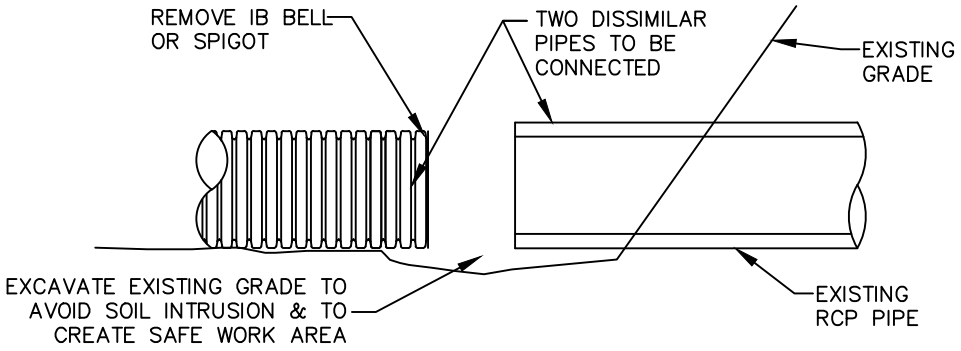
1. ASTM SPECIFICATIONS:
   - 1.1. ASTM C-478 (MANHOLE STEPS AND LADDERS)
   - 1.2. ASTM A-615 GRADE 60 (STEEL REBAR)
   - 1.3. ASTM 4101 (POLYPROPYLENE)
2. STEPS SHALL BE INSTALLED BY THE "PRESS-FIT" METHOD UTILIZING A SPECIALLY TAPERED PIN TO FORM THE INSERT HOLE AS SHOWN. FOLLOWING MANUFACTURER'S RECOMMENDED PROCEDURE AND SHALL NOT BE GROUTED IN PLACE.
3. INSTALLED STEPS SHALL BE CAPABLE OF WITHSTANDING A PULL OUT FORCE OF 2500 LB. PER LEG FOR A MINIMUM PERIOD OF TWO MINUTES.
4. PINS MUST BE SMOOTH AND CONTINUOUSLY TAPERED. W.M.D. INSTALLATIONS REQUIRE A MATCHED COMBINATION OF A TAPERED INSERT PIN AND MANHOLE STEP, AS RECOMMENDED OR REQUIRE BY SPECIFIC MANUFACTURE OF THE STEP TO BE USED.
5. THIS STEP CAN ALSO BE USED IN TOE POCKET INSTALLATIONS PROVIDED 5" TOE CLEARANCE IS ALLOWED. MANHOLE STEPS SHALL NOT BE INSTALLED OVER THE FLOW CHANNEL. THEY SHALL BE PLACED 12" MINIMUM OR 16" MAXIMUM IN STRAIGHT VERTICAL ALIGNMENT WITH THE BOTTOM STEP 8" ABOVE THE BENCH MINIMUM.

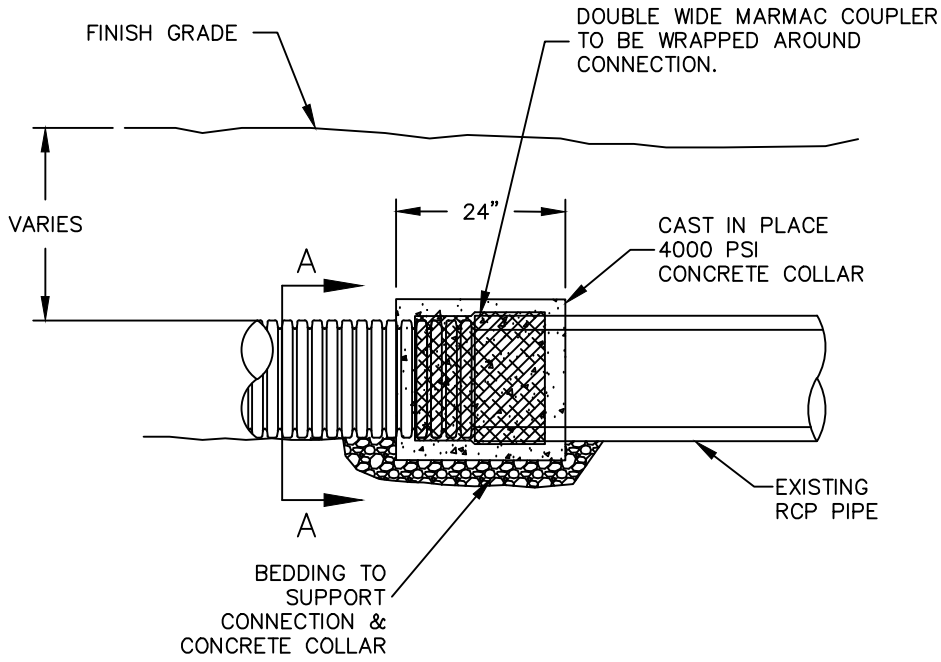
* STORM MANHOLES ONLY. NO STEPS IN SANITARY SEWER MANHOLES.

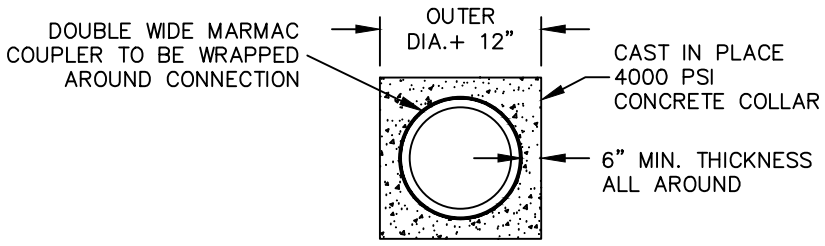


FLAT TOP WITH ECCENTRIC OPENING
NO SCALE

09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	MANHOLE STEPS & FLAT TOP SECTION PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SW10 DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH







SECTION "A–A"

DISSIMILAR PIPE CONNECTION DETAIL

09/03/2024 01/01/2023 REVISIONS	city of PUEBLO colorado	STORM PIPE DISSIMILAR CONNECTION PUBLIC WORKS DEPARTMENT - ENGINEERING DIVISION 211 EAST "D" ST. PUEBLO, CO 81003 (719) 553-2295 PHONE	SW11 DRAWN BY: NLS CHECKED BY: JS APPROVED BY: JH