2009

# CITY OF CORTEZ

# CONSTRUCTION DESIGN STANDARDS and SPECIFICATIONS

June 9, 2009

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# SECTION I

# GENERAL CONDITIONS

# 1.0 – GENERAL CONDITIONS

SECTION I – SCOPE; TERMS; DEFINITIONS; ABBREVIATIONS; SYMBOLS; PLANS AND SPECIFICATIONS; PLAN REVISIONS; AND "AS-BUILT" PLANS

## *1.1 – SCOPE:*

The stipulations that follow are general in scope and may refer to conditions which will not be encountered in performance of the work, and which are not applicable thereto. The provisions of this article shall be enforced and administered by the City of Cortez City Engineer. Upon written consent from the City Engineer, a City employee as designated by the Director of Public Works may enforce these articles.

Currently adopted building codes, State regulations, Federal standards, Empire Electric Standards., Atmos Gas Standards., and the Cortez Sanitation District Pipeline and Manhole Specifications, shall be adopted herein and followed. Where any of these codes may conflict, the more restrictive standard shall apply.

## *1.2 – TERMS:*

All construction of new public improvements within the City of Cortez shall be completed in accordance with these Construction Design Standards and Specifications. The maintenance and rehabilitation of existing public facilities shall be in accordance with accepted construction practices and based upon sound engineering principles as directed by the Public Works Department. This document shall be subject to modification, from time to time, upon recommendation of the Public Works Department and approval by the City Council. A full and complete set of Construction Design Standards and Specifications shall be available for sale to the public at all times at the offices of the Public Works Department. Unless otherwise stated, the words "directed, required, permitted, ordered, instructed, designated, considered, necessary, prescribed, approved, acceptable, satisfactory", or words of like import, refer to actions, expressions, and prerogatives of the City Engineer. The City Engineer shall have the authority to make all interpretations of the text of this code.

Building permits may be issued prior to placement of asphalt or other utilities if a bond or an irrevocable letter of credit is prepared, or the extension of the accepted bond or letter of credit is approved and accepted by the City Engineer. A certificate of occupancy shall not be issued until all conditions of the construction design standards have been met, all improvements completed, and written approval has been given by the City Engineer. No work shall commence prior to approval of the final construction drawings by the City Engineer, unless otherwise authorized by the City Engineer. All plans specs, reports, and construction documents shall be stamped by a Colorado licensed Civil Engineer prior to submittal. All new work being performed within the City limits as of June 2009 shall comply with the Construction Design Standards.

APPEALS: Appeals of final decisions by the City Engineer and/or Director of Public Works, or their designees as authorized in Section 1.1 of the City of Cortez Construction Design Standards and Specifications, shall be made pursuant to Section 6.15-Board of Adjustment and Section 6.16-Appeals City of Cortez Land Use Code as currently adopted or as may be amended from time to time.

## *1.3 – DEFINITIONS:*

Base Course – CDOT Class 6 road base as specified in the current edition of the Colorado Department of Transportation, *Standard Specifications for Road and Bridge Construction.*

Building Connection Sewer – A sewer within a public street or right-of-way, proposed to connect any parcel, lot, or part of a lot with a main line sewer.

Building Sewer – A sewer, wholly within private property, proposed to connect any building to a building connection sewer.

City – The City of Cortez, County of Montezuma, State of Colorado.

Contractor – The individual, partnership, corporation, joint venture, or other legal entity performing the work. In the case of work being performed under permit issued by the City, the Permittee shall be construed to be the Contractor.

Construction documents – shall consist of Plans (Drawings), Specifications, drainage report, geotechnical report, wetland delineation, required state and federal permits, and appropriate calculations which complement each other.

Days – Days shall mean consecutive calendar days, unless otherwise specified.

Engineer – The City Engineer of the City of Cortez, or authorized representative as stated in writing by the City Engineer.

Inspector – An authorized and documented representative of the Public Works Director, assigned to make any or all necessary inspections of materials furnished and work performed by the Contractor. Inspectors shall be designated in writing by the Public Works Director. Outside inspectors may be hired by either the City or the contractor. Outside inspectors must be approved by the Public Works Director in writing.

Permittee – The, responsible party, applicant, contractor, developer, or any other person which is allowed to perform construction of public improvements or facilities within the City of Cortez.

Plans – The drawings, street profiles, street cross sections, grading plan, drainage plan, utility plan, working drawings, and supplemental drawings, or reproductions thereof, approved by the City Engineer or representative, which show the location, character, dimensions, and details of the work.

Private Contract – Work subject to City inspection, control, and approval, involving private funds, not administered by the City.

Reference Specifications – Those bulletins, standards, rules, methods of analysis or tests, codes and specifications of other agencies, engineering societies, or industrial associations referred to in the Contract Documents. These refer to the latest edition, including amendments in effect and published at the time of advertising the project or issuing the permit, unless specifically referred to by edition, volume, or date.

Reports – Shall include all reports as stated in Section 2.0.

Service Connection – Service connections are all or any portion of the conduit, cable, or duct, including meter, between a utility distribution line and an individual consumer.

Sewer – Any conduit intended for the reception and transmission of sewage and fluid industrial waste.

Special Provisions – Any written provisions which supplement or modify these specifications.

Specifications – Standard specifications, reference specifications, special provisions and specifications in supplemental agreements between the Contractor and the City.

Standard Plans – Details of standard structures, devices, or instructions referred to on the Plans or in Specifications by title or number.

Streets – Arterial, collector, and local streets are those defined on the City of Cortez's Street Plan.

Storm Sewer – Any conduit and appurtenances intended for the reception and transfer of storm water.

Superintendent – Authorized representative for the Contractor present on the work at all times, authorized to receive and act upon instructions from the City Engineer.

Supervision – Supervision, where used to indicate supervision by the Engineer, shall mean the performance of obligations, and the exercise of rights specifically imposed upon and granted to the City in becoming a party to the contract. Except as specifically stated herein, supervision by the City shall not mean active and direct superintendence of details of the work.

Surety – Any individual, firm or corporation, bound with and for the Contractor for the acceptable performance, execution, and completion of the work, and for the satisfaction of all obligations incurred.

Utility – Tracks, overhead or underground wires, pipe lines, conduits, ditches, ducts or structures, sewers or storm drains owned, operated, or maintained in or across a public right-of-way or private easement.

Work – All improvements to be constructed or done under the contract or permit, including the furnishing of all labor, materials, supervision, tools and equipment.

## 1.4 – ABBREVIATIONS:

AASHTO----------American Association of State Highway and Transportation Officials
Aban ----------Abandon
ABC ----------Aggregate base course
AC ----------Asphalt concrete
ACB ----------Asphalt concrete base
ACI ----------American Concrete Institute
ACP ----------Asbestos cement pipe
ACWS ----------Asphalt concrete wearing surface
AD ----------Assessment District
ADA ----------Americans with Disabilities Act
AIA----------American Institute of Architects
AIEE----------American Institute of Electrical Engineers
AISC ----------American Institute of Steel Construction
ANSI ----------American National Standards Institute
APA ----------American Plywood Association
API----------American Petroleum Institute
APWA----------American Public Works Association
AREA ----------American Railway Engineering Association
ASCE ----------American Society of Civil Engineers
ASME----------American Society of Mechanical Engineers
Asph----------Asphalt
ASTM ----------American Society for Testing & Materials
Ave ----------Avenue
AWG ----------American Wire Gage (non-ferrous wire)
AWPA----------American Wood Preservers Association
AWSC ----------American Welding Society Code
AWWA----------American Water Works Association
Bk----------Book
BC ----------Beginning of curve
BCR ----------Beginning of curve return
Blvd----------Boulevard
BM----------Bench mark
BOC---------- --Back of Curb
BVC ----------Beginning of vertical curve
BST----------Bituminous surface treatment
BW---------- -----Bottom of Wall or Back of Walk
BWG ----------Birmingham Wire Gage (iron and steel wire)
C ----------Centigrade
CC or C/C ----------Center to Center
CE ----------City Engineer
Cem----------Cement
CB ----------Catch basin
CF ----------Curb face
cfs----------Cubic feet per second
Ch----------Chimney
CIC---------- Cable in Conduit
CIP ----------Cast iron pipe
CL or $C_L$ ----------Center line
Cm----------Centimeter

CMP----------Corrugated metal pipe
CSDC----------Cortez Strom Drainage Criteria
CO----------Cleanout
Col----------Column
Conc----------Concrete
Const----------Construct
CSI----------Construction Specifications Institute
CSP----------Corrugated steel pipe
CMP----------Corrugated metal pipe
Cu----------Cubic
D----------Diameter of pipe or inside height of semi-elliptical conduit
Deg----------Degree or degrees
DF----------Douglas fir
DI----------Diameter
Dim----------Dimension
DIP----------Ductile iron pipe
Div----------Division
DMH----------Drop Manhole
Dr----------Drive
Dwy----------Driveway
E----------East
Ea----------Each
EC----------End of curve
ECR----------End of curve return
El or Elv----------Elevation
ELC----------Electrolier lighting conduit
Ellip----------Elliptical
Eq----------Equation
EVC----------End of vertical curve
Ex or Exist----------Existing
F----------Fahrenheit
FB----------Field Book
FH----------Fire hydrant
FL----------Flow line or floor line
FM----------Force main
Fnd----------Found
fps----------Feet per second
FS----------Finished surface
ft----------Foot or feet
g or gm----------Gram
Ga----------Gage
Galv----------Galvanized
GL----------Ground Line
Gpm----------Gallons per minute
Gr----------Grade
H----------High or height
H & T----------Hub and tack
HC----------House connection sewer
Hdwl----------Headwall
Hor----------Horizontal
Hwy----------Highway
ID----------Improvement District or Inside Diameter

IEEE ----------Institute of Electrical and Electronic Engineers
Inv ----------Invert
IP ----------Iron pipe
IPS ----------Iron pipe size
Irrig ----------Irrigation
JB ---------- Junction Box
JC ----------Junction chamber
JS ----------Junction structure
Jt ----------Joint
L ----------Length
lb ----------Pound
L & T ----------Lead and tack
LD ----------Local depression
LF ----------Linear feet
LH ----------Lamp hole
Lin ----------Linear
Long ----------Longitudinal
Lt ----------Left
M ----------Map or maps
Max ----------Maximum
MB ----------Map book
Meas ----------Measured
MH ----------Manhole
MHF & C ----------Manhole frame and cover
Min ----------Minute or minimum
Misc ----------Miscellaneous
MJ ----------Mechanical Joint
Ml ----------Milliliter
Mm ----------Millimeter
Mon ----------Monolithic or monument
MTC ----------Multiple tile duct
MUTCD----------Manual on Uniform Traffic Control Devices
N ----------North
NBS ----------National Bureau of Standards
NCPI ----------National Clay Pipe Institute
NE ----------Northeast
NEC ----------National Electrical Code
NEMA ----------National Electrical Manufacturer's Association
NESC ---------- National Electrical Safety Code
NFPA ----------National Fire Protection Association
NRCP ----------Non-reinforced concrete pipe
No ----------Number
NSF ----------National Safety Foundation
NSPE ---------- National Society of Professional Engineers
NW ----------Northwest
OC ----------On center
OD ----------Outside diameter
OR ----------Official records of the City
OSHA ----------Occupational Safety and Health Administration
Oz ----------Ounces
PC ----------Point of curve
PCC ----------Point of compound curve or Portland cement concrete

Ped ---------- Pedestal
PI ----------Point of intersection
PL ----------Property line
PP ----------Power pole
PRC ----------Point of reverse curve
ppm ----------Parts per million
Prod ----------Produced
Prop ----------Proposed or property
psi ----------Pounds per square inch
psf ----------Pounds per square foot
PT ----------Point of tangency
PVC ----------Poly-vinyl chloride
Pvlt ---------- Primary Voltage
pvmt ----------Pavement
Q ----------Rate of flow
R ----------Radius or rate of grade (percent)
RC ----------Reinforced concrete
RCP ----------Reinforced concrete pipe
Rd ----------Road
Rdwy ----------Roadway
Reinf ----------Reinforced
Ret. Wall ----------Retaining wall
rpm ----------Revolutions per minute
Rt ----------Right
R/W ----------Right-of-way
S ----------South or slope (ft per ft)
San ----------Sanitary
SCCP ----------Steel cylinder concrete pipe
SD ----------Storm drain or Sanitation District
Sdl ----------Saddle
Sec ----------Seconds
Sect ----------Section
SE ----------Southeast
Spec ----------Specifications
Sp. MH ---------- Special manhole
Sq ----------Square
SS ----------Sanitary sewer
St ----------Street
Sta ----------Station
Std ----------Standard
S & T ----------Spike and tin
Str. Gr ----------Straight grade
Struct ----------Structure or structural
Svlt ---------- Secondary Voltage
SW ----------Southwest
T ----------Tangent distance
TC ---------- ------Top of Curb
Tel ----------Telephone
Temp ----------Temporary
TH ----------Test hole
TLMH ----------Terminal manhole
TMH ----------Trap manhole

TP ----------Telephone pole
Tr ----------Tract
Trans ----------Transition
TS ----------Traffic signal or transition structure
TSC ----------Traffic signal conduit
TYP ----------Typical
TW ----------Top of Wall
UDFCD----------Urban Drainage and Flood Control District
UL ----------Underwriter's Laboratory
* USASI ----------United Sates of America Standards Institute
USC & GS----------United States Coast and Geodetic Survey
USDCM----------Urban Strom Drainage Criteria Manual
USGS ----------United States Geological Survey
V ----------VeloCity of flow or depth of inlet
VC ----------Vertical curve
VCP ----------Vitrified clay pipe
Vert ----------Vertical
W ----------West or width
WD ----------Water District
W & SD----------Water and Sanitation District
WS ----------Wearing surface or Water surface
WI ----------Wrought iron
Wt ----------Weight
XFMR ----------Transformer
Yd ----------Yard or yards

* Formerly known as ASA, American Standards Association

## 1.5 – SYMBOLS:

′----------Feet or minutes
″ ----------Inches or seconds
° ----------Degrees
△----------Delta, the central angle (angle between tangents), also Change or transformer
#----------Number
n----------Manning's roughness coefficient
%----------Percent
@ ----------At
/----------Per
=----------Equals
□ ----------Sectionalizing Cabinet
O ----------Power Pole
▫ ----------J box or Meter Pedestal

## *1.6 – PLANS AND SPECIFICATIONS:*

### 1.6.1 –Construction Documents:

*A – Approval, Acceptance of Plans:*

Construction standards and specifications for development in the City of Cortez, as set forth herein, shall be followed in the design and construction of public improvements and facilities. Construction documents must be submitted to the City engineer for approval prior to construction, unless otherwise authorized. Construction documents shall consist of Plans (Drawings) and Specifications. Additionally, a drainage report, geotechnical report, wetland delineation, required state and federal permits, and appropriate calculations which complement each other may be required by the City Engineer depending on the scope of work. The Construction Documents will depend upon the size, nature, and complexity of the project. Construction documents of public facilities submitted for approval must emphasize the following:

- Life Safety
  - Separation of differing utility facilities
  - OSHA Standards and regulations
- Means of egress
- Barrier free accessibility
- Structural integrity
- Building code compliance
- Definition of scope of work
- Compliance with Federal, State, and Local laws

Acceptance of the construction of public improvements shall be given in writing by the City Engineer and shall be contingent upon:

- Submittal of approved as-built plans.
- Submittal of test results required as part of the City specifications.
- Construction phase inspections and final inspection by the City.

*B – Plan Compliance:*

Plans shall be provided to ensure compliance with federal, state, and local laws that govern construction. Plans and specifications are to be prepared based on appropriate planning criteria and applicable standards and requirements. All design work is to be prepared and signed by a Registered Professional Engineer or Architect as applicable. Plans are to be completed in sufficient detail to facilitate review and to clearly describe the existing conditions and proposed development of the project in its entirety.

*C – Submittal of Plans and Reports:*

- Plans, Profiles, and Details shall be submitted to the Public Works Department for all proposed construction of public roads, and utilities such as water distribution lines, electric lines, gas lines, communication lines, cable TV lines, sewers, and storm sewers, showing the grades, length of vertical curves, stationing and elevations of BVC's, EVC's and PIVC's, culverts, structures, service lines, and other controls. The existing features, utilities, grade or ground lines shall be shown by dashed or ghosted lines while proposed features on the plans are to be shown as heavy, or solid lines.

- Profiles must be provided for roads, electric lines, gas lines, CATV lines, telephone and communication lines, sewers, and storm sewers. The vertical scale is to be distorted 10 to 1, except in those situations where other distortions can better convey the relationship peculiar to the project between vertical and horizontal elements of the design.
- Site development plans shall be required for development.
- Construction of public improvements shall be guaranteed by an irrevocable letter of credit, or appropriate financial guarantee, as set forth in the Land Use Code. The cost of improvements shall be approved by the City Engineer prior to construction.

## 1.6.2 – Development Plan Standards:

A cover sheet shall include the project identification, project address and a location map. All licensed architects and engineers shall be identified on construction plans.

*A - Street or Road Plan shall show at a minimum:*

- The length of all tangents and curves.
- Widths of right-of-way.
- Existing contour and finished grade slope lines to prove that the right-of-way is of sufficient width.
- Stationing on EC's and BC's, curve radii, delta angles, bearings, distances, centerline stationing at no more than 100-foot intervals.
- Dimensions of all road elements, curbs, gutters, utilities, easements and other structures.
- Include the location and size of culverts and designation of the type and gauge or strength classification.
- Provide construction details for all structures, bridges, box culverts, etc.
- A description of at least one usable bench mark for each project shall be required.
- Also show north arrow, scale, street names, drainage patterns, and striping.
- Typical road cross –sections, and typical details for construction of all project elements.

*B - Site Development Plans shall show at a minimum:*

- The project location and the existing site conditions that include all property lines with dimensions, all streets, easements and, terrain contours, buildings or structures, utilities, drainage, and other physical features on or near the project site. For small projects, this information can be shown in the site plan; however, for large or complex construction projects, it is often shown in a separate existing conditions topographic map.
- Planned demolition of existing buildings, structures, utilities, or other physical features that must be demolished as a part of the project. Dependent upon the complexity of the project, this may be shown in the site plan or in a separate demolition plan.
- Planned grading for surface drainage (shown by a combination of contours and spot elevations) and the planned grading and paving of driveways, access roads, parking areas, landscape areas and slopes. Indicate drainage patterns, finished floor elevations, inflow and outflow locations and specify areas required to be maintained for drainage purposes. The plan shall indicate erosion control measures during construction activities and measures for final stabilization.
- Proposed locations of new buildings or structures in relation to property lines and setbacks. Show all required parking facilities with accessible elements that must comply with the Department of Justice ADA Regulations. Show dimensions, cross sections and details for all components delineated on the site plan including curbs, gutters, sidewalks, parking and drainage structures. The plan should indicate the proposed layout with

dimensions, size, locations, thickness, materials, strengths, and the necessary support to describe the new construction fully.

- Include all new utilities such as water, sewer, communication, gas, telephone, and electrical services and routes with points of connection for proposed utility services.
- Include a Storm Water Management Plan as required by the Colorado Department of Public Health and Environment.
- All Sidewalks, Retaining walls, landscaping, street lights, curb lines, Finished floor elevations, Common and limited Common areas, storm water management plan, best management practices, detention/retention ponds, parking, outlet structures, and all public improvements.
- Building plans shall be submitted and approved by the Building Department.

*C - Utility Plan layout within the City street right-of-way shall include:*

- Utility plan shall clearly depict accurate locations and depths of all utilities including but not limited to: water, storm sewer, sewer, gas, electric, telephone, fiber optic, and empty conduits.
- All lengths, dimensions, and depth/height of line elements and locations in relation to street elements or structures shall be shown.
- Designate the size, type, and classification of the utility line (pipe) and include all details for the construction of the significant components.
- Excavations within the City right-of-ways shall comply with Section 2.0.
- Shall be approved by the City Engineer prior to construction.

## *1.7 – PLAN REVISIONS:*

Should circumstances warrant changes to the approved plans or specifications, the proposed revision must be submitted and written approval must be obtained from the City Engineer. No work shall proceed on that portion of the project being revised until said revisions are submitted, approved, and distributed. Minor deviations from the plans or specifications may be by written permission from the City Engineer.

## *1.8 – "AS-BUILT" PLANS:*

It shall be the responsibilities of the developer to have his/her engineer provide the City Engineer with a set of 'as-built" plans at the completion of the project verifying all elevations, all utility locations, and any other change that has taken place prior to acceptance of the subdivision.

Before final approval of public improvements by the City of Cortez, a complete "as-built" plan set shall be submitted by the developer to the City Engineer.

# SECTION II

# CONSTRUCTION REGULATIONS

# 2.0 – CONSTRUCTION REGULATIONS

SECTION II – ADMINISTRATIVE REQUIREMENTS; QUALITY REQUIREMENTS; PRODUCT REQUIREMENTS; GENERAL CONSTRUCTION CRITERIA; AND TEMPORARY FACILITIES AND CONTROLS

## *2.1 – ADMINISTRATIVE REQUIREMENTS:*

Prior to any construction of public facilities, it is essential to coordinate with all regulatory agencies (federal, state, or local) that have interests in the development.

### 2.1.1 – Permits:

*A – Permit Conformance:*

Responsible party shall conform to all requirements of the Construction Design Standards and Specifications, the City Land Use Code, the currently adopted building codes, as well as any other regulatory agency (federal, state, local) permits that may be required for special cases. Working without issuance of a permit may result in termination of all construction activity and additional rework for corrective action at the expense of the contractor.

*B– Grading Permits:*

A Grading Permit must be obtained from the City Engineer to control clearing, excavation, grading and earthwork construction, including placement of fill or embankments within the City of Cortez. Stormwater Discharge Permits will be issued in conformance with the Colorado Department of Public Health and Environment (CDPHE). A Stormwater Discharge Permit may be required by (CDPHE) prior to issuance of a grading permit.

*C – Right-of-Way Construction Permits:*

- A Right-of-Way Construction Permit must be obtained from the City Engineer prior to any construction or excavation within any public right-of-way except for services provided by the City of Cortez Public Works Department's employees.
- Right-of-Way Construction Permits shall be required for, but not limited to, sidewalk construction/reconstruction, sewer, storm sewer, water line, culverts, empty conduits, telephone, gas, construction and repair, curb cuts, underground and overhead utility line construction or repair, curb, gutter, street, or alley construction or reconstruction, and any utility work within the City right-of-way.
- Before any excavation work can be started on public streets or utilities in any existing or proposed new subdivision, a right-of-way construction permit must be obtained.
- Line locates must be obtained by calling 811.

*D –Floodplain Development Permits:*

A Floodplain Development Permit must be obtained from the City of Cortez Public Works Department prior to any construction or excavation within any designated flood hazard area that has been mapped by FEMA's National Flood Insurance Program.

### 2.1.2 – Safety Conditions:

*A – General:*

The Contractor shall observe all rules and regulations of Federal, State, and local health officials. The Contractor shall not require any worker to work in surroundings or under conditions which are unsanitary, hazardous, or dangers to health or safety.

The Contractor shall preserve private and public property and protect it from damage. Land monuments and property marks shall not be disturbed or moved until their location has been witnessed or referenced, and their removal approved. The Contractor shall be responsible for the damage or injury to property resulting from:

(1) The Contractor's neglect, misconduct, or omission in the manner or method of execution or non-execution of the work, or
(2) The Contractor's defective work or the use of unacceptable materials.

The Contractor's responsibility shall not be released until the work has been completed in compliance with the Contract. The Contractor shall restore damaged or injured property, at the Contractor's expense, to a condition similar or equal to that existing before the damage or injury occurred, by repairing, rebuilding, or restoring the property.

Existing trees, shrubs, bushes, or grass, outside the designated work areas but inside project limits, which are damaged due to the Contractor's operations, shall be replaced in kind at the Contractor's expense.

*B – Construction Debris:*

When any earth, gravel, or other excavated material is caused to fall, roll, flow, or wash upon any street, the responsible party shall remove the debris immediately. In the event that earth, gravel, or other excavated material so deposited is not removed, the City Engineer shall cause such removal and the cost incurred shall be paid by the responsible party.

All paved streets wherein excavation or construction activity has been performed will be thoroughly cleaned to prevent a safety and health hazard.

## 2.1.3 –Traffic Regulations:

The latest Edition of the MUTCD is hereby adopted by reference.

*A –General:*

One lane of traffic in each direction shall be maintained when possible, where any work is performed on a City street as designated by the City's Master Street Plan. Traffic on major streets shall not be restricted between the hours of 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m., Monday through Friday, unless otherwise authorized by the City Engineer. Weekend and holiday work shall require proper notice and the City Engineer's permission. A traffic control plan shall be submitted to the City Engineer for all operations requiring work within the City ROW. The traffic control plan shall be signed by a certified traffic control supervisor.

*B –Access to Private Property:*

Vehicular access shall be maintained to private business and residential property located within or adjacent to any construction zones.

*C –Street Closing:*

Prior to closing any public street for construction purposes, the City as well as the local emergency services shall be notified not less than 48 hours in advance. When traffic conditions permit, the City Engineer may, by written approval, permit the closing of streets to all traffic for a period of time prescribed by him. In addition, the approval of the City Engineer may require that the responsible party give 48 hour notification to various public agencies

and to the general public affected by the closure. In such cases, such written approval shall not be valid until such notice is given.

*D – Permanent Traffic Signs, Signals and Devices-*

All post-mounted signs, striping, markers, delineators, signals, and other traffic control devices are to conform to the requirements of the Federal Highway Administration, as outlined in the latest version of the "Manual on Uniform Traffic Control Devices"(MUTCD).

## 2.1.4 – Monuments:

Survey monuments of concrete, iron, or other lasting material set for the purpose of locating or preserving the lines of any street or property subdivision, or a precise survey reference point or a permanent survey bench mark within the City, shall not be removed or disturbed unless permission to do so is first obtained in writing from the City Engineer. Permission shall be granted only upon condition that the responsible party shall pay all expenses incident to the proper replacement of the monument.

## 2.1.5 – Protection of Existing Improvements:

*A –Protection of Existing Utilities:*

In the prosecution of work, existing utilities shall be protected and located by request to the Utility Notification Center of Colorado (UNCC) at 811 (or 1-800-922-1987) not less than 3 working days before performing work. Underground utilities shall be located and marked within and surrounding the construction area.

All existing utility lines, pipes, and structures shall be located sufficiently ahead of the work to avoid damage to these facilities and permit their relocation, if necessary. Existing utilities are to be located by the respective utility company or acknowledgement that no utility is located in the construction area.

Reasonable care shall be exercised in showing the location of existing utilities on the plans. The exact location of such utilities may not be known in all cases. The contractor shall explore the area ahead of the earthwork operations by observations and/or electronic devices to locate and shall conduct his work so as to minimize damage to the existing structures.

Existing utilities shall be properly supported as required by the owner and protected from damage during the progress of the work. All pipe lines, utilities, or structures which are broken or damaged shall be reconstructed of the same material, to the satisfaction of the owner. Where it was reasonably possible for the contractor to have located the utilities, he shall assume the responsibility for proper repair or replacement of them. The contractor shall immediately report any damaged utilities.

The contractor shall contact the owners of all irrigation ditches, and make arrangements for necessary construction clearances and/or dry-up periods. All irrigation ditches, dikes, head gates, pipe, valves, checks, etc., damaged or removed by the contractor, shall be restored to their original condition or better, at the contractor's expense.

*B – Protection of Existing Physical Features:*

Where trenches are located closely adjacent to buildings, foundations, and street surface structures, the contractor shall take all necessary precautions to prevent damage to them. The contractor shall be liable for any damage caused by the construction.

Plant life, fences, mailboxes, poles, sidewalks, paving, curb, and all other property shall be protected unless their removal is authorized by the City Engineer, and property damage or removed structures shall be satisfactorily restored by the contractor at his sole expense.

Work shall be performed and conducted so as not to interfere with access to fire hydrants, fire stations, fire escapes, water gates, underground vaults, valve housing structures, and all other vital equipment as designated by the City Engineer. An excavation protection plan may be required to be submitted for large projects that require sheeting, shoring, and bracing and describes the installation required to protect excavations, adjacent structures, and property.

## 2.1.6 – Special Procedures:

*A. General*

All proposed development within the City of Cortez may be required to submit the following reports to the City Engineer for approval prior to construction: Geotechnical Report, Drainage Report, Traffic Impact Study, Environmental Impact Study, Wetlands delineation Report, and other reports as deemed necessary by the City Engineer. The request for all reports shall be made in writing by the City Engineer.

*B. Reports / Studies –*

1. A Geotechnical Report may be required for proposed development prior to construction. The report shall include at a minimum the following: a description of soil types, locations, and characteristics with supporting maps, soil logs of test pits or holes and other information necessary to determine soil suitability for the scope of the development. The report shall also include a narrative that describes the constraints on the proposed development based on the findings, an analysis and evaluation of such information with recommendations regarding structural constraints, and a determination of the adequacy of the characteristics of the soil as they relate to the proposed uses of development. Furthermore, the report shall be accompanied by approved street cross section designs.

2. A Drainage Report – may be required for proposed development prior to construction. The report shall include at a minimum the following:

Existing drainage and surface conditions and corresponding hydrologic classifications of the site soils. The analysis of the site shall include methods used to determine existing peak storm flows associated with the given rainfall frequency, assumptions and calculations of runoff characteristics and calculations for travel time and/or time of concentration.

Off-Site drainage areas that affect the site shall have their corresponding peak discharges analyzed. Methods for controlling or routing off-site flows shall be incorporated into the report.

Post-Developed analysis of the site shall include methods used to determine post-developed peak storm flow values associated with the given rainfall frequency, assumptions and calculations of runoff characteristics and calculations for travel time and/or time of concentration.

Storm water discharge controls such as detention or retention facilities shall be included in the report. The analysis of such facilities shall include hydrograph routing through the

required storage to offset the quantity of runoff associated with the new development. Outlet controls shall be used to regulate the amount of discharge from such facilities.

Drainage Reports shall be prepared in accordance with the Cortez Storm Drainage Criteria (CSDC) as stated in Section 6.0.

3. A Traffic Impact Study - for the proposed development shall include the analyses to forecast, describe, and suggest ways of mitigating the traffic effects of the development within the geographic area. The traffic impact study shall also show ADT loading, necessary turning lanes, deceleration and acceleration lanes, and traffic lights/Signals.

4. An Environmental Impact Study, if required for the proposed development, may include the following:

Existing site geologic hazard areas describing potential erosion problems, high groundwater table or wetlands, flood hazard areas or flood zones, biological effects to wildlife and vegetation, archaeological or historic preservation analysis, and aesthetic considerations to the surrounding environment. The analysis of the site shall include plans and methods used to mitigate the environmental impacts associated with the proposed development.

5. A wetlands delineation report – prepared by an individual approved by the United States Army Corps of Engineers shall be submitted to the City Engineer.

*C - Improvements Agreement:*

Until such time as a segment of a subdivision street is officially accepted by the City, the developer or owner shall be fully responsible for the maintenance and correction of any faulty construction, including unsuitable street cuts, potholes, water line leaks, and sewer line blockages.

A Subdivision Improvements Agreement, (SIA) shall be obtained in accordance with the City of Cortez Land Use Code.

*D - Floodplain Development*

Development situated within a FEMA mapped flood hazard area within the City of Cortez requires that assurance be made that the development does not cause any adverse impact on the stream or cause flood water surface elevations to increase. The responsible party shall ensure that his procedures and methods of development comply with the Cortez Flood Hazard Ordinance.

All provisions and design calculations for flood control shall be established at the hydrologic point of interest to handle the 100-year frequency storm for the maximum period of intensity over the entire watershed the development lies within. Procedures for preparing floodplain information shall be based on acceptable hydrologic and hydraulic methods approved by the Colorado Water Conservation Board (CWCB).

Approximate methods for determination of floodplain information may be used for limited development such as parks, open space, golf courses, agriculture, bridges and culverts that serve a single home and single family structure.

Detailed methods for determination of floodplain information are required for significant development that does not fall under one of the categories listed under the limited development. Federal regulations require that developments involving more than 5 acres or more than 50 units submit a detailed study. Failure of the City to require a detailed study will result in a violation of the National Flood Insurance Program, which can have negative impacts and possibly higher insurance rates on floodplain property owners within the community.

### 2.1.7 – Liability:

*A – General:*

No person shall interfere with or relocate any existing line, pipe, or structure without the written consent of the owner in accordance with existing State laws and regulations. No facility owned by the City shall be moved to accommodate any responsible party unless the cost of such work is borne by the responsible party. The cost of moving privately owned facilities shall be similarly borne by the responsible party, unless other arrangements are made with the owner of the facility. Excavations shall be performed in such a way as to support and protect all pipes, conduits, poles, wires, or other apparatus which may be in any way affected by the excavation work, and do everything necessary to support, sustain, and protect them under, over, along, or across said work. The responsible party shall secure approval of the required method of support and protection from the owner of the facility. In case any of said pipes, conduits, poles, wires, or apparatus should be damaged, and for this purpose pipe coating or other encasement or devices are to be considered as part of the facility, the responsible party shall promptly notify the owner thereof.

*B – Indemnification:*

In no case shall any excavated opening made by a responsible party be considered in the charge or care of the City or any of its officers or employees, and no officer or employee is authorized in any way to take or assume any jurisdiction over any such opening, except in the exercise of the police power, or when it is necessary to protect life and property.

*C – Warranty:*

A maintenance agreement will be required in accordance with the Land Use Code.

## *2.2 – QUALITY REQUIREMENTS:*

### 2.2.1– Quality Control and Tolerances:

*A – Installation*

Construction within the City of Cortez shall be done in accordance with sound construction practices and in conformity with the specifications as listed in these standards. Performance of work for construction of public improvements or facilities shall be by persons qualified to produce the required and specified quality as specified herein. Work shall conform to applicable federal, state, and local codes for environmental and safety requirements such as but not limited to: disposal of debris, burning debris on-site, use of herbicides, and use of explosives to disintegrate rock.

*B– Tolerances:*

The control of products to produce acceptable work shall comply with the manufacturers' requirements. When manufacturers' tolerances conflict with the City specifications, the more stringent shall apply.

*C– Construction Meetings:*

Construction meetings shall be held at a set time and date as accepted by the City Engineer. Frequency of meetings may be changed depending on the scale and progress of construction.

## 2.2.2 – Inspection and Testing:

*A – Inspections:*

The City Engineer, or authorized City personnel, or other authorized inspectors shall make inspections as necessary. For street improvements, the responsible party shall work closely with the Engineer and give at least one working day's notice of inspections and greater notice whenever possible. For underground installation, the City recognizes that other agencies require inspections and the City's concern is that the surface is properly restored. Inspections may be requested by calling the Public Works Department during normal working hours.

It is the responsibility of the contractor or the developer to contact the City Inspector one day in advance of the required inspections. Failure to call for a required inspection may require the contractor to remove and replace improvements at the discretion of the City Engineer.

When the City Engineer finds that the materials furnished, work performed, or the finished product is not in conformity with the Contract and has resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by and at the expense of the Contractor.

*B – Required Inspections:*

Inspections shall be required prior to placing and after placing any improvements. Examples include but are not limited to: prior to placement and after placement of backfill, reconditioning of subgrade, ABC, pavement, concrete, utilities, lights, grass, grates, inlets, fire hydrants, sprinklers, valves, boxes, sprinkler systems, irrigation systems, signs, miscellaneous structures, retaining walls, and placement of any and all public improvements.

*C – Testing:*

When required by the City engineer, a recognized testing firm shall certify to the quality of materials or construction. All testing shall be by recognized methods and shall be at the contractor's, developer's, or owner's expense. When tests indicate that work does not meet specified requirements, the materials shall be reworked, or removed and replaced prior to retesting.

Location, frequency and types of test shall be as required by the City Engineer.

The general types of testing required for public improvements are as follows:

Culverts, Water Lines, Sewer Lines, all Utilities and Appurtenances – Compaction of bedding or backfill; Testing to be requested by certified tech. when backfill is completed to one-half the depth of culvert, water line, or sewer line; Pipeline testing for disinfection, 150 lb pressure test, and leakage.

Structures, Including Manholes, and all concrete work – Finished excavation, grade, forming, reinforcing steel, concrete pour, finish, and test cylinders. Inspections required: (1) prior to placing steel, and (2) prior to the concrete pour.

Roadway – Compaction of finished subgrade, subbase, base course and paving to be called for at each completed stage. Locations of required field tests will be determined by the City Engineer. Gradations, Atterberg Limits, and R-Value, etc. may be required. Proof rolling with pneumatic tire equipment shall be performed using a minimum axle load of 18 kips per axle. 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 recompaction, these areas shall be proof rolled again and all failures again corrected at the Contractor's expense.

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

Any observed yielding shall be removed and replaced as specified by the City Engineer.

Final – A request for the final inspection and acceptance for maintenance or release from bond must be made in writing to the City Engineer after all other inspections have been passed.

Laboratory material tests for soils/aggregates shall be in accordance with ASTM D698 or ASTM D1557 for the intended type of work. Field compaction tests shall be in accordance with ASTM D2922, ASTM D3017, or equal. Gradations shall be required for all fill material.

Laboratory material tests for concrete shall be in accordance with ACI 301

## *2.3 – PRODUCT REQUIREMENTS:*

### 2.3.1– Products:

Products used for construction of public facilities shall be furnished by qualified manufacturers and shall be suitable for the intended use. Materials and products used from existing premises may not be allowed except as specifically permitted by the City.

### 2.3.2– Product Delivery, Storage and Handling:

Products shall be transported and protected in accordance with the manufacturer's instructions to ensure that products are undamaged. All products shall be handled by personnel and equipment by proper methods.

### 2.3.3 – Product Options and Substitutions:

Whenever materials or equipment are indicated by the name of a proprietary item or the name of a particular Supplier, the naming of the item is intended to establish the type, function, and quality required. Substitution of materials or equipment may be permitted if sufficient information is submitted to allow the City Engineer to determine that the material or equipment proposed is equivalent or equal to that named.

The City Engineer will be the sole judge as to the type, function, and quality of any such substitution and may require additional data about the proposed substitution and/or a special performance guarantee or other surety with respect to any substitution.

## *2.4 – GENERAL CONSTRUCTION CRITERIA:*

This section covers the construction requirements within the City and site development for Subdivisions, PUD's and commercial/industrial projects. The design of subdivisions and of commercial/industrial projects shall be based on the endeavor to protect the health, safety, and welfare of the general public. The objective is to apply sound engineering principles with a commitment to safety and mobility needs, and simultaneously preserve and protect the environment and community concerns. All subdivision and site development projects shall conform to the applicable standards of the Cortez Land Use Code, zoning ordinance, floodplain ordinance, currently adopted building codes, and City standards.

### 2.4.1 – Excavation:

*A – Trench Cuts:*

Trenches across existing streets are to be made so that traffic is not closed. Short duration closure may be allowed by the City Engineer. Open trench cuts shall not exceed 50 feet beyond backfill and cleanup operations within an established residential area and/or paved street, except by special permission of the City Engineer. Trenches should be backfilled as soon as possible to eliminate potential hazards and traffic accidents. Where open trenches are allowed over night, proper traffic warning devices and barricading shall be used for the protection of work and safety of the public in accordance with the MUTCD and OSHA.

If moveable trench shields are used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and moved without binding against the trench sidewalls. If the trench walls cave in to slough, the trench shall be excavated as an open trench with sloped sidewalls or with trench shoring, as required by OSHA Safety and Health Standards for Construction.

*B – Pavement Cutting:*

Where trenches lie within the Portland Cement Concrete section of streets, alleys, driveways, or sidewalks, etc., such concrete shall be saw-cut (to a depth of not less than 2") to near, vertical, true lines in such a manner that the adjoining surface will not be damaged (i.e. saw-cut at existing joints). Dowling into adjacent concrete may be required at the discretion of the City Engineer. Asphalt pavement shall be clean-cut, clean, straight, and true at a minimum distance of one-foot wider than the trench on each side. No ripping or

rooting will be permitted outside limits of cuts. Surfacing materials removed shall be hauled from the jobsite immediately, and will not be permitted in the backfill.

*C – Site Excavation:*

Construction activities include clearing, grading, excavation, and other ground disturbance procedures shall comply with the following:

Topsoil and Subsoil shall be excavated from designated areas and stockpiled separately to prevent intermixing or contamination. Wet topsoil shall not be excavated. Excess excavated material not intended for, or not meeting requirements for reuse shall be removed from the site. Soil and aggregate materials shall be stockpiled individually to prevent mixing on site. Surface water shall be directed away from stockpiles to prevent erosion or deterioration of the materials. Unsuitable or hazardous materials shall be stockpiled on impervious material and covered until disposed of. Upon removal of stockpiles, the area shall be left in a clean and neat condition. The site surface shall be graded to prevent free standing surface water.

## 2.4.2 – Grading and Backfilling:

*A – General:*

All pavement cuts, openings, and excavations shall be properly made, backfilled, and a temporary surface installed by the responsible party according to the City regulations, design standards, and construction specifications. All excavations that are made in a public right-of-way must be completely restored subsequent to acceptance of backfill by the City Engineer.

Proof Rolling shall be performed as outlined in Section 203.09 of the Colorado Department of Transportation, *Standard Specifications for Road and Bridge Construction.* Any observed yielding shall be removed and replaced as specified by the City Engineer.

*B – Backfilling:*

Backfilling shall be done in accordance to the specifications as listed in these design standards. The responsible party shall backfill all cuts as soon as possible to allow normal traffic usage. Backfill material for structures and underground conduits shall meet or exceed specified requirements for the intended type of work.

It is the intent of these specifications that the backfill material will be uniformly moisture conditioned to optimum moisture content, placed in sufficiently thin layers to permit the specified relative compaction level throughout the depth of the lift. Lift depths shall not exceed eight (8) inches. Backfill material shall be compacted with hand and/or mechanical work methods using equipment such as rollers, pneumatic tamps, hydro-hammers, or other approved devices which secure uniform and required density without injury to the pipe or related structures.

Flooding or jetting of trenches shall not be permitted.

Trench backfill above the pipe zone in all existing platted City ROW, roadways, alleys, and driveways, shall be approved road base material (CDOT class 6 A.B.C), or approved flowfill material, for the full depth of the trench. The backfill material shall be compacted to at least ninety-five (95) percent of the maximum dry density for the material as defined by ASTM D1557.

All materials testing expenses shall be borne by the owner or contractor. The City Engineer may require additional tests be taken to substantiate compaction requirements, regardless of any other certifications or guarantees made by the owner or contractor. If the additional tests are passing, the City shall bear the costs.

*C – Earth Backfill Material:*

In new subdivisions or planned unit developments, trench backfill may consist of native material. The Contractor shall provide, at no cost to the City, a geotechnical report by a certified professional geologist that the material is suitable for trench backfill. The report shall include, but not be limited to, adequate compaction guidelines, optimum moisture content, and recommended testing frequency.

Earth backfill material shall consist of approved materials developed from project excavations or imported from another source. To be suitable for backfill, earth or earth and rock material shall be free from muck, frozen lumps, ashes, trash, vegetation, and other debris. All excavated materials which, in the opinion of the City Engineer, are unsuitable for use in the backfill shall be removed from the site and disposed of by the Contractor at his expense. The maximum size of rock or clod allowed within 6" of any plastic pipe shall be one (1) inch. The maximum size of rock or clod allowed within 6" of a rigid pipe or structure shall be three (3) inches. All backfill material shall be adjusted to within two percent (2%) of the optimum moisture content prior to its placement in the trench.

All backfill shall be frequently tested to insure that the required density is being attained. Minimum testing requirements shall be as follows: for every 200 lineal feet of trench and each branch or section of trench less than 200 lineal feet in length, at least one compaction test shall be performed for each two feet vertical of depth of backfill material placed. The first test shall be taken approximately two feet (2') above the top of pipe and the last test shall be at the pavement subgrade or six inches (6") below the ground surface in unpaved areas. If the geotechnical report recommends an alternate, the more restrictive (i.e. greater frequency of testing) shall apply. Compaction tests shall be taken at random locations along the trench and wherever poor compaction is suspected. If any portion of the backfill placed fails to meet the minimum density specified, the failing area shall be defined by additional tests, if necessary, and the material in the designated area shall be removed and replaced to the required density at the Contractor's expense.

Failed compaction tests shall be immediately reported to the City Engineer and the Contractor. A summary report of all compaction test results, including retests of failed tests and a test location map or other approved location format shall be submitted to the City Engineer and to the Contractor. Compaction test results are required as a basis of acceptance of infrastructure by the City.

*D – Site Fill:*

Construction activities include grading and placement of fill for supporting foundations or structures shall not be placed on soil material containing appreciable amounts of organic or other deleterious material, soft, yielding or frozen material. Irregularities in existing substrate gradient and elevation shall be corrected by scarifying, reshaping, and recompacting prior to placement of any fill material.

Fill materials shall meet or exceed specified requirements for the intended type of site work and samples may be required to be submitted to a testing laboratory to determine the suitability of the fill material for the intended application.

Existing slopes greater than 4:1 shall be benched horizontally to key placed fill material to the slope and provide firm bearing.

Fill material shall be placed in continuous layers at a maximum 8 inches compacted depth. The uniform compaction for subsoil fill, structural fill, and granular fill materials that will support structural components including paved areas shall be to a minimum of 90% of maximum density as defined by ASTM D1557 or to the specified compaction level recommended by the City Engineer. The optimum moisture content of fill materials shall be maintained in order to attain the required relative compaction level. The optimum moisture content of fill materials shall be maintained in order to attain the required relative compaction density. The slope away from buildings shall be graded at a minimum of 2% in 10 feet.

Prior to placing topsoil, all building, trench backfilling, and other site substrate base must be properly cleaned, contoured and compacted to eliminate uneven areas and low spots. Where topsoil is scheduled, the top 3 inches of the substrate surface shall be scarified.

## 2.4.3 – Pavement and Surface Replacement:

*A – Basis:*

Street re-surfacing on, or street cuts for utility lines shall be done in accordance to methods stated on the permit as issued. If the area to be resurfaced exceeds fifty percent (50%) of the total pavement surfacing in any block, the City Engineer may require the responsible party to resurface the entire block. Fifty percent (50%) or greater damage shall be deemed to require 100 percent (100%) restoration. This damage may be caused where trenches are laid in close proximity to one another, or where the equipment or method used causes damage.

*B – Preparation:*

If the existing subgrade is disturbed, a minimum of ten (10) inches of select base material shall be installed and thoroughly compacted to at least 95% of the maximum dry density as defined by ASTM D1557 immediately beneath the paving or concrete patch to be installed, and no less than the base course immediately adjacent to such cut will be acceptable.

In the event that asphaltic concrete base, soil cement base, or other base course materials be encountered by excavation, restoration shall be made in kind subject to the approval of the City Engineer

*C - Bituminous Pavement Patch*

Permanent hot mix asphalt cement patches shall be a minimum of three (3) inches in thickness, or not less than the hot mix asphalt cement adjacent to the excavation if the existing is >three (3) inches, and shall be installed in accordance with good construction practices and these specifications. Prior to replacement of the pavement, the exposed edges of the existing pavement and base course shall be neatly trimmed to a neat straight line by a saw cut.

*D - Concrete Pavement Patch*

When a concrete patch is used, the width shall be extended twelve (12) inches on each side of the undisturbed trench shoulders. The pavement edges shall be trimmed to form a uniform edge to allow better adherence between materials. Due care should be taken to assure that no voids or air pockets are left in the concrete or along the edge between concrete and asphaltic material. The patch shall be a minimum of eight (8) inch thick concrete with a minimum of 4500 psi compressive strength (C-DOT Class D).

*E - Gravel Streets*

In areas where existing gravel surfacing is removed from the streets the Contractor shall replace the graveled surfacing with material at least equal in depth and quality to that removed, but in no case shall the surface be less than ten (10) inches in thickness. The existing graveled surfacing may be salvaged and re-used if handled so as to prevent mixing with other excavated materials and approved by the City Engineer.

*F - Driveway Entrances*

Resurfacing of driveways and entrances crossed by the construction shall be performed as outlined above for bituminous surfaced streets and granular surfaced streets for the particular driveway and entrance involved.

*G - Other surface Improvements*

Driveways, sidewalks, or other surface improvements shall be replaced with a CDOT Class 6 base course, four (4) inches minimum.

Grassed Area – The upper six (6) inches of the trench shall be backfilled with topsoil, fertilized, and seeded. The seed shall be applied at the rate of one pound per 500 square feet and the area so seeded shall then be mulched with peat or an approved equal to retard evaporation of water. The seeding shall be done at a time approved by the City Engineer. In lieu of seeding, the Contractor may have the option of removing and replacing the existing sod or sodding the backfilled area if approved by the City Engineer.

## 2.4.4 – Adjusting Frames, Covers, and Valve Boxes:

*A – General:*

The Contractor shall notify the Owner prior to making necessary adjustments. The frames shall be set to grades approved by the City Engineer, or one-eighth (1/8) inch below finished pavement grade, in a manner hereinafter specified.

The Contractor may elect to remove old frames, covers, and valve boxes and to install new frames and/or boxes at no cost to the City.

*B - Adjusting Frames*

The contractor shall loosen frames in such a manner that existing monuments, cleanouts, or valve boxes will not be disturbed or manholes damaged. Should the frame or cover become damaged as a result of mishandling by the Contractor, it shall be replaced by the Contractor with a ring and cover of comparable weight, size, and quality at no cost to the City or property owner. Debris shall not be permitted to enter sanitary or storm drain conduits. All loose material and debris shall be removed from the excavation and the interiors of structures prior to resetting frames.

Manhole sidewalls that require adjustment shall be constructed of concrete grade rings. Additional manhole steps shall be added for each fifteen (15) inch increase in the height of the manhole sidewalls.

Manhole frames shall be left or lowered sufficiently below grade so as not to interfere with or form an obstruction to the preparation of the subbase, base, and pavement. The manhole openings shall be temporarily covered by suitable means and the work constructed there over. Due care shall be exercised to prevent foreign material from entering the manholes. After the pavement has been constructed, the necessary portions of the subbase, base, and

pavement shall be neatly cut away, the manholes built up, and the cover frames set to grade, following which any surrounding area from which the pavement base or subbase has been so removed shall be backfilled with concrete.

*C - Adjusting Valve Boxes*

Adjustable cast iron boxes shall, if possible, be brought to grade by adjustment of the upper movable section. It may be necessary to provide an extension to lengthen the box enough to match the required grade. An excavated area shall be filled with six-inch concrete to the level of the existing pavement, or as directed by the City Engineer.

### 2.4.5 – Underground Warning Tape and Tracer Wire:

*A – Basis:*

Underground warning tape shall be required in all utility trenches within City right-of-ways (ROWs) and easements. When replacing or repairing existing lines, warning tape shall be added during backfill. Service lines also require warning tape within the ROW. See Section 4.3.3

*B – Location*

The tape shall be placed approximately half-way between the top of the pipe and the surface. The City will inspect placement at the time. (See Figure 2.1 and 4.4)

*C – Type of Warning Tape and Tracer Wire:*

The underground warning tape shall be six inches (6") wide, .004" thick, and have the type of utility printed on the tape. Each utility shall use a specific color as listed in Table 2.1.

Tracer wire for PVC water mains shall be minimum 10-gauge solid copper for direct bury, wrapped around each joint of pipe and extended upward into valve boxes.

TABLE 2.1 COLOR CODES FOR MARKING UNDERGROUND UTILITY LINES

| | |
|---|---|
| Blue | Potable Water |
| Red | Electric |
| Orange | Communication CATV |
| Yellow | Gas-Oil-Steam |
| Purple | Irrigation, Reclaimed Water, Slurry Lines |
| Green | Sewer |
| Pink | Temporary Survey Markings |
| White | Proposed Excavation |

## *2.5 – TEMPORARY FACILITIES AND CONTROLS:*

### 2.5.1 – Temporary Traffic Control:

*A – Safety:*

It shall be the duty of every person performing street construction, utility work, maintenance operations, and incident management in or upon any public place, to place and maintain barriers and warning devices necessary for safety of the general public in accordance with the MUTCD. Said person shall be responsible for the furnishing of barriers and warning

devices through his own means. The responsible party shall take appropriate measures to assure that during the performance of the work, traffic conditions as near normal as possible shall be maintained at all times so as to minimize inconvenience to the occupants of the adjoining property and to the general public. The responsible party shall submit a traffic control plan prepared by a certified traffic control supervisor to the City Engineer for approval prior to commencement of work.

*B – Traffic Control Devices:*

- Traffic cones, drums, barriers, warning signs, lights, etc., shall conform to the requirements of the Federal Highway Administration as outlined in the "Manual on Uniform Traffic Control Devices"(MUTCD). During hours of low visibility (from one hour before sunset of each day to sunrise of the next day) the use of traffic cones, drums, flares, warning lights, electrical markers or flashers shall be used to indicate a hazard to traffic, delineate traffic lanes and to guide traffic.
- Warning signs shall be placed far enough in advance of the construction operation to alert traffic within a public street, and cones or other approved devices shall be placed to channel traffic, in accordance with the instructions of the City Engineer. Provide signs at approaches to site, at crossroads, detours, and elsewhere as needed to direct construction and affected public traffic.
- Relocate as work progresses, to maintain effective traffic control.
- Flag Persons - Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public street lanes.
- Haul routes - Consult with the Public Works Department to establish public streets to be used for haul routes and site access. Confine construction traffic to designated haul routes and provide traffic control at critical areas of haul routes to regulate traffic and/or to minimize interference with public traffic.
- Remove equipment and devices when no longer required.
- Remove post settings and repair damage caused by installation.

## 2.5.2 – Vehicular Access and Parking:

*A – Access to Site:*

- Construct temporary (all-weather) access roads from public streets to serve construction area, of sufficient width and load bearing capacity to accommodate traffic for construction purposes.
- Construct temporary bridges and culverts to span drainage areas to allow unimpeded storm water flows.
- Provide unimpeded access for emergency vehicles, maintain 12 feet wide (all-weather) traffic lane with adequate turning space.
- The use of designated on-site streets and driveways for construction traffic is permitted. Tracked vehicles are not allowed on paved streets without protection.
- Avoid traffic loading beyond paving design capacity.

*B – Parking:*

- Provide temporary (all-weather) surface parking areas to accommodate construction personnel. When site space is not adequate, designate additional off-site parking.
- Maintain traffic and parking areas in sound condition(free of excavated material, junk, debris, mud, snow, and ice)
- Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original or specified condition.

- Upon completion of the project, remove temporary materials and construction equipment.

## 2.5.3 – Environmental Controls for Construction:

- Obtain permits as required by the Colorado Department of Public Health and Environment
- Provide positive drainage and maintain excavations free of water.
- Execute work by methods to minimize raising dust from construction operations.
- Plan and execute construction by methods to control surface drainage from cuts and fills, and from borrow and waste disposal areas. Prevent erosion and sedimentation.
- Minimize surface area of bare soil exposed at one time.
- Provide temporary measures including berms, dikes, and drains, and other devices to prevent water flow.
- Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
- Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- Provide methods, means, and facilities to minimize noise produced by construction equipment and operations.
- Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
- Comply with pollution and environmental control requirements of authorities having jurisdiction.
- Comply with Archeological requirements of authorities having jurisdiction.

## 2.5.4 – Temporary Facilities:

- Provide Temporary utility service, water and sanitary facilities as required.
- Provide Field offices, sheds, Barriers, Enclosures and fencing as required.
- Remove temporary utilities, equipment, facilities, and materials, prior to final acceptance of work.
- Remove temporary underground installations and grade site as indicated on drawings or to prior conditions.
- Clean and repair damage caused by installation or use of temporary work.
- Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

# SECTION III
# STANDARD STREET SPECIFICATIONS

# 3.0 – STANDARD STREET SPECIFICATIONS

SECTION III – GENERAL; CLASSIFICATION; DESIGN CRITERIA; CONSTRUCTION MATERIALS; AND CONSTRUCTION METHODS

## *3.1 – GENERAL:*

### 3.1.1 – Description:

Road layout shall bear a logical relationship to existing or platted roads in adjacent properties and thoroughfare plan. The standards set forth in this section are to be used in the design and construction of new roads as well as guides in the improvements of existing streets and right-of-way. Arrangements of streets shall conform as nearly as possible to and be compatible with the Cortez Thoroughfare Plan. Access to buildings or lots shall front upon a dedicated public street in accordance with the Land Use Code. All construction plans for street improvements shall be approved by the City Engineer prior to beginning construction.

The provisions stipulated in this section are general in nature and shall be considered as applicable to all other parts of these specifications, including any supplements and revisions. All streets and appurtenances shall be designed by a Registered Professional Engineer, licensed to practice in the State of Colorado.

### 3.1.2 – Related Work:

*A. Maintenance of Existing Utilities: Section 2.1.5*

*B. Excavation, Trench Widths, Pipe Bedding, Shoring-Sheeting-Bracing: Section 2.4.1*

*C. Grading, Backfill and Restoration: Section 2.4.2 – 2.4.3*

*D. Quality Assurance: Section 2.2*

*E. Product Assurance: Section 2.3*

## *3.2 – CLASSIFICATION:*

### 3.2.1 – Local Streets:

The basic function of local streets shall be to provide direct access to adjacent properties and shall include cul-de-sac streets. Benefits derived from such streets will, therefore, most directly be reflected in such properties. Local streets offer the lowest level of mobility in such a manner that through traffic within the subdivision will be discouraged.

### 3.2.2 – Collector Streets:

The basic function of collector streets shall be to collect and distribute traffic between local and major streets. Collector streets will, therefore, be of general benefit to neighborhood areas and the entire community, as well as direct benefit to adjacent properties.

### 3.2.3 – Minor Arterials:

The basic function of minor arterial streets will be to permit relatively unimpeded traffic movement throughout the City connecting major land use elements and areas of the City with one another. Minor Arterial streets will, therefore, be principally of general benefit to the entire City.

## *3.3 – DESIGN CRITERIA:*

### 3.3.1 – Street System Parameters:

*A – Objective:*

The geometric design of City streets shall be based on the context of the proposed transportation facility. The objective is to apply sound engineering principles with a commitment to safety and mobility needs, and simultaneously preserve and protect the environment and community concerns.

*B – Subdivision Features:*

- Alleys – Alleys shall be provided if required by the City Engineer or Planning Commission. The minimum width of the alley shall be 20 feet. Dead-end alleys shall not be permitted. All alleys shall be graveled with a minimum surface width of 15 feet or as required by the City Engineer.
- Easements – Easements shall be provided for all utilities, drainage ways, channels, or streams which traverse across the subdivision.
- Block Lengths – The length, width, and shape of blocks shall be determined by the type of use, zoning requirements, needs for convenient access, circulation and safety of street traffic, and limitations and opportunities of topography. Minimum block lengths shall be 300 feet and not more than 450 feet.
- Cul-de-sacs – Cul-de-sac streets, however, shall not exceed 400 feet in length with provisions made for turning of emergency vehicles. Dead-end streets are prohibited unless they are to connect with future streets and shall be provided with a temporary turnaround surface diameter of 100' or "hammerhead" (T or Y) of 120'.
- Street and Right-of-Way Width – Street right-of-way must be sufficient to accommodate vehicular traffic, bicycles, pedestrians, public utilities, storm drain facilities and other special considerations such as medians, or traffic calming devices and acceleration/deceleration channelization. Street and right-of-way width shall conform to Table 3.2. Greater widths may be required by the City Engineer or when the need for such additional width is supported by a traffic study.
- Roundabouts – Roundabouts shall be designed is accordance with: *Roundabouts: An Informational Guide* (FHWA-RD-00-067). To obtain a copy of the document, contact the FHWA Report Center.

*C – Street Names:*

Street names shall not duplicate an existing street name in whole or part, unless the said street is an extension of the existing street. Street names shall be subject to the approval of the Planning Commission.

*D – Street Intersection Layout:*

- Streets shall be laid out so as to intersect as nearly as possible at right angles except where topography or other site conditions justify variations. In no case shall the angle of intersection vary more than thirty (30) degrees.
- Streets intersecting with centerline offsets from 10 to 125 feet shall be subject to approval by the City Engineer or Public Works Director.

- The safe operation of intersections requires that they be designed with adequate site distance. Two types of clear site triangles shall be considered in intersection design, approach site triangles, and departure site triangles. The dimensions of the legs of the sight triangles depend on the design speeds of the intersecting streets and the type of traffic control used at the intersection.
- The minimum intersection site triangle leg distance in feet shall conform to Table 3.1.

**TABLE 3.1 INTERSECTION SITE DISTANCE**

| Intersection | Description | 20 mph Design Speed | 25 mph Design Speed | 30 mph Design Speed | 35 mph Design Speed |
|---|---|---|---|---|---|
| Case 1 | No Traffic Control and Driveways | 90 (approaching triangle leg) | 115 | 140 | 165 |
| Case 2 | Left Turn from Minor Street w/ Stop Control | 225 (Major St. leg)<br>15 (Minor leg) | 280<br>15 (Minor leg) | 335<br>15 (Minor leg) | 390<br>15 (Minor leg) |
| Case 3 | Right Turn or Crossing from Minor Street w/ Stop Control | 195 | 240 | 290 | 335 |
| Case 4 | Left or Right Turn from Yield Control | 240 | 295 | 355 | 415 |
| Case 5 | Left Turns from Major Road | 165 | 205 | 245 | 285 |
| Case 6 * | All-Way Stop or Traffic Signal Control | 1st vehicle on each approach must be visible to the 1st vehicle on all other approaches | 1st vehicle on each approach must be visible to the 1st vehicle on all other approaches | 1st vehicle on each approach must be visible to the 1st vehicle on all other approaches | 1st vehicle on each approach must be visible to the 1st vehicle on all other approaches |

* If right turns on red are permitted, the departure sight triangle for right-turns from a stop, Case 3, should be provided.

** Objects within a sight triangle at a height of 3.5 feet above the adjacent roadway grade shall not be permitted except for traffic control devices.

## 3.3.2 – Horizontal Alignment:

*A – Objective:*

The major considerations in horizontal alignment design are: safety, grade profile, road type, design speed, sight distance, and topography. . All these factors must be balanced to produce an alignment that is safest, most economical, and adequate for the type of road proposed.

*B – Curvature:*

The minimum horizontal curve radius of street centerlines shall be as shown in Table 3.2. Horizontal alignment must provide at least the minimum stopping sight distance for the design speed at all points. This includes visibility at intersections, as well as around curves and roadside encroachments.

## 3.3.3 – Vertical Alignment:

*A – Objective:*

Street gradients and vertical curves shall relate to the natural topography in a practical manner to minimize the need for cuts or fills while being in accordance with a safe geometric design as shown in Table 3.2.

The grade line is the reference line by which the elevation of the pavement and other features of the road are established. It is controlled mainly by topography, the factors of horizontal alignment, safety, sight distance, design speed, drainage, and construction costs.

Grade Line – The profile grade line should be positioned with relation to the cross-section as follows:

- It should coincide with the road centerline on two-lane and multi-lane undivided roads.
- Separate grade lines may be required on divided multi-lane roads.

*B – Street Grades:*

Maximum and minimum grades are shown in Table 3.2 and shall be based on individual situations and topography. In no case shall the running slope of a street and its components exceed the following:

Minimum - - - - - - - - - - 1%
Maximum - - - - - - - - - - 7% (where practical)

Maximum grades at intersections shall be limited to 2% for 30'. Maximum grades may be exceeded for individual situations upon approval of the City Engineer.

*C – Vertical Curves:*

The minimum rate of vertical curvature is shown in Table 3.2. Properly designed vertical curves should provide adequate stopping and passing sight distance, headlight sight distance, driver comfort, good drainage, and pleasing appearance.

- Long, flat vertical curves should be avoided as they may develop poor drainage at the level section and tend to create driver insecurity in passing maneuvers.
- Grade changes with an algebraic grade difference of more than 2.5% shall be connected with vertical curves.
- Drainage on vertical curves needs careful profile design to retain a grade of not less than 1%.
- Unequal tangent vertical curves are permitted only in special circumstances as approved by the City Engineer.

## 3.3.4 – Sight Distance:

All portions of the grade line must meet sight distance requirements for the design speed. The minimum stopping sight distance is the distance required by the driver of a vehicle, traveling at a given speed, to bring his vehicle to a stop after an object on the road becomes visible. Stopping sight distance is measured from the driver's eyes, which are assumed to be 3.50-feet above the pavement surface to an object 2.0-foot high on the road. The required stopping sight distance for a given design speed shall be designed by the Engineer. Table 3.2 shows minimum stopping sight distances for different street classifications and assumptions.

## 3.3.5 – Crown Slopes:

| Type of Surface | Min. Crown | Max. Slope |
|---|---|---|
| Portland cement concrete | 1.5% | 4.0% |
| Bituminous mix pavements | 1.5% | 4.0% |

**TABLE 3.2 STREET DESIGN CRITERIA**

| Classification | Minimum Right of Way Width | Minimum Pavement Width | Minimum Vertical Curvature Rate, K | Minimum Centerline Horizontal Curvature | Minimum Stopping Sight Distance | Maximum Grades Per Cent | Design Speed mph |
|---|---|---|---|---|---|---|---|
| Cul-de-Sac | 130 (Diameter) | 110 (Diameter) | 17 Sag 7 Crest | 90 | 122 | 7 | 20 |
| Local Streets | 56 | 32 | 26 Sag 12 Crest | 165 | 168 | 7 | 25 |
| Collector | 60 | 36 | 37 Sag 19 Crest | 270 | 219 | 7 | 30 |
| Minor Arterial | 80 | 42 | 49 Sag 29 Crest | 415 | 266 | 5 | 35 |
| Minor Arterial | 80 | 42 | 64 Sag 44 Crest | 600 | 327 | 5 | 40 |

The values in this table are minimum requirements unless otherwise approved by the City

Horizontal curve values for all streets are based on low speed urban criteria with a normal crown section (assumes 0% super-elevation). Side friction factors based on AASHTO are 0.300 for 20 mph, 0.252 for 25 mph, 0.221 for 30 mph, 0.197 for 35 mph, and 0.178 for 40 mph design speeds respectively.

Vertical curve values based on rate of vertical curvature, K, which is the length of curve per algebraic difference in percent of intersecting grades, $K = L/(G_1 - G_2)$.

Minimum stopping sight distance values based on maximum downgrades and wet pavement conditions for the street design speed. This will automatically provide the appropriate SSD for traffic in both directions (SSD on downgrades is larger than on upgrades).

Roundabouts shall be designed is accordance with: *Roundabouts: An Informational Guide* (FHWA-RD-00-067) and subject to approval by the City Engineer.

## 3.3.6 – Clearances:

The following are minimum clearances to structures or other roadside obstructions. Additional clearance must be provided for sight distance and other requirements. Where streets or highways under the jurisdiction of other agencies are involved, the clearance as required by

said agency or the AASHTO Roadside Design Guide, if more restrictive than City standards, shall apply.

- Horizontal Clearance – The minimum horizontal clearance from the edge of traveled way should be 10 feet to the right and 4 feet to the left when facing in the direction of travel. An exception may be made where guardrail protection is provided.
- Vertical Clearance – The minimum vertical clearance to major overhead structures shall be 18 feet above the traveled way and 16 feet above the shoulders. For minor overhead structures, such as signs, cables, electrical lines, etc., the minimum vertical clearance shall be 18 feet.
- Corner clearances areas along intersection approach legs shall be clear of obstructions that might block a driver's view of potentially conflicting vehicles. These areas are known as clear site triangles and the dimensions of the legs depend on the design speeds and the types of traffic control used at the intersections. Minimum triangle leg distances are indicated in Section 3.3.1 and Table 3.1.

### 3.3.7 – Pavement Thickness Design:

The City engineer may require that a pavement thickness design be performed by an engineer registered in the State of Colorado depending on the size of the pavement project. The pavement design will incorporate a representative amount of soil sampling for the project site and potential different soil types/characteristics. Determination of the strength characteristics of the subgrade soil material (R-value, Resilient Modulus, CBR value, etc…) will be determined by a suitable soils testing laboratory. The strength characteristics of the subgrade material will be used in conjunction with a post development traffic analysis to determine an appropriate pavement section for the project. The following pavement section presented in Table 3.3 will be used if a project specific pavement design is not required by the City engineer.

TABLE 3.3 Minimum Asphalt Pavement Sections

| Street Type | Asphalt Depth | CDOT Class 6 Depth | CDOT Class 2 Depth | Reconditioned Subgrade Depth |
|---|---|---|---|---|
| Local and Cul-de-sac | 3 inches | 10 inches | 0 | 12 inches |
| (<200,000 18k ESAL's per 20 years) | 3 inches | 4 inches | 8 inches | 12 inches |
| Collector (<400,000 18 k ESAL's per 20 years) | 3 inches | 12 inches | 0 | 12 inches |
| | 3 inches | 4 inches | 10 inches | 12 inches |
| Minor Arterial | Pavement Analysis Required | | | |

Rigid Pavements shall be designed in accordance with the latest version of the CDOT Standard Specifications for Road and Bridge Construction.

## 3.3.8 – Concrete Work:

- Concrete work within any street, park, trail, or alley ROW or in any part of the water system, parks, and storm drainage system of the City shall meet the requirements of these Standards and Specifications.
- Engineering, plans, licenses, permits, inspection, warranties and acceptance shall be as detailed in these applicable Standards and Specifications for the type of construction involved.
- Permits shall be obtained before work begins. Responsible Party shall give the City Engineer twenty-four (24) hours notice and inspection shall be made before placement of concrete can occur.
- Inspector's approval to place materials shall be obtained by Responsible Party after inspection has been made and before concrete is placed.
- Rejection shall be given to Responsible Party in the event any aforementioned conditions given by the Engineer are not met, and work shall be halted until such time as corrective action is taken. Copies of the approved drawings and the permit shall be on the job site and available to the Inspector.

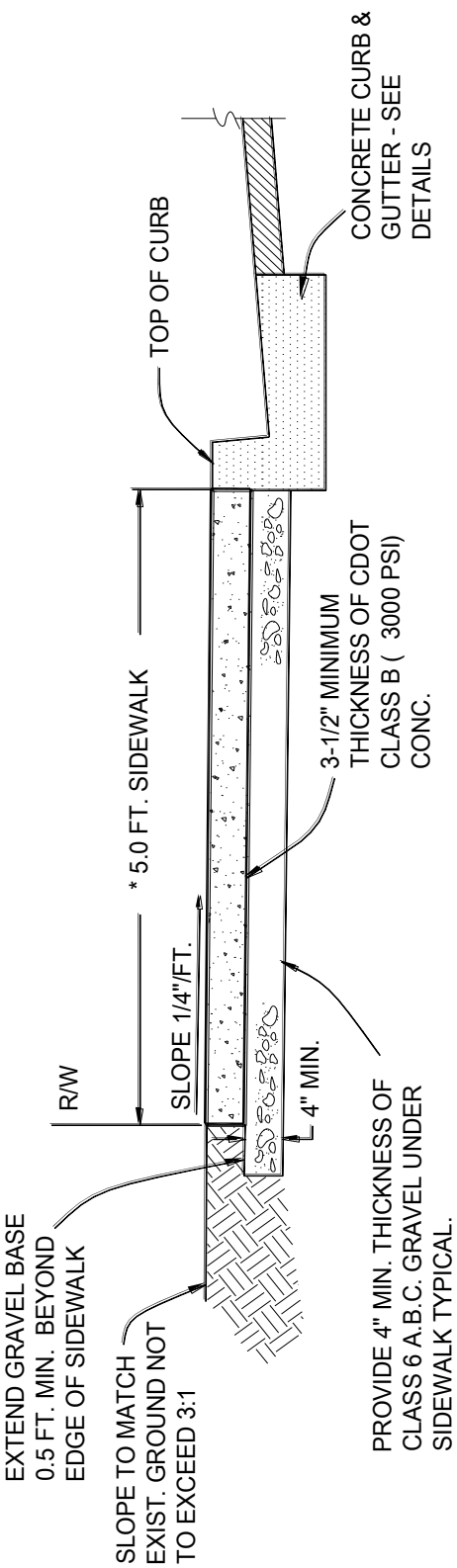
## 3.3.9 – Sidewalks:

*A – Design Parameters:*

Sidewalks are required in all new subdivisions. Residential sidewalks shall be constructed 4 feet wide with 3½-inch thick concrete. In commercial areas, the sidewalk width shall be at least 5 feet wide and may be required to be larger. Backfill and restoration of surface behind sidewalk to match existing conditions or as stated in the specifications. Minimum Class 6 A.B.C. under sidewalks shall be four inches and shall also extend six inches beyond edge of sidewalk as depicted in Figure 3.1. All sidewalks shall meet the minimum standards set by the ADA Accessibility guidelines.

*B – Special Features:*

- Sidewalk driveway interfaces shall be constructed to provide a minimum clear width across the driveway with a cross slope not to exceed 2%. See Figure 3.2 and 3.3.
- If roadside features such as hydrants, utility poles, etc. are situated within the sidewalk area, additional width shall be required to secure a minimum clear width of 3-feet.
- Additional width of sidewalks may be required by the City Engineer for City Trail Expansion.
- Sidewalks and curb ramps for roundabouts shall be designed in accordance with: *Roundabouts: An Informational Guide* (FHWA-RD-00-067) and the latest draft proceedings of the roundabout accessibility summit.




NOTE:

1. SIDEWALK WIDTHS SHALL BE 4 FT. MIN. AND MAY BE REQ'D TO BE AT LEAST 5 FT. WIDE IN AREAS OF HEAVY TRAFFIC, PARKS, SCHOOLS AND COMMERCIAL AREAS.
2. 1/2" EXPANSION JOINT MATERIAL SHALL BE PLACED AT 150 FOOT MAXIMUM INTERVALS.
3. BACKFILL AND RESTORATION OF SURFACE BEHIND SIDEWALK TO MATCH EXISTING CONDITIONS. SEE SPECIFICATIONS.
4. GRAVEL BASE (C-DOT CLASS 6) SHALL BE COMPACTED TO 95% OF MODIFIED PROCTOR (ASTM-D1557) .
5. CONTROL JOINTS AT 5 FOOT INTERVALS.

**FIGURE 3.1 TYPICAL CITY SIDEWALK**

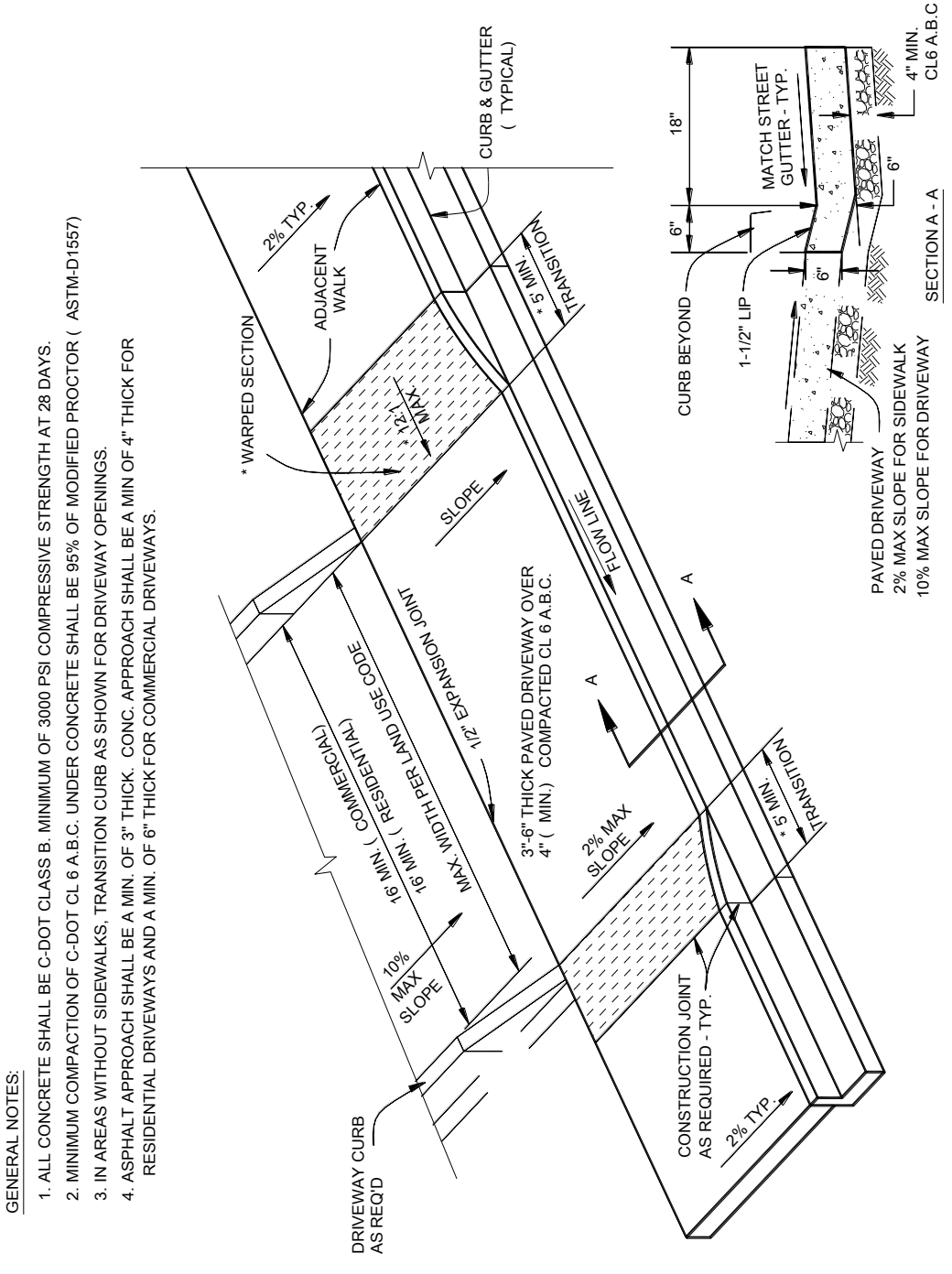



**FIGURE 3.2 CURB CUT DRIVEWAY/SIDEWALK INTERFACE**

## 3.3.10 – Curbs & Gutters:

Street curbs are to allow greater use of the available width and for control of drainage, protection of pedestrians, and delineation. Curb configurations shall be of the following:

- Vertical curbs – intended to discourage vehicles from leaving the roadway shall range from 6 to 8 inches in height.
- Roll-back curbs – for vehicles to cross over when the need arises such as at driveways. Mountable curbs heights shall range from 3 to 4 inches.

Approved types of concrete curb and gutter are required in all subdivisions. Exceptions may be made as part of a comprehensive storm water management plan when included in a planned unit development, or other situations and circumstances as determined by the City Engineer and approved by the Public Works Director. On divided streets, the type of median curbs shall be compatible with the intended use, drainage, and traffic control. Where curb and gutter sections are to be used, the minimum width shall be 24-inches. See Figure 3.4 and Figure 3.5.

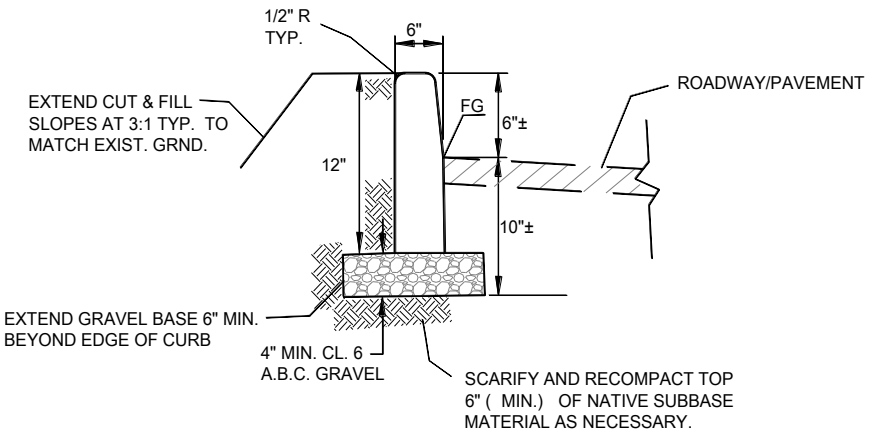
## 3.3.11 – Handicap Ramps:

Sidewalk curb ramps shall be provided at crosswalks to accommodate persons with disabilities as required by the American Disabilities Act, ADA. Such ramps should be the same width of the approach sidewalk and not be less than a minimum width of 3-feet exclusive of the side slopes as shown in Figure 3.6. Detectable warnings must be placed whenever a walkway crosses a vehicular way, at all curb ramps, medians, and islands. Detectable warnings must consist of ADA-compliant truncated domes.

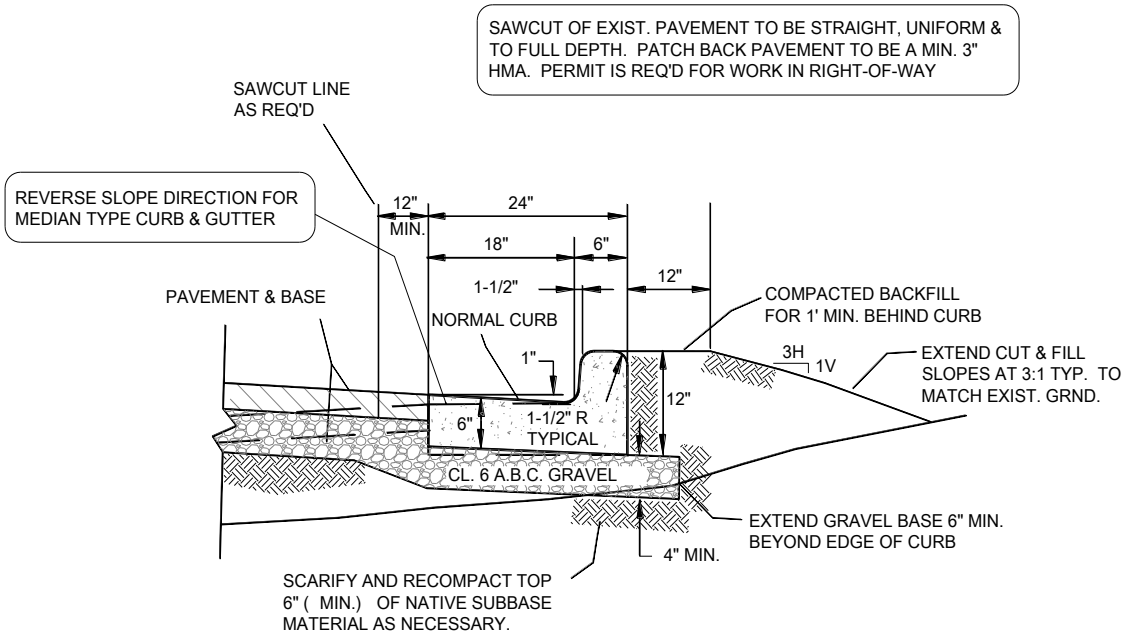
Where pedestrian and/or vehicular volumes are moderate to high, use of a ramp located at the middle of the curb radius is discouraged and the use of ramps at the ends of the curb radius shall be required.

## 3.3.12 – Concrete Pan:

Concrete gutter pans shall be provided at intersections or driveways as indicated on the plans. The concrete spandrel area at the curb returns shall be a monolithic pour with the curb. The minimum concrete thickness shall be six (8) inches and shall be reinforced as indicated in Figure 3.6.



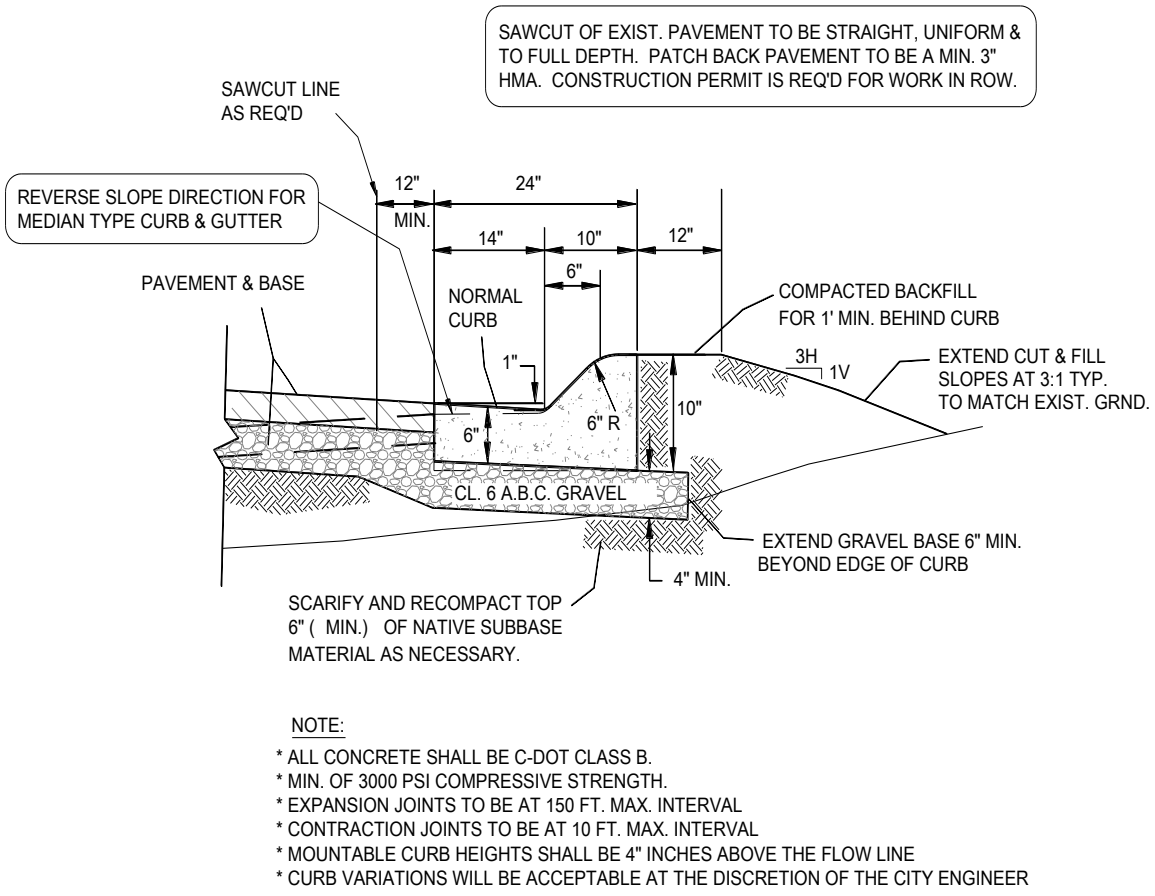

STAND-UP CURB ( 6" BARRIER)




NOTES:

* ALL CONCRETE SHALL BE C-DOT CLASS B 3000 PSI COMPRESSIVE STRENGTH.
* EXPANSION JOINTS TO BE AT 150 FT. MAX. INTERVAL.
* CONTRACTION JOINTS TO BE AT 10 FT. MAX. INTERVAL.

**FIGURE 3.3 VERTICAL CURBS**




NOTE:

* ALL CONCRETE SHALL BE C-DOT CLASS B.
* MIN. OF 3000 PSI COMPRESSIVE STRENGTH.
* EXPANSION JOINTS TO BE AT 150 FT. MAX. INTERVAL
* CONTRACTION JOINTS TO BE AT 10 FT. MAX. INTERVAL
* MOUNTABLE CURB HEIGHTS SHALL BE 4" INCHES ABOVE THE FLOW LINE
* CURB VARIATIONS WILL BE ACCEPTABLE AT THE DISCRETION OF THE CITY ENGINEER

**FIGURE 3.4 ROLL BACK CURB**

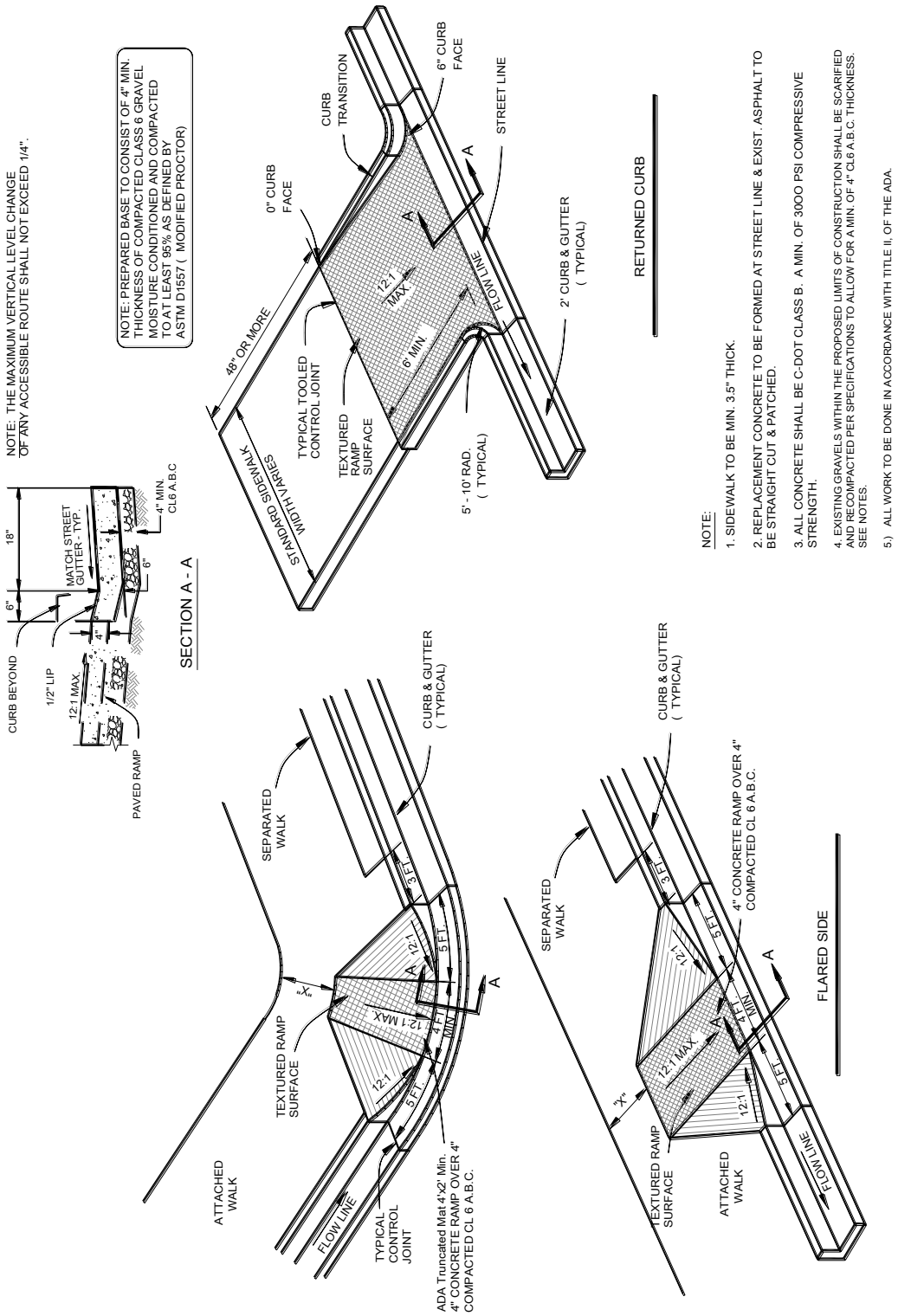



**FIGURE 3.5 ADA SIDEWALK RAMPS**

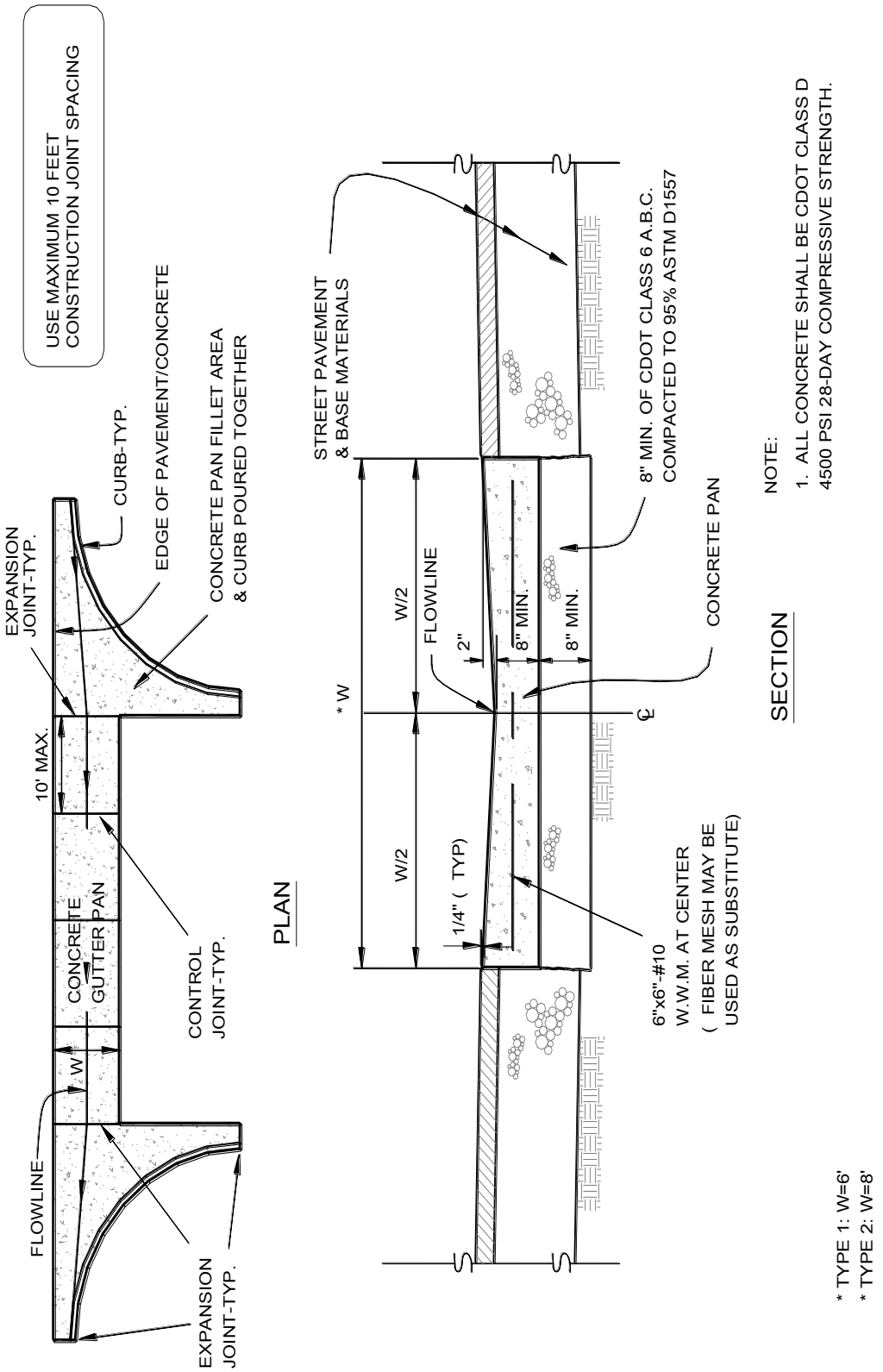



**FIGURE 3.6 CONCRETE GUTTER PAN**

## *3.4 – CONSTRUCTION MATERIALS:*

Construction materials shall meet the requirements of Section 106 Control of Material as stated in the Colorado Department of Transportation, *Standard Specifications for Road And Bridge Construction (2005)* along with the revision of Section 106 Certificates of Compliance and Certified Test Reports dated June 29, 2006, is hereby adopted by reference.

### 3.4.1 – Asphalt:

#### *A – General:*

These specifications cover the requirements for the construction of Superpave Hot Mix Asphalt (HMA) pavements. They include the general requirements for the construction of one or more lifts of HMA pavement on a prepared surface. A mix design shall be composed of well graded aggregate, mineral filler, anti-stripping agent (if required), asphalt binder and meet the requirements of Table 3.3. A mix design shall be submitted to the Engineer for approval prior to beginning paving operations.

#### *B – Materials:*

- All materials shall conform to the latest Colorado "Standard Specifications for Road and Bridge Construction", prepared by the State Department of Highways.
- Asphalt concrete shall be from an approved mix design stating the volumetric properties, optimum asphalt content, job mix formula with associated target values, and recommended mixing and placing temperatures in accordance with the superpave procedures (Asphalt Institute Manual SP-1).
- Asphalt Aggregate materials shall conform to CDOT Grading SX and S specifications. Aggregate properties shall meet CDOT requirements and be of uniform quality, clean, hard, durable particles of crushed stone, crushed gravel, natural gravel or crushed slag free from clay balls, vegetation or other deleterious materials meeting the requirements in Table 3.4. The mix design shall meet the requirements of Table 3.5 for voids in mineral aggregate.
- Asphalt Binder shall be non-modified Grade PG 64-22 or PG 58-28. Any asphalt binder supplied must be from an approved source certified by CDOT.
- If mineral filler is required, it shall conform to the requirements of AASHTO M17. It shall consist of rock dust, slag dust, hydrated lime, hydraulic cement, fly ash or other suitable mineral matter. Mineral filler shall have a plasticity index not greater than four (4) excluding hydrated lime and hydraulic cement. Mineral filler shall meet the grading requirements of CDOT.
- Additives to the mineral aggregate shall be added if the asphalt binder will not coat or stick to the aggregates. Additives shall be either Hydrated Lime or Anti-Stripping Agent. Hydrated lime shall conform to ASTM C207, Type N. The residue retained on a #200 sieve shall not exceed 10% in accordance with ASTM C110. When required, hydrated lime shall be added at the rate of 1% by dry weight of the aggregate. Liquid Anti-Stripping Agent shall conform to CDOT requirements.
- Bituminous curb shall be constructed of the same gradation of aggregate and the same grade of bituminous material as the top layer or top course of bituminous pavement used on the project.

## TABLE 3.3 SUPERPAVE MIXTURE PROPERTIES

| | Traffic Levels | |
|---|---|---|
| **Test Property** | Trails and Pathways | Low, Moderate, Parking Lots |
| Traffic Level – Design Period ESAL's | < 100,000 | < 3 million |
| Initial Gyrations, $N_{ini}$ | 6 | 7 |
| Air Voids @ $N_{ini}$ | > 8.5 | > 9.5 |
| Design Gyrations, $N_{des}$ | 50 | 75 |
| Hveen Stability, CDOT L5106 | NA | 28 minimum |
| Voids Filled w/Asphalt, VFA, MS-2 | 70-80 | 65-78 |
| Lottman, Tensile Strength Ratio % Retained | 80 minimum | 80 minimum |
| Lottman, Dry Tensile Strength, psi, | 30 min. | 30 min. |

## TABLE 3.4 HMA AGGREGATE PROPERTIES

| **Property** | **Test Procedure** | **Coarse Retained on #4 Sieve** | **Fine Passing #4 Sieve** |
|---|---|---|---|
| Fine Aggregate Angularity<br><br>Traffic Level Low, Trails and Pathways<br><br>Traffic Level Moderate To High, Parking Lots | CDOT-L5113 Method A | | 40% Minimum<br><br>45% Minimum |
| Fractured Faces | CDOT-45 | 80% Minimum | |
| LA Abrasion | AASHTO T96 | 45% Minimum | |
| Sodium Sulfate Soundness | AASHTO T104 | 12% Maximum Combined Coarse and Fine | |
| Flat & Elongated Pieces | AASHTO M283 | 10% Maximum | |
| Adherent Coating | ASTM D5711 | 0.5% | 45% Minimum |
| Sand Equivalent | AASHTO T176 | | 45% Minimum |

## TABLE 3.5 VOIDS IN MINERAL AGGREGATE

| **Nominal Maximum Particle Size** | **Minimum VMA, %** | | |
|---|---|---|---|
| | Design Air Voids, % | | |
| | **3.0** | **4.0** | **5.0** |
| ½" | 13 | 14 | 15 |
| ¾" | 12 | 13 | 14 |
| 1" | 11 | 12 | 13 |
| The nominal maximum particle size is one sieve size larger than the first sieve to retain more than 10 percent | | | |

## 3.4.2 – Concrete:

*A – General:*

The work covered by this section consists of concrete within any street, park, trail, or alley ROW or in any part of the water system, wastewater system, parks, and storm drainage system of the City. Concrete shall be composed of Portland cement, aggregate, and water, and shall be reinforced with steel bars, steel wire fabric or fibrous reinforcing where required. No admixture other than air-entraining agents shall be used without permission of the City Engineer. Unless otherwise specified, concrete shall be CDOT Class B and have a minimum crushing strength at 28 days of 3000 psi. Concrete mix design shall be approved prior to being incorporated into work.

*B – Specifications:*

- Cement used in concrete work will be Portland cement conforming to the requirements of ASTM C-l50, Type I, IA, Type I/II modified, II, Type V, or IIA. In general, Type II or IIA shall be used in concrete which shall be in contact with the soil, unless otherwise allowed or directed by the Engineer.
- Cement, which for any reason has become partially set or which contains lumps of caked cement, shall be rejected.
- The Responsible Party shall be responsible for the proper storage of cement until it is used. No damaged cement shall be used in the work, and such cement shall be immediately removed from the site when so ordered by the Engineer.
- When requested by the Engineer, the Responsible Party shall, at his own cost and expense, furnish the Engineer with a certificate from an acceptable testing laboratory for each load of cement from which cement is taken for use in the work, stating that the cement meets the requirements of these Standards and Specifications for Portland cement.

*C – Ready-Mixed Concrete:*

- The use of ready-mixed concrete in no way relieves the Responsible Party of the responsibility for proportion, mix, delivery, or placement of concrete; concrete must conform to the requirements of these Standards and Specifications and ASTM C-94.
- Concrete shall be continuously mixed or agitated from the time the water is added until the time of use and shall be completely discharged from the truck mixer or truck agitator within one and one-half (1½) hours after it comes in contact with the mixing water or with the aggregates. Retempered concrete shall not be allowed.
- The City shall have free access to the mixing plant during times of operation. The organization supplying the concrete shall have sufficient plant and transportation facilities to assure continuous delivery of the concrete at the required rate. (The Responsible Party shall collect the delivery, or batch tickets from the driver for concrete used on the project and deliver them to the Engineer).
- Batch tickets shall provide the following information:
    l.) Weight and type of cement and fly ash;
    2.) Weights of fine and coarse aggregates;
    3.) Volume (in gallons) of water including surface water on aggregates;
    4.) Quantity (cubic yards) per batch;
    5.) Times of batching and discharging of concrete;
    6.) Name of batch plant;
    7.) Name of consumer;
    8.) Type;
    9.) Name and amount of admixture; and
    10.) Date and truck number.

11.) Water added.

*D – Water:*

Water for concrete shall be clean and free from sand, oil, acid, alkali, organic matter, or other deleterious substances. Water from public supplies or water which has been proven to be suitable for drinking is satisfactory.

*E – Admixtures:*

- The supplier shall use air-entraining admixtures for concrete that will have exposed surfaces.
- The Responsible Party may elect to use another admixture provided the admixture is specifically approved by the Engineer.
- Admixtures to be used for plasticizing, densifying, or acceleration of hardening of concrete shall, when added to the mixture, produce a concrete of specified strength in seven (7) day and twenty-eight (28) day tests.
- Documented evidence of acceptability shall be required when new or unknown admixtures are proposed for use.
- Air-entraining admixtures shall conform to the requirements of ASTM C-260.

*F – Aggregate:*

- Aggregate materials for concrete work shall conform to the latest issues of the Colorado "Standard Specifications for Road and Bridge Construction", prepared by the State Department of Highways.
- Fine aggregate shall be composed of clean, hard, durable, uncoated particles of sand, free from injurious amounts of clay, dust, soft or flaky particles, loam, shale, alkali, organic matter, or other deleterious matter. Fine aggregate shall be well graded from coarse to fine and when tested by means of laboratory sieves shall meet the CDOT Concrete Aggregate Gradation Table and shall also conform to AASHTO M6:
- The coarse aggregate shall consist of broken stone or gravel composed of clean, hard, tough and durable stone and shall be free from soft, thin, elongated or laminated pieces, disintegrated stone, clay, loam, organic, or other deleterious matter. Coarse aggregate shall conform to the CDOT Concrete Aggregate Gradation Table 703.1 except the maximum aggregate size shall be one (1) inch, which shall also conform to AASHTO M80.

*G – Fibrous Reinforcing:*

- Fibrous reinforcing may be used in Portland cement concrete used for curb, gutter, sidewalks, curb turn fillets, cross pans, and valley gutters.
- The fibrous concrete reinforcement materials should be added at the rate of 1.5 lbs of fiber to each cubic yard of each type of concrete.
- The City Engineer shall require one (1) copy of each batch delivery ticket indicating amount of fibrous concrete reinforcement material added to each batch of concrete.
- Fibrous concrete reinforcement shall consist of:
  1. One hundred (100) percent virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no reprocessed olefin materials.
  2. Fibrous concrete reinforcement shall be as manufactured by Fibermesh Company, or approved equivalent. Substitutions may be considered at the discretion of the Engineer.

3. Fibrous concrete reinforcement materials provided by this subsection shall produce concrete conforming to the requirements for each type and class of concrete required as indicated.

*H –Reinforcing Steel and Forms:*

Reinforcing Steel:

- Before being positioned, reinforcing steel shall be thoroughly cleaned of mill and rust scale and of coatings that will destroy or reduce the bond.
- Where there is delay in depositing concrete, reinforcement shall be re-inspected and, if necessary, cleaned.
- Reinforcement shall be carefully formed to the dimensions indicated on the plans by the cold bending method.
- Reinforcement shall not be bent and then straightened. Bars with kinks or bends not shown on the plans shall not be used.
- Precast mortar blocks, or other non metal supports not approved by ACI shall not be allowed to remain in the concrete placement.
- Reinforcing steel shall be accurately placed and secured against displacement by using annealed iron wire of not less than No. l8 gauge, or by suitable clips at intersections. Where necessary, reinforcing steel shall be supported by metal chairs or spacers, approved precast mortar blocks, or metal hangers.
- Splicing of bars, except where shown on the plans, shall not be permitted without approval of the Engineer.
- Responsible Party shall submit to the City Engineer shop drawings of the reinforcement for his approval. The Engineer's approval of shop drawings and bar schedules shall not relieve the Responsible Party of fulfilling his responsibilities as outlined in the plans and specifications.

Welded Wire Fabric:

- Welded wire fabric for concrete reinforcement shall be of the gauge, spacing, dimensions, and form specified on the plans or detailed drawings and shall comply with "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement" (ASTM A-741) or "Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement" (ASTM A-497).

Clear Cover:

- Unless otherwise shown on the plans, the minimum clear cover for reinforcing steel shall be the following, which is specified in ACI 30l, Section 5.5:
    1. Bottom bars on soil bearing foundations and slabs, three (3) inches
    2.  Bars adjacent to exposed surfaces or earth backfill: For bars more than three-quarter (¾) inch in diameter, two (2) inches. For bars three-quarter (¾) inch or less in diameter, one and one-half (1½) inches
    3.  Interior Surfaces: slabs, walls, joints with one and three-eighths (l 3/8) inch diameter or smaller, three quarter (¾) inch

Forms:

- Whenever necessary, forms shall be used to confine the concrete and shape it to the required lines.
- Forms shall have sufficient strength to withstand, without deformation, the pressure resulting from placement and vibration of the concrete.
- Forms shall be constructed so that the finished concrete shall conform to the shapes, lines, grades and dimensions indicated on the approved plans.

- Any form which is not clean and has not had the surface prepared with a commercial form oil that shall effectively prevent bonding and that will not stain or soften concrete surfaces shall not be used.
- Plywood forms, plastic coated plywood forms, or steel forms shall be used for surfaces requiring forming which are exposed to view, whether inside or outside any structure. Surfaces against backfilled earth, interior surfaces of covered channels, or other places permanently obscured from view, may be formed with forms having substandard surfaces.
- Forms shall not be disturbed until the concrete has hardened sufficiently to permit their removal without damaging the concrete or until the forms are not required to protect the concrete from mechanical damage.
- Minimum time before removal of forms after placing concrete shall be one (1) day for footings and structures that do not resist dead load bending, and two (2) days for other concrete street structures except in curbs, gutters, sidewalks and pavements where forms shall not be removed until the concrete is strong enough to withstand potential damage.
- The use of slip forms and concrete paving machines shall be allowed, with approval of the Engineer.
- Forms shall be of wood, metal, or other suitable material, and shall extend for the full depth of the concrete. All forms shall be straight, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

*l – Joints:*

Joint materials shall conform to AASHTO, ASTM Specifications according to type as follows:

- AASHTO / ASTM
- Concrete joint sealer, hot poured elastic or 888 M l73 / D1190-74
- Corning Cold or approved equivalent
- Preformed expansion joint filler (Bituminous Type) M 33 / D994-71
- Preformed sponge rubber and cork expansion M l53 / D1752-67 joint fillers
- Preformed expansion joint fillers - nonextruding and resilient bitumen M 2l3 / D1751-73

### *3.4.3 – Sidewalks and Bikeways:*

Concrete for sidewalks, bikeways, and curb ramps shall meet the requirements of Section 3.4.2. Bituminous material for sidewalks, bikeways, and curb ramps shall meet the requirements of Section 3.4.1. Concrete and bituminous mixes will be subject to inspection and tests as required to assure compliance with quality requirements.

### 3.4.4– Curb & Gutter:

Cast-in-place concrete for curb shall meet the requirements of Section 3.4.2, except that when curb machines are used, a lesser slump will be permitted. Bituminous curb mixes shall meet the requirements of Section 3.4.1. Concrete and bituminous mixes will be subject to inspection and tests at the plants for compliance with quality requirements.

### 3.4.5 – Flowcrete / Flowfill Concrete:

The following Table 3.6 is the specification of the flowcrete/flowfill concrete. Mix Proportions: (per cubic yard of concrete)

**TABLE 3.6 FLOWFILL CONCRETE MIX PROPORTIONS**

| Material ASTM | Specification Weight |
|---|---|
| Cement ASTM C150 | 60 lbs |
| Sand ASTM C33 | 1845 to 1850 lbs |
| Aggregate ASTM C33 | 1700 to 1750 lbs |
| Air Entrainment ASTM C260 | 5.0 ounces |
| Water ASTM C94 | 39 gallons |

DESIGN PHYSICAL PROPERTIES: Slump shall be six (6) to eight (8) inches

Use of flowfill within the City ROW will be subject to approval of the City Engineer.

### 3.4.6 – Base Course:

Base Course shall meet the requirements of CDOT Class 6, as specified in the most current edition of the Colorado Department of Road and Bridge Construction, *Standard Specifications for Road and Bridge Construction.* Acceptance will be contingent upon approval of submitted gradations, Atterberg Limits, and compaction to 95% of the Modified Proctor ASTM D1557.

## *3.5 – CONSTRUCTION METHODS:*

### 3.5.1 – Clearing and Grubbing:

*A – General:*

- Clearing and grubbing shall consist of removing trees, stumps, brush, roots, rubbish, and other objectionable matter from the right-of-way and such other areas as may be designated. Clearing and grubbing shall be performed in advance of grading operations and in accordance with the requirements herein specified, subject to erosion control requirements.
- Within the right-of-way or limits established by the Engineer all stumps, large roots, buried logs and all other objectionable material shall be removed 24 inches (24") below subgrade or slope of embankments, or as directed by the City Engineer.
- Tree branches extending over the roadway, which hang within 20 feet of the profile grade or that restrict sight distance, shall be cut off close to the trunk or stem of the tree in a neat workmanlike manner and in accordance with good tree surgery practices. Scars resulting from the removal of branches shall be treated with an approved asphalt base paint prepared especially for tree surgery.

*B – Preservation of Property:*

Existing improvements, adjacent property, utility and other facilities, and trees and plants that are not to be removed shall be protected from injury or defacement or damage resulting from the contractor's operation.

*C – Removal and Disposal of Materials:*

- All materials removed for construction purposes shall be legally disposed of except that suitable material which may be salvaged for riprap or bank protection as ordered by the City Engineer. The roadway and adjacent areas shall be left with a neat and finished appearance.
- The contractor may remove existing fences, pipes, aprons, curbs and/or gutters, sidewalks, and other similar items, the removal of which is necessary in connection with construction of the project upon approval of the City Engineer. Culvert pipe, castings

and items suitable for reuse shall be protected from damage and be salvaged. All salvaged items within the Public Right-of Way shall be the property of the City and delivered to a destination approved by the City Engineer at no cost to the City.

## 3.5.2 – Excavation and Grading:

*A – General:*

Excavation and grading shall be in accordance with Section 2.4.This item shall consist of all excavation and grading of whatever nature, above or below subgrade elevation, required to bring the street, alley, curb, gutters, sidewalks, ditches, or other areas to be constructed to the proper subgrade elevation, construction of embankments, excavation and proper sloping of all cuts, and other items of excavation not separately designated.

*B – Excavations:*

All excavations shall be made to subgrade elevations and shall be true to grade. Material below subgrade elevation in deep cuts of undisturbed soils shall not be loosened by plowing, ripping or other methods during the progress of the work except with the approval of the City Engineer. No excavation shall be made below subgrade elevation except to remove unsuitable material as ordered by the Engineer. In the event the contractor does excavate any other area below subgrade elevation, he shall replace the excavated material with satisfactory material and shall thoroughly compact the same.

*C – Unsuitable Material:*

Material that is unsuitable for the planned use shall be excavated and disposed of as directed by the City Engineer. Stabilization of poor subgrade soils may be accomplished by the addition of an appropriate binder such as lime, Portland cement, or emulsified asphalt to increase the stiffness and/or reduce swelling tendencies.

*D – Base Course:*

- Marginally poor subgrade soils may be compensated for by using additional base layers consisting of crushed stone or recycled pulverized asphalt/gravel. The base course is immediately beneath the surface course (HMA) and provides load distribution as well as contributes to drainage and frost resistance.
- The subbase course is between the base course and the subgrade. It functions primarily as structural support but can also minimize the intrusion of fines from the subgrade, improve drainage, minimize frost action damage and provide a working platform for construction equipment. The subbase course consists of lower quality materials than the base course but better than the subgrade.
- The subbase layer may not be needed or used for a pavement over a high quality, stiff subgrade. However, a pavement constructed over a low quality subgrade soil may require either the removal of the soil to a satisfactory depth or the use of a subbase course.

*E – Excavation Below Subgrade:*

Whenever excavation below subgrade elevation to remove unsuitable material is ordered by the City Engineer, the contractor shall remove the same to the satisfaction of the Engineer and shall replace it with satisfactory material in layers not to exceed six (6) inches in thickness, or as designated by the Engineer, and shall thoroughly compact each layer to 90% relative compaction of the Modified Proctor, ASTM D1557, (AASHTO Designation: T180) before the next layer is placed.

*F – Surplus Material:*

Unless otherwise shown on the plans or specified in the Special Provisions, no surplus excavated material may be disposed of within the right-of-way unless approved by the City Engineer.

*G – Embankments*:

Embankments shall be constructed up to subgrade elevation in layers not to exceed six (6) inches to twelve (12) inches in thickness depending on the type of compaction equipment used, and shall be compacted for the full width of the embankment. Each layer of the embankment shall be thoroughly compacted to 90% relative compaction based on a modified Proctor (ASTM D1557). Embankment fill material shall be placed at + or – two (2) percent of the optimum moisture content for that material. When borrow is required it shall be taken from a source approved by the Engineer.

*H – Compaction of Subgrade:*

After excavating has been completed to approximate grade, upon direction of the Engineer, the subgrade shall be scarified to the depth of not less than six (6) inches, properly moisture conditioned, and compacted until a density equal to 90% relative compaction based on a Modified Proctor Method ASTM D1557 (AASHTO) Designation: T180) is obtained in the upper twelve (12) inches. Areas of yielding or pumping soil material shall either be removed or scarified and properly moisture conditioned for re-compaction. The City Engineer may require a pavement design at his discretion.

*I – Subgrade for Curbs, Gutters, and Sidewalks:*

- The subgrade shall be constructed true to grades and lines shown on the plans. All construction debris, organic material or soils containing appreciable amounts of deleterious material, or soft soil material, shall be removed to a depth of not less than six (6) inches below subgrade or, when necessary in the opinion of the City Engineer, to a greater depth and replaced with material satisfactory to the Engineer.
- The finished subgrade under curb and gutter shall be compacted to 90% of maximum density as determined by the Modified Proctor Method (ASTM D1557).
- Subgrade areas occupied by sidewalks shall be excavated, backfilled, and compacted to established grade. This work shall be done with particular care in accordance with all requirements herein. Subgrade under sidewalks shall be compacted to 90% of the density as determined by the Modified Proctor Method ASTM D1557 (AASHTO Designation: T180).
- Filled sections shall be compacted and compaction shall extend a minimum of one (1) foot outside the form lines
- Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The foundation shall be shaped and compacted to a firm even surface conforming to the section shown on the plans or as staked. When the Engineer determines that subgrade material is unsuitable for the intended purpose, the material shall be removed and replaced in accordance with subsection C above.

*J – Slopes:*

Excavation slopes shall be finished in conformance with the lines and grades shown on the plans. All debris and loose material shall be removed. Fill slopes shall be constructed in conformance with the lines and grades shown on the plans. In general slopes shall be built to 4:1 maximum.

*K – Dust Control:*

The Contractor shall provide and maintain adequate dust control at all times during construction operations. Dust control may be accomplished by water sprinkling or by other means approved by the City Engineer.

## 3.5.3 – Asphalt Paving:

A – *Subgrade and Aggregate Base:*

Subgrade shall be prepared as specified and applicable to roadways. The surface of the subgrade after compaction shall be hard, uniform, smooth, and crowned to the specified finished road crown grade to permit the full specified section of aggregate base course and asphalt thickness. Subgrade for pavement shall not vary more than 0.04 foot for the specified grade and cross-section as shown on the plans.

Aggregate base course shall be provided where shown and to the thickness specified. Aggregate bases shall be delivered to the job site as uniform mixtures and each layer of specified thickness shall be spread in one operation. Segregation shall be avoided and the base shall be free of pockets of course and fine material. Where the required thickness is more than 6 inches, the material shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any one layer shall not exceed 6 inches. The relative compaction of each layer of aggregate base course shall not be less than as specified in Section 2.4. The compacted surface of the finished aggregate shall be hard, uniform, smooth, and shall not vary more than 0.02-foot for the specified grade and cross-section as shown on the plans

*B – Tack Coat:*

Tack coat material shall be emulsified asphalt conforming to AASHTO M140 or M208. A tack coat shall be applied to existing paved surfaces where new asphalt concrete is to be placed on existing pavement. It shall also be applied to the contact surfaces of all cold pavement joints, curbs, gutters, manholes and the like, immediately before the adjoining asphalt pavement is placed. Care shall be taken to prevent the application of tack coat material to surfaces that will not be in contact with the new asphalt concrete pavement. Diluted emulsified asphalt shall be applied at the rate of 0.05 to 0.15 gal/sy. Undiluted emulsified asphalt shall be applied at the rate of 0.025 to 0.075 gal/sy.

*C – Weather Restrictions:*

The HMA mixture shall be placed only on properly constructed surfaces that are dry, unfrozen surfaces and only when weather conditions allow for proper hauling, handling, and compaction of the mixture. The HMA shall be placed in accordance with the temperature limits shown in table 3.7 and only when weather conditions permit the pavement to be properly placed and meeting the compaction requirements stated herein.

TABLE 3.7 PAVEMENT PLACEMENT TEMPERATURE LIMITS

| Paving Course | Thickness | Minimum Air Temperature, ºF | Minimum Surface Temperature., ºF |
|---|---|---|---|
| Surface | All | 50 | 55 |
| Subsurface | < 3” | 44 | 48 |
| Subsurface | > 3” | 36 | 40 |

*D – Hauling:*

- Trucks used for hauling HMA mixtures shall have tight, clean and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution or other approved release agent material.
- Each truck shall have a suitable cover to protect the mixture from adverse weather and to maintain temperature of the mixture. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.
- Contractor's shall have an adequate number of vehicles so delivery of the HMA mixture can be continuous with a minimum of interruptions of material to the paving equipment in order for a continued non-stop paving operation and before the temperature of the HMA material falls below 250 ºF or satisfactory compaction temperature. Deliveries shall be planned during daylight hours unless approved by the Engineer.
- Hauling over newly placed asphalt mixture or newly placed concrete surfaces shall not be permitted until sufficient compaction and bonding/cooling of the asphalt mat, or specified strengths have been obtained.

*E – Placing:*

- Pavers shall be self-propelled, with an activated screed assembly, heated as necessary, to spread and finish the HMA mixture to the desired width, thickness, smoothness, and grade shown. The pavers shall have sufficient power to propel themselves and the hauling equipment without adversely affecting the finished pavement surface.
- The receiving hopper of the paver shall have sufficient capacity to permit a uniform spreading operation to apply the mixture without segregation and avoiding stop and go operations. A construction joint shall be placed anytime the paver stops and the screed drops enough to cause a surface dip greater than the allowable specified, or the mat temperature falls below specified. The screed shall be capable of maintaining a transverse slope within 0.1 percent.
- The mixture shall be laid upon an approved surface, spread and struck off to obtain the required grade and elevation after compaction. The mixture should be placed approximately 25 percent thicker than the existing adjacent surface to account for compaction. Raking is discouraged and will not be allowed except to correct major problems of grade and elevation. Casting or raking that caused any segregation will not be permitted.
- On areas where the use of mechanical spreading and finishing equipment is impracticable, the mixture shall be carefully dumped, spread, raked, screeded, and luted by hand tools to the required compacted thickness plus 25 percent. Carefully move or minimally work the HMA mix with the used of rakes, lutes, or shovels to avoid segregation.
- Each lift of compacted bituminous pavement shall be of uniform thickness. The minimum compacted lift thickness shall be three (3) times the nominal aggregate size of the mixture. The maximum lift thickness shall be 3 inches unless the ability to achieve the required compaction of thicker lifts can be demonstrated. The final lift, when placed adjacent to gutters, shall extend ¼ to ½ inch above the edge of the catch curb and gutters when compacted, and shall be even with the edge of spill curb and gutters.
- The formation of joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture and smoothness as other sections of the mat and meet the requirements of smoothness and grade. Joint density shall be not less than 1.5% of the adjacent mat density. The free edge of the paved pass shall be laid as straight as possible and to the

satisfaction of the Engineer. If this joint is cold, it shall be tack-coated prior to placement of the new paving.

- The new mat shall overlap the adjacent previously placed mat no more than 1.5 inches. Excess overlap or thickness shall not be raked or cast onto the new mat, but shall be wasted by pulling back and removing. The hot edge shall be blocked or bumped in a smooth line consistent with the previous longitudinal edge. Minor raking will only be allowed to correct major grade problems or provide mix around manhole and valve box covers. Longitudinal joints in successive layers of pavement shall be offset by a horizontal distance of at least 6 inches from the layer below. Longitudinal joints shall not cross the centerline, lane lines or outer edge lines of lanes unless approved by the Engineer.
- Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the pavement course. Tack coat shall be applied to contact surfaces before additional mixture is laid against the previously placed course. Transverse joints shall be located so they will be constructed with a full head of mix in front of the screed. When butt joints are constructed, runoff boards shall be used to support the roller on the downstream side of the joint. All tapered sections, rounded edges, and segregated areas shall be removed to achieve a vertical face at the butt joint before paving is started.

*F – Compaction:*

- All compaction equipment used on the project for obtaining the required density of the HMA pavement shall be self propelled vibratory, steel wheel, or pneumatic tire type. Unless specified otherwise, asphalt pavement shall be compacted to 92 to 96 percent of the maximum theoretical density, determined according to AASHTO T209, without crushing the aggregate. They shall be in good condition and capable of operating at slow speeds to avoid displacement and tearing of the HMA mixture. Vibratory rollers shall be equipped with separate energy and propulsion controls. The number, type and weight of rollers shall be sufficient to compact the mixture to the required density while still in a workable condition. The use of equipment which causes excessive crushing of the aggregate will not be permitted.
- The Contractor shall construct a control strip with production materials and equipment and shall determine the roll pattern to meet specified density and shall follow the pattern throughout the paving operation or until conditions change.
- Compaction shall begin immediately after the mixture is placed and be continuous until the required density is obtained. Compaction below a mat temperature of 185 ºF will be permitted only if compaction requirements have not been met and the procedure can be accomplished without causing damage to the pavement.
- HMA mixture shall be prevented from adhering to the rollers by using very small quantities of detergent or other approved material.
- Longitudinal joints shall be rolled from the hot side and overlap the joint on the cold side by approximately 6-inches. The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint. Transverse joints shall be made by means of placing a bulkhead or by tapering the course.
- Any displacement occurring as a result of reversing the direction of the roller or from any other cause shall be corrected at once. All roller marks shall be removed with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted during the final rolling of the surface course.
- In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers or small mechanical hand compactors.

- Any mixture that becomes loose and broken, mixed with dirt, contains check cracking or in any way is defective shall be removed and replaced with fresh HMA mixture and immediately compacted to conform to the surrounding area at the Contractor's expense.

G – *Testing*

The City Engineer may request material testing at the contractor's expense. Material testing required shall include the following, but is not limited to; density testing with a nuclear field gauge that is correlated to the measured density of at least three (3) test cores obtained from the asphalt mat, gradation of a representative sample of the asphalt material, and oil content of the asphalt material.

## 3.5.4 – Concrete:

*A – Mixing and Proportioning:*

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

- Proportioning the "dry" constituents of concrete mixtures shall be accomplished by weighing. There shall be no variance permitted in the minimum cement content and maximum water to cement ratio as specified by the concrete mix design. The total quantity of mixing-water per sack of cement, including free water in the aggregates, shall not exceed the maximum specified herein. The Responsible Party shall be responsible for developing the proper proportions of aggregates, cement and water that shall conform to the various requirements of these Standards and Specifications. Mix design shall be submitted to the City Engineer for review and approval, along with at least two (2) sets of ACI laboratory certified twenty-eight (28) day compressive strength test results, and applicable field testing performed by an ACI certified technician, for at least two (2) separate batches of the concrete mix. No concrete shall be incorporated into the work until the proportions are approved by the Engineer.

*B – Placement:*

- The concrete shall be properly graded with the forms securely set to provide the section and surface elevations shown on the plans.
- Concrete shall be placed on a compacted CDOT Class 6 (3/4") gravel base. Gravel base course shall extend a minimum of six (6) inches outside the form lines.
- At the engineer's request, the relative compaction of the concrete support materials shall be checked prior to placement of the concrete at no cost to the City.
- Before depositing concrete, debris shall be removed from the space to be occupied by the concrete and the forms.
- Existing concrete surfaces and bearing surfaces shall be thoroughly wetted.
- Concrete shall not be placed until forms and reinforcing steel have been inspected and approved by the City Engineer.
- Concrete shall be handled from the mixer to the place of final deposit as rapidly as possible by methods which prevent separation or loss of constituents. The concrete shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling.

It shall be deposited in continuous layers, the thickness of which generally shall not exceed twelve (12) inches.

- Concrete shall be placed in a manner that shall avoid segregation and shall not be dropped freely more than five (5) feet. If segregation occurs, the Engineer may require the concrete to be removed and replaced at the Responsible Party's expense.
- Concrete shall be placed in one continuous operation, except where keyed construction joints are shown on the plans or as approved by the Engineer. Delays in excess of thirty (30) minutes in the continuous operation may require removal and replacement of that pour, as determined by the City Engineer.

*C – Vibrating and Workability:*

- Proper consolidation of concrete flatwork shall be achieved by tamping, spading, screeding, vibrating, or other applicable methods. All other concrete shall be compacted by internal vibration using mechanical vibrating equipment. Care shall be taken in vibrating the concrete to vibrate only long enough to bring a continuous film of mortar to the surface.
- Vibration equipment must be used properly to avoid segregation of the concrete. Mechanical vibrators shall be an approved type as specified in ACI Publication 309 Chapter 5. Vibrators shall not be used to move or spread the concrete.
- Any evidence of the lack of consolidation or over-consolidation shall be regarded as sufficient reason to require the removal of the section involved and its replacement with new concrete at the Responsible Party's expense. The Responsible Party shall be responsible for any defects in the quality and appearance of the completed work.
- The consistency of concrete shall be kept uniform throughout the job. At the City Engineer's request slump tests may be required to verify uniformity with the concrete mix design at no cost to the City. The workability of the concrete shall be varied as directed by the Engineer. Concrete shall have a consistency such that it can be worked into corners and angles of the forms and around joints, dowels, tie-bars and reinforcing steel, etc…, without excessive spading, or vibrating or an excessive water to cement ratio.
- If, through accident, intention, or error in mixing, concrete fails to conform to the proportions of the approved mix design, such concrete shall not be incorporated in the work but shall be properly disposed of off the project site as waste material at no cost to the City.
- Water may be added at the job site not to exceed design w/c ratio. If approval is obtained and water is added at the job site, the Engineer may require that slump tests shall be run and test cylinders cast following the addition of the water at no cost to the City.

*D – Joints:*

Expansion joints and block joints shall be constructed straight, plumb, and shall extend through the curb and gutter or curbwalk section from top to bottom and from front to back (See Figure 3.1).

1. Expansion Joints

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

   - At each end of curb returns.
   - At both edges of driveway.
   - Between back of sidewalk and driveway slab or service walk.
   - Between new concrete and existing masonry buildings.
   - Between new and existing concrete.

- Every one hundred and fifty (150) feet in sidewalk, curb and gutter when hand-formed.
- Every two hundred (200) feet in sidewalk, curb and gutter when placed slip formed.
- Inlets
- As shown on the drawings.
- As directed by the Engineer.

2. Contraction Joints

   Transverse joints shall be placed at maximum intervals of ten (10) feet to control random cracking; joints shall be formed, sawed, or tooled to a minimum depth of one-quarter (l/4) of the total thickness. If divider plates are used, the maximum depth of plates shall not be greater than one-half (½) depth at the finished surface and shall be no less than one (1) inch. Additional joints may be required as directed by the City Engineer.

3. Tool Joints

   Tool joints shall be spaced as follows:

   - Not more than ten (10) feet or less than five (5) feet apart in curb and gutter and combination curb-walk.
   - Not more than the width of the sidewalk (up to eight (8) feet), nor less than five (5) feet apart in sidewalk.
   - At least two (2) joints equally spaced at not greater than ten (10) foot intervals as applicable in driveways.
   - As directed by the City Engineer.

*E – Finishing and Curing:*

- Sidewalk and curb shall be broomed or combed and edged, unless otherwise directed by the Engineer. Exposed faces of curbs and sidewalks shall be finished to true-line and grade as shown on the plans. Surface shall be floated to a smooth but not slippery finish. The surface shall be floated with a wooden or magnesium float and given a transverse broom finish. No plastering of the surface will be permitted. All outside edges of the slab and all joints shall be edged with a minimum ¼ inch radius edging tool.
- After completion of brooming and before concrete has taken its initial set, edges in contact with the forms shall be tooled with an edger. No dusting or topping of the surface or sprinkling with water to facilitate finishing shall be permitted.
- Immediately following the removal of the forms, fins and irregular projections shall be removed from surfaces except from those which are not to be exposed or are not to be waterproofed. On surfaces, the cavities produced by form ties, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement, glue, and fine aggregate. The surface shall be left sound, of acceptable finish, even, and uniform in color. Mortar used in pointing shall not be more than thirty (30) minutes old. Construction and expansion joints in the completed work shall be left carefully tooled and free of mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.
- Fresh concrete shall be protected from weather damage and mechanical injury during the curing periods. Curing processes described herein may be used at the option of the Engineer. The selected curing process shall be started as soon as it can be done without injury to the concrete surface. The use of a membrane curing compound is required.
- The following curing procedures may be used subject to the approval of the Engineer:
  A. Ponding (for slabs or footings)
  B. Membrane curing compound

C. Wet burlap, earth, or cotton mats
D. Waterproof paper or polyethylene plastic cover

Membrane curing compound shall be Type 2, Class B in accordance with AASHTO M148. The membrane curing compound shall be applied at the rate of three hundred (300) square feet per gallon.

Membrane curing compound shall not be used when the concrete surface will be painted. The type of membrane curing compound chosen shall not permanently discolor the concrete surface.

- Where membrane curing compound is not used, the curing process shall be carefully adhered to as follows:
  1. Surfaces being wetted by ponding, spraying, or wetted material shall be kept completely wetted, with an excess of free water on the surface, for the first seventy-two (72) hours. After this period, for the next four (4) days, a wetting schedule shall be followed whereby the concrete is wetted on a schedule approved by the Engineer.
  2. Surfaces being protected by waterproof paper or polyethylene plastic cover shall receive special attention during the first seventy-two (72) hours to ensure there is actually free moisture on the surface of the concrete under the waterproof surface. The engineer may require the removal of the cover and a wetting of the surface when, in his judgment, there is insufficient moisture for curing. After the first seventy-two (72) hours the cover shall be kept tightly in place for the remainder of the curing period.

*F – Protection Cold Weather Concreting:*

- During extreme weather conditions, placing of concrete shall be permitted only when the temperature of the concrete placed in the forms shall not be less than sixty (60) degrees Fahrenheit nor more than ninety (90) degrees Fahrenheit.
- To maintain this temperature range, the Responsible Party shall provide acceptable heating apparatus for heating the aggregates and the water.
- No concrete shall be placed, regardless of the present temperature, when the weather forecast promises freezing weather before final set of the concrete unless special means of heating and protection are used.
- Protection against freezing is the Responsible Party's responsibility regardless of the weather forecast or climatic conditions at the time of placing.
- Small structures and slabs may be protected by completely covering fresh concrete with dry straw and canvas to a depth that ensures protection. Material shall be secured to prevent displacement by the elements. Large structures or vertical walls shall be protected against freezing by enclosing the structure and heating with heaters, or other devices capable of providing uniform and even heat throughout the structure.
- Concrete placed in cold weather shall be protected from extreme temperatures as follows:
  (1) A temperature of at least fifty (50) degrees Fahrenheit for the first seventy-two (72) hours shall be maintained.
  (2) After the first seventy-two (72) hours and until the concrete is seven (7) days old, it shall be protected from freezing temperatures.
  (3) Concrete adjacent to heaters or salamanders shall be protected from direct heat of the unit.
  (4) Temperatures shall be measured by maximum and minimum thermometers furnished by the Responsible Party and installed adjacent to the concrete.

- Concrete slabs shall not be placed, regardless of temperature conditions, if the supporting ground is frozen or contains frost. Use of salt or other additives to prevent concrete from freezing shall not be allowed. Concrete which has been frozen shall be completely removed and replaced as directed by, and to the satisfaction of the City Engineer.

*G – Protection Hot Weather Concreting:*

Except by written authorization, concrete shall not be placed if the temperature of the plastic concrete cannot be maintained at ninety (90) degrees Fahrenheit or lower. The placement of concrete in hot weather shall comply with ACI 305.

## 3.5.5 –Sidewalks and Bikeways:

*A – Concrete Walks and Bikeways:*

1. Joints - Expansion joints, at intervals of not more than 200 feet, shall be filled with 13 mm (½ inch) thick full depth, preformed expansion joint filler. The sidewalk or bikeway shall be divided into sections by Control joints formed by a jointing tool or other acceptable means as directed. These dummy joints shall extend into the concrete for at least ¼ of the depth and shall be approximately 3 mm (1/8 inch) wide. Dummy joints shall be spaced at intervals approximately equal to the width of the sidewalk or bikeway.

Construction joints shall be formed around all appurtenances such as manholes, utility poles, etc., extending into and through the sidewalk. Preformed expansion joint filler 13 mm (½ inch) thick shall be installed in these joints. Expansion joint filler 13 mm (½ inch) thick or the thickness indicated shall be installed between new concrete and any fixed structure such as a building or driveway. This expansion joint material shall extend for the full depth of the contact surface. Expansion joint filler type is subject to approval.

2. Curing (See Section 3.5E) - Immediately upon completion of the finishing, sidewalks and bikeways shall be moistened and kept moist for three days, or they shall be cured by the use of membrane forming curing compound. The method and details of curing shall be subject to the approval of the Engineer. During the curing period all traffic, both pedestrian and vehicular, will be excluded. Vehicular traffic will be excluded for such additional time as the Engineer may direct.

*B - Bituminous Sidewalks and Bikeways:*

1. Excavation and Forms. Excavation and forms shall meet the requirements of subsection 3.5.

2. Bed Course. Aggregate base course material shall be placed in layers not exceeding four (4) inches in depth and each layer shall be thoroughly compacted.

3. Placing Bituminous Material. Bituminous sidewalk and bikeway material shall be placed on the compacted bed course in one or more mats as indicated so as to give the required depth when rolled. When practicable, spreading, finishing, and compaction shall be accomplished by equipment conforming to CDOT requirements. When the Engineer determines such equipment is not practicable, bituminous material may be spread by small or special pavers, by rake boxes, blade graders and may be compacted by small self propelled rollers or vibratory compactors acceptable to the Engineer. In areas inaccessible to the roller, hand or mechanical tamping will be permitted. Bituminous material shall be uniformly compacted. The Contractor shall state at the preconstruction conference what type of paving equipment will be used.

*C – Joints:*

Expansion joints and block joints shall be constructed straight, plumb and shall extend through the curb and gutter or curbwalk section from top to bottom and from front to back.

Expansion joint filler ½ inch thick, performed bituminous-treated fiberboard, conforming to AASHO Specification M59, shall be used to form transverse expansion joints. Expansion joints shall be constructed at the intersection with the existing curb and gutter, curbwalk, and sidewalk, at all radius pints and at 150 foot intervals and/or as directed by the City Engineer.

## 3.5.6 – Curb and Gutter:

*A – Cast in Place Concrete Curb:*

Concrete shall be proportioned, mixed and placed in accordance with the requirements for the class of concrete specified. Forms shall be left in place until the concrete has set sufficiently so that they can be removed without injury to the curb. Upon removal of the forms, the exposed curb face shall be immediately finished to a uniform surface. For the purpose of matching adjacent concrete finishes or for other reasons, the Engineer shall approve methods of finishing. Plastering will not be permitted.

1. Sections. Curb shall be constructed in sections having a uniform length of 3 m (10 feet), unless otherwise ordered. Sections shall be separated by open joints 3 mm (1/8 inch) wide except at expansion joints.

2. Expansion Joints. Expansion joints shall be formed at the intervals shown on the plans using a 13 mm (½ inch) preformed expansion joint filler. When the curb is constructed adjacent to or on concrete pavement, expansion joints shall be located opposite the expansion joints in the pavement. Expansion joints shall be installed between concrete curb and any fixed structure or driveway. Expansion joint material shall extend the full depth of contact surface.

3. Curing. Immediately upon completion of the finishing, the curb shall be moistened and kept moist for three days, or the curb shall be cured by the use of membrane forming curing compound. The method and details of curing shall be subject to the approval of the Engineer.

4. Backfilling. After the concrete has set sufficiently, the spaces in back of the curb shall be backfilled to the required elevation with suitable material which shall be thoroughly tamped.

5. Curb Machine. With the approval of the Engineer, the curb may be constructed by the use of a curb-forming machine. A test strip minimum length of 25 feet will also be required. The approval or rejection shall be given in writing.

6. Surface Tolerance. The Engineer may determine that the exposed surfaces of the concrete curb, gutters, or combination curb and gutter shall be tested with a 3 m (10 foot) straightedge laid along the exposed surface in a longitudinal direction. The Contractor shall furnish an approved 3 m (10 foot) straightedge and provide an operator to aid the Engineer in testing the exposed surfaces. All surfaces shall be measured in a longitudinal direction. Deviation of any exposed surface in excess of that specified shall be corrected at no cost to the City. Longitudinal surface tolerances are:

- On tangent roadway alignments and curves with radius greater than 300 m (1000 feet): 9.5 mm (0.375-inch) from the edge of the straightedge.
- On sharp vertical curves and horizontal curves with radius of 300 m (1000 feet) or less: 9.5 mm (0.375-inch) from the edge of the straight edge with allowance made for curve deflection.

*B – Bituminous Curb:*

1. Preparation - Bituminous curb shall be placed on a clean dry surface. Immediately prior to placing of the bituminous mixture, the surface shall receive a tack coat of bituminous material of the type and grade approved by the Engineer. The rate of application of the tack coat material shall be 0.2 to 0.7 liters per square meter (0.05 to 0.15 gallons per square yard) of surface. In the application of this tack coat, the Contractor shall prevent the spread of this tack coat to areas outside of the area to be occupied by the curb.

2. Placing - Bituminous curb shall be constructed by use of a self-propelled curb machine or a paver with curb attachments.

*C – Curb Machines:*

Automatic curb machines shall meet the following requirements and shall be approved prior to its use:

- The mass (weight) of the machine shall be such that compaction is obtained without the machine riding above the bed on which curb is constructed
- The machine shall form curb that is uniform in texture, shape and density.
- The Engineer may permit the construction of curb by other means, when short sections or sections with short radii are required, or for such other reasons as warranted. The resulting curb shall conform in all respects to the curb produced by the use of the machine. Upon completion of placement of bituminous curb, a fog coat of emulsified asphalt shall be placed on the exposed surfaces of the curb at the rate of approximately 0.5 liters per square meter (0.1 gallon per square yard).

*D – Painting and Sealing:*

When sealing or painting is required, it shall be performed only on a curb which is clean and dry and which has reached the ambient temperature.

## 3.5.7 – Repairs:

*A – New Concrete:*

After stripping of the forms, if any concrete is found to be not formed as shown on the drawings or is out of alignment or level, or shows a defective surface, it shall be considered as not conforming with the intent of these Standards and Specifications and shall be removed and replaced by the Responsible Party at his expense unless the Engineer gives written permission to patch the defective area. In this case, patching shall be done as described in the following paragraphs:

1. Defects that require replacement or repair are those that contain honeycomb, damage due to stripping of forms, loose pieces of concrete, bolt-holes, tie-rod holes, uneven or excessive ridges at form joints, and bulges due to movement of the forms. Ridges and bulges shall be removed by grinding. Honeycombed and other defective concrete that does not affect the integrity of the structure shall be chipped out, and the vacated areas shall be filled in a manner acceptable to the Engineer. The repaired area shall be patched with a non-shrink, non-metallic grout with a minimum compressive

strength of five thousand (5,000) psi in twenty-eight (28) days. Repair areas treated with an epoxy bonding agent shall have the approval of the Engineer before the repair filling is placed.

2. Bolt-holes, tie-rod holes, and minor imperfections as approved by the Engineer, shall be filled with dry-patching mortar composed of one (1) part Portland cement to two (2) parts of regular concrete sand (volume measurement) and only enough water/glue so that after the ingredients are mixed thoroughly, the mortar shall stick together on being molded. Mortar repairs shall be placed in layers and thoroughly compacted by suitable tools. Care shall be taken in filling rod and bolt holes so that the entire depth of the hole is completely filled with compacted mortar. The mortar mix proportions described above are approximate. Those areas with excessive deficiencies as determined by the Engineer shall be removed and replaced at the Responsible Party's expense.

*B – Existing Concrete:*

Where repairs are made in existing curbs or sidewalks, all edges of the old concrete allowed to remain shall be saw cut to a minimum depth of two (2) inches. No rough edges shall be permitted where new construction joins the old section. Unless directed by the Engineer, no section less than five (5) feet in length shall be placed or left in place. Where new concrete construction abuts existing curbs or sidewalks, the work shall be accomplished so that there is no abrupt change in grade between the old section and the new work. Doweling into the existing concrete may be required by the Engineer.

*C – Cleanup and Backfill:*

The exposed surfaces of the concrete shall be thoroughly cleaned upon completion of the work, and the site shall be left in a neat and orderly condition. When side forms are removed and the concrete has gained sufficient strength, the space adjoining the concrete shall be promptly backfilled with suitable material, properly compacted, and brought flush with the surface of the concrete and adjoining ground surface. In embankments, the backfill shall be level with the top of the concrete for at least one (1) foot and then sloped as shown on the drawings or as directed by the Engineer. Existing pavement which is damaged during construction shall be repaired at the Responsible Party's expense. Patching required to match existing asphalt or concrete shall be the Responsible Party's liability.

## 3.5.8 – Special Features:

*A – General:*

The work covered by this section consists of street undulations, surface pavers, and pavement texturing.

*B – Street Undulations:*

Street undulations – such as speed bumps or raised humps shall not be used without approval of the City Engineer.

*C – Pavement Texture:*

Pavement texturing – is a finishing system which treats the surface of hot mix asphalt (HMA) by imprinting freshly laid, fully compacted, asphalt, or reheated existing asphalt pavement, with "grid style" or other styles of depressions to replicate the concrete grout depressions found common to hand-laid brick or cobblestones patterns, and coating the imprinted asphalt surface with acrylic polymer resins containing aggregates and pigments specially formulated to adhere to asphalt surfaces.

1. Imprinting shall be performed by pressing flexible woven wire templates into hot, fully compacted, HMA. Imprinting can proceed immediately after the hot asphalt has been placed and compacted, while the asphalt is still in a warm to hot pliable state.

2. Reheating of existing asphalt to soften the surface shall be by equipment such as infrared heaters or hot air heaters. The surface temperature must be continuously monitored to avoid overheating or burning and degradation of the asphalt surface. The use of an infrared thermometer is recommended. Equipment that is specifically excluded and shall not be used for reheating of the asphalt is any form of direct flame heaters. The asphalt pavement must be adequately softened to a depth of at least ½ inch without burning the asphalt. The asphalt surface temperature shall not exceed 300° F (150° C). Overheating of the asphalt occurs when blue/black smoke is emitted from the surface.

3. The application of the surface coatings shall be only when the air temperature is at least 50 F and rising, and will not drop below 50 F within 8 hours of the application. There shall be no precipitation expected within 2 hours after applying the top coat.

4. Application shall be by qualified persons specializing in performing the work.

# SECTION IV

# DOMESTIC WATER SYSTEM SPECIFICATIONS

# 4.0 – DOMESTIC WATER SYSTEM SPECIFICATIONS

SECTION IV – GENERAL; DESIGN CRITERIA; CONSTRUCTION MATERIALS; AND CONSTRUCTION METHODS

## *4.1 – GENERAL*

### 4.1.1 – Description:

All water distribution facilities installed within the public right-of way or easements shall be constructed in accordance with these standard drawings and specifications of the City. In addition, all minimum standards of the federal and state agencies shall be followed in the planning and construction of water pumping, distribution, and transmission facilities. All water system construction plans shall be approved by the City Engineer prior to beginning of any construction.

The provisions stipulated in this section are general in nature and shall be considered as applicable to all other parts of these specifications, including any supplements and revisions. All water mains and appurtenances shall be designed by a Registered Professional Engineer, licensed to practice in the State of Colorado.

### 4.1.2 – Related Work:

*A. Maintenance of Existing Utilities: Section 2.1.5*

*B. Excavation, Trench Widths, Pipe Bedding, Shoring-Sheeting-Bracing: Section 2.4.1*

*C. Backfill and Restoration: Section 2.4.2 – 2.4.3*

*D. Concrete Work: Section 3.3*

*E. Quality Assurance: Section 2.2*

*F. Product Assurance: Section 2.3*

## *4.2 – DESIGN CRITERIA:*

### 4.2.1 – Size:

The minimum main size shall be six (6) inches. This size may be larger if the City Engineer deems necessary to meet fire flow requirements or where the potential exists for future development. Whenever an action by the City requires a developer to install water mains in a development or subdivision with an increase in size, an agreement shall be made with the developer in the event the Engineer deems it required for water supply outside the development. Service laterals shall be ¾" minimum sizing.

### 4.2.2 – Location:

All water mains shall be extended to the furthest property line of any lot or development whenever future development is at all possible. Water mains shall be designed through a subdivision so that a continuous loop is provided for an alternate source of supply. When connecting lines will benefit the water system, the City Engineer shall direct that such looping

take place. Generally, water line extensions and replacements shall be located in the street a distance of seven (7) feet from the existing or proposed curb line.

## 4.2.3 – Depth:

All water lines shall have a minimum cover of forty-eight (48) inches from the top of pipe to the finished surface grade, and shall be bedded and blocked according to drawings. The developer will be responsible to ensure proper depth for all water line installations. The developer will be responsible for excavating service trenches for the City of Cortez at no cost to the City.

## 4.2.4 – Dead-End Lines:

Valves shall be installed at all temporary dead end lines. Permanent dead-ends are not allowed. A hydrant shall be placed at dead-ends to provide for occasional flushes to prevent stale water accumulation.

## 4.2.5 – Valves:

*A – Shut-Off Valves:*

Valves shall be located such that no single shut down will result in more than one block of continuous line be shut off at one time and in no case shall more than one fire hydrant along a section of line be removed from service. The City Engineer may require valves at more frequent spacing as deemed necessary. All-weather ground surface for vehicular access shall be provided to each valve location.

*B – Air Release Valves:*

As required by the City Engineer, air/vacuum release valves or combination valves may be required at high points in system transmission lines to evacuate air from the line when filled, and to allow discharge of air accumulated under operating pressure. Vacuum release valves are needed to permit air to enter the line when it is being emptied or subjected to a vacuum. For distribution mains, the preferred method to discharge air is to locate fire hydrants at the high points.

If hydrants or blow-offs are not available at high points and dead-ends, the contractor shall have the necessary taps made by the Cortez Public Works Department to expel the air at those locations. The size of these blow-offs will be specified by the City Engineer.

## 4.2.6 – Fire Hydrants:

*A – General:*

All fire hydrants required by code for unusually large or hazardous structures shall be in place, functional, and accepted before any construction of combustible materials occurs above the floor or slab grade. Coordination of the water system will be done through the Building Department and the Fire Official.

A three foot (3') clear space shall be maintained around the circumference of all fire hydrants. Fire hydrants shall be a minimum 4-1/2 foot bury and have an elevation from ground elevation to center of pumping nozzle of approximately 18 inches.

*B – Spacing:*

The Cortez Fire Protection District has minimum standard requirements for fire flow and fire hydrant locations. Existing fire hydrants on public streets are considered as available. For new developments, the maximum distance to a fire hydrant from a functional location proximate to a structure (i.e. fire lane or frontage street), shall not exceed one hydrant in 400 feet and two within 800 feet. For dead-end streets the maximum distance may be reduced

to 200 feet. Additional fire hydrants shall be installed as needed to meet required fire flow to premises upon which buildings or portions of buildings are constructed. All fire hydrant locations shall be spaced for effective use by the Cortez Fire Protection District and will be reviewed by the Fire Marshall. In instances where the currently adopted International Fire Code and these standards deviate, the more restrictive shall apply.

## 4.2.7 – Thrust Blocks:

Thrust blocks shall be placed behind all tees, bends, plugs, caps, and other locations specified by the City Engineer (See Figure 4.1). Concrete used for thrust blocking shall be a minimum 3,000 psi compressive strength at 28 days.

## 4.2.8 – Corrosion Protection:

Polyethylene wrap will be required with ductile-iron pipe in possible corrosive areas according to AWWA C-105-77 specifications.

## 4.2.9 – Water Taps and Services:

*A. Connections:*

It shall be unlawful for any person except the Department of Public Works employees to tap any water main, adjust or interfere with any corporation stop, curb stop, or service meter. All connections to the City water distribution system shall be metered of a sufficient size as set forth by the City Engineer, based on projected demands. All Tapping of a main line for a service line will be performed by Water Department personnel or designated agent and should be done at the time of main construction, after the main line has been tested and approved by the City of Cortez. The service line shall then be laid to the property line with a curb box and optional meter pit installed approximately near the property line but behind any existing or future sidewalk. All meters installed must be in an accessible place for reading and servicing. The developer, contractor or owner shall be responsible for trenching water service lines at no cost to the City. Backfilling shall be done in accordance to Section 2.4.2. Individual lots being developed along an improved and existing street may be trenched and backfilled by the City with approval of the City Engineer.

*B. Service Lines:*

Typically, Service lines from the main, up to and including the meter, shall be the responsibility of the City of Cortez and shall be maintained by City personnel. The line from the meter on shall be the responsibility of the homeowner. When the meter is located within a building or interior property, the City shall maintain and repair the meter and only the service up to the property line. The property owner shall be responsible for all other fixtures and pipes inside the premises. The developer will provide an initial line extension or conduit sleeve from the meter to a point within the interior property to the extent of crossing all other utility lines by no less than 5 feet leaving provision for future tie on by the property owner in and away from other utility lines. See Section 4.3.3 warning tape/tracer wire to be included with initial service lateral extension.

*C. Disclaimer:*

The City reserves the right to shut off water from the mains, when necessary for repairs, making connections or extensions or performing any other necessary work. No claim shall be made against the City on account of shutting off the water from the mains and service lines.

## *4.3 – CONSTRUCTION MATERIALS:*

### 4.3.1 – Pipe:

Mains shall be a minimum 6 inch diameter class 52 cement-lined ductile iron pipe or an alternate class 200, AWWA C900 DR-14 polyvinyl chloride (PVC)

*A – Polyvinyl Chloride (PVC):*

Pipe material as defined in ASTM D 1784 and complies with NSF 61 in 6-inch and 8- inch diameters using bell and spigot with rubber gasket push-on type joints and mechanical joints at fittings and shall be DR 14, rated at 200 psi working pressure conforming to AWWA C 900.

*B – Ductile Iron (DIP):*

Pipe Cast in accordance with AWWA C 151. Water Mains shall be of thickness class 52, cement-lined ductile iron pipe (DIP) in accordance to AWWA C 104, and constructed with push-on joints and mechanical joints at fittings. Pipe lines inside of structures and exterior non-buried lines shall be with flanged joints.

*C – Copper Tubing:*

Pipe shall meet the requirements of ASTM B 88 Type "K" for services.

*D – Casing Pipe:*

Installation of water mains through other agency rights-of-way or easements such as CDOT, etc. will be specified by the agency granting permission to cross. Such crossings, sleeve pipe size, length, type and wall thickness shall be approved by the City Engineer. Casing pipe shall be a minimum of 6-inches larger than the diameter of the carrier pipe. Water mains shall not be inserted into the casing or sleeve pipe without providing insulating skids for each joint of carrier pipe. Casing pipes shall be protected both inside and out with corrosion resistant materials and end seals. Care must be exercised to avoid metal to metal contact and to avoid the transfer of loads to the carrier pipe.

Pipe Alternatives due to special conditions will be determined by the City Engineer.

### 4.3.2 – Valves and Fittings:

*A – Gate Valves:*

Gate valves of sizes 6" – 12" shall be resilient seat type that meets or exceeds all applicable requirements of AWWA C 509 and certified to ANSI/NSF 61. Valves shall be iron-body with epoxy coated interior and exterior surfaces in accordance with AWWA C 550. Valves should be equipped with two-inch square operating nuts, and a non-rising bronze stem. All valves shall open counter-clockwise (left) and be rated at a working pressure of 250 psi. Flanged ends shall comply with ANSI B16.1, class 125. Mechanical joint ends shall comply with ANSI/AWWA C 111 standard.

*B – Butterfly Valves:*

Butterfly valves (12-inch diameter or larger) shall conform to AWWA C 504 standards. All valves shall be rated at a minimum 200 psi working pressure and shall open counter-clockwise.

*C – Valve Boxes:*

Cast iron two-piece box and lid shall be provided for each underground valve. Valve boxes shall be minimum 5 1/4 inch inside diameter, adjustable screw together type, as shown in

Figure 4.2, sized for the type of valve and depth of bury. Top and bottom section shall be belled. The lid shall have the word "WATER" permanently cast in the top.

*D – Fittings:*

Pipe fittings shall be cast iron or ductile iron conforming to AWWA C 110 or AWWA C 153 for compact fittings and shall have a pressure rating equal to that of the pipe on which it is used. Fittings shall be supplied with mechanical joint accessories unless specified otherwise. Ductile iron mechanical joint fittings shall be rated for 350 psi working pressure; ductile iron flange fittings shall be rated at 250 psi working pressure; and all cast iron fittings shall be rated at 250 psi working pressure.

Flanged fittings shall be 125 pound fittings meeting ANSI B 16.42 or ANSI B 16.1 for fittings not available in ductile iron.

*E – Couplings:*

Couplings shall be bolted sleeve type couplings and flange coupling adapters shall be provided for use in joining new pipe to existing pipe or water mains of differing pipe materials and shall comply with requirements of AWWA C219. Couplings and adapters must be capable of fitting cast iron, ductile iron, asbestos cement, steel, or PVC pipe. Center sleeves and follower rings shall be steel or ductile iron in accordance with the referenced standard. The minimum length for couplings shall be twelve (12) inches for pipe diameters up to and including twelve (12) inches, and at least fifteen (15) inches for pipe diameters greater than twelve (12) inch. Gaskets shall meet requirements of ASTM D2000. Similar materials shall be used for protection of bolts and nuts in buried installations where the environment is highly corrosive.

*F – Pipe Joint Restraints:*

Pipe joint restraints are to be used on water mains for PVC C900 pipe, and for DIP sizes up to 16 inch diameter. Joint restraint systems shall be of the "mechanical joint" type for fittings, and appurtenances conforming to AWWA C110 and AWWA C153, but are not a replacement for thrust blocks. All mechanical joint pipe restraints shall have a minimum working pressure rating equal to that of the pipe on which it is used. The restraint system shall utilize a standard MJ rubber gasket with a ductile iron follower gland meeting AWWA C10 and shall include a mechanism which imparts multiple wedging actions to restrain the pipe. Torque limiting (twist-off) actuating screws shall be used to insure proper set of the gripping wedges. Approved mechanical joint restraint devices shall be:

Ductile Iron MJ Restraint:
- EBBA Iron, Inc. – Megalug, Series 1100
- Uni-Flange Corp. - Series 1400

PVC MJ Restraint:
- EBBA Iron, Inc. – Megalug, Series 2000 PV
- Uni-Flange Corp. – Series 1500

For applications of connecting Valves to Fittings or Fittings to Fittings,
- Foster Adaptor
- Flex Adaptor (for compact fittings and hydrant shoes)

## 4.3.3 – Underground Warning Tape and Tracer Wire:

Underground warning tape shall be installed approximately half-way between the top of pipe and the ground surface. (See Section 2.4.5 and Figure 4.4) At utility crossing points, warning tape shall be above each applicable line by nine 9 inches minimum and below the overlaying utility line crossing by nine inches minimum.

Tracer wire for PVC water mains shall be minimum 10-gauge insulated solid copper for direct bury, wrapped around each joint of pipe and extended upward into valve boxes. Splices are to be cap connected and gel-wrapped.

## 4.3.4 – Fire Hydrants:

Fire hydrants shall be dry barrel type and adhere to the following specifications: No substitutes will be accepted (See Figure 4.3).

- Manufacturers and models allowed are: Muller Centurion, Waterous Pacer, and MH Model 129.
- Complies with AWWA C-502 specifications
- Bury depth of four and one-half (4 1/2) feet minimum
- Two - 2 ½-inch hose and one 4-1/2-inch pumper nozzles
- All threads to be National Standard Fire Thread
- All nozzle and hose connections to conform to National Standard specifications
- 6-inch connecting pipe from main to plug
- 5-1/4-inch valve opening
- Operating nut turns left (counter-clockwise) to open
- Hydrant color to be approved by engineer
- All hydrants to be traffic (break-away) models with the break-away base set 6” above ground level.
- Bottom or end connection to be mechanical or flange
- Pentagon shape operating nut 1-1/2 inches from point to opposite flat side
- Drip valve to drain
- Nozzle caps shall be securely chained to the upper barrel section

## 4.3.5 – Water Service:

Residential water service line shall be of the following material:

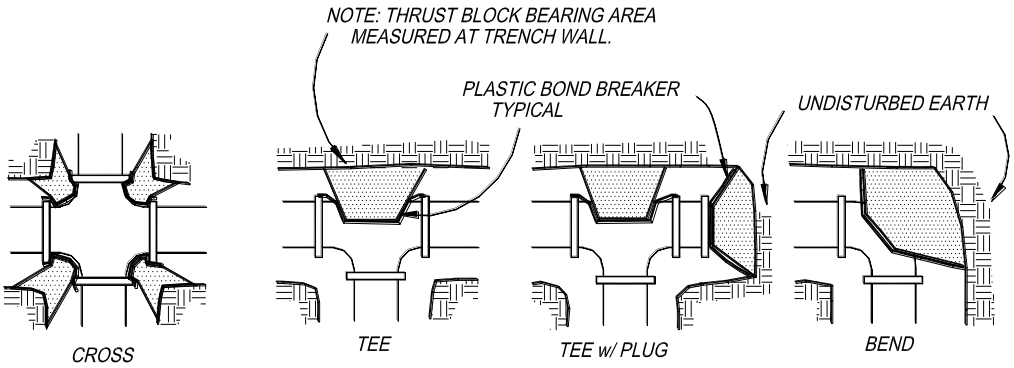
- Type “K”, ¾-inch copper line
- Ford F-600 series corporation stop of brass alloy body ASTM B 62 conforming to AWWA C 800 with taper thread inlet by flare copper outlet
- Ford B22-333 curb stop of brass alloy body ASTM B 62 conforming to AWWA C 800 and ball valve type with flare copper ends
- Tyler series 6500 curb box of cast-iron body, adjustable two-piece screw type, and lid with inscription “WATER” and pentagon plug

MINIMUM THRUST BLOCK BEARING AREA
( SQ. FT.) *

| FITTINGS | PIPE DIAMETER 4" | 6" | 8" | 10" | 12" | 14" & 16" |
|---|---|---|---|---|---|---|
| TEE OR CAP ( DEAD END) | 1.3 | 2.8 | 5.0 | 7.8 | 11.3 | 21 |
| 90 DEGREE BEND | 1.8 | 4.0 | 7.1 | 11.1 | 16.0 | 29 |
| 45 DEGREE BEND | 1.0 | 2.2 | 3.8 | 6.0 | 8.6 | 16 |
| 22-1/2 DEGREE BEND | 0.5 | 1.1 | 2.0 | 3.0 | 4.4 | 8 |
| CROSS w/ PLUG | 1.3 | 2.8 | 5.0 | 7.8 | 11.3 | 21 |
| TEE w/ PLUG | 1.3 | 2.8 | 5.0 | 7.8 | 11.3 | 21 |

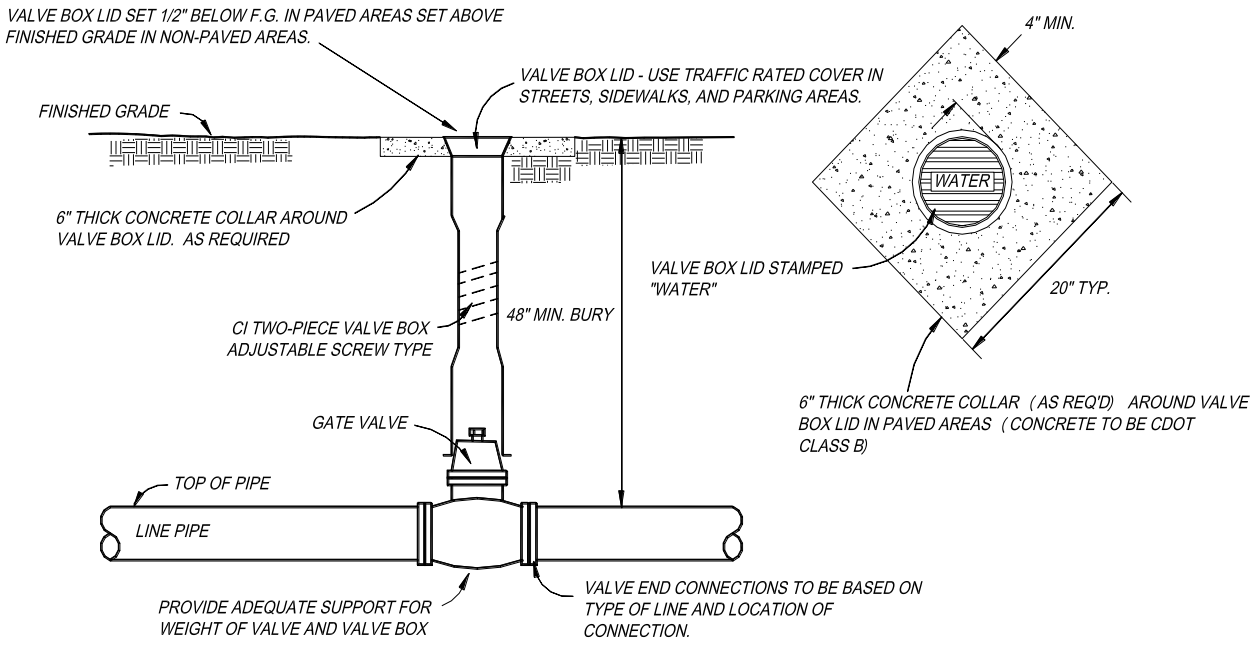
* MAY BE ADJUSTED PER GEOTECHNICAL ANALYSIS & CITY REQMNTS.

VERTICAL THRUST BLOCKS TO BE CONSTRUCTED PER ENGINEER'S REQUIREMENTS.




1. BASED ON 100 PSI MAX. PRESSURE AND 1000 LBS/S.F. SOIL BEARING CAPACITY
2. ALL FITTINGS MUST BE WRAPPED WITH POLYETHYLENE TO PREVENT CONCRETE FROM ADHERING TO BOLTS AND TO ENSURE THAT JOINTS ARE ACCESSIBLE FOR REPAIRS.
3. CONCRETE SHALL BE CDOT CLASS B MIX DESIGN

**FIGURE 4.1 THRUST BLOCKS**




GENERAL NOTES:

1. ALL GATE VALVES SHALL MEET OR EXCEED ALL APPLICABLE REQUIREMENTS OF ANSI/AWWA C509 STANDARD AND SHALL BE CERTIFIED TO ANSI/NSF 61.

2. ALL GATE VALVES SHALL BE IRON BODY - RESILIENT WEDGE TYPE WITH FUSION EPOXY COATED INTERIOR & EXTERIOR SURFACES. EPOXY COATING SHALL MEET ALL APPLICABLE REQMT'S. OF ANSI/AWWA C550.

3. 4" - 12" SIZES SHALL BE RATED AT 250 psig MAXIMUM WORKING PRESSURE. ( 500 psig STATIC TEST PRESSURE) .

**FIGURE 4.2 WATER VALVE AND VALVE BOX**

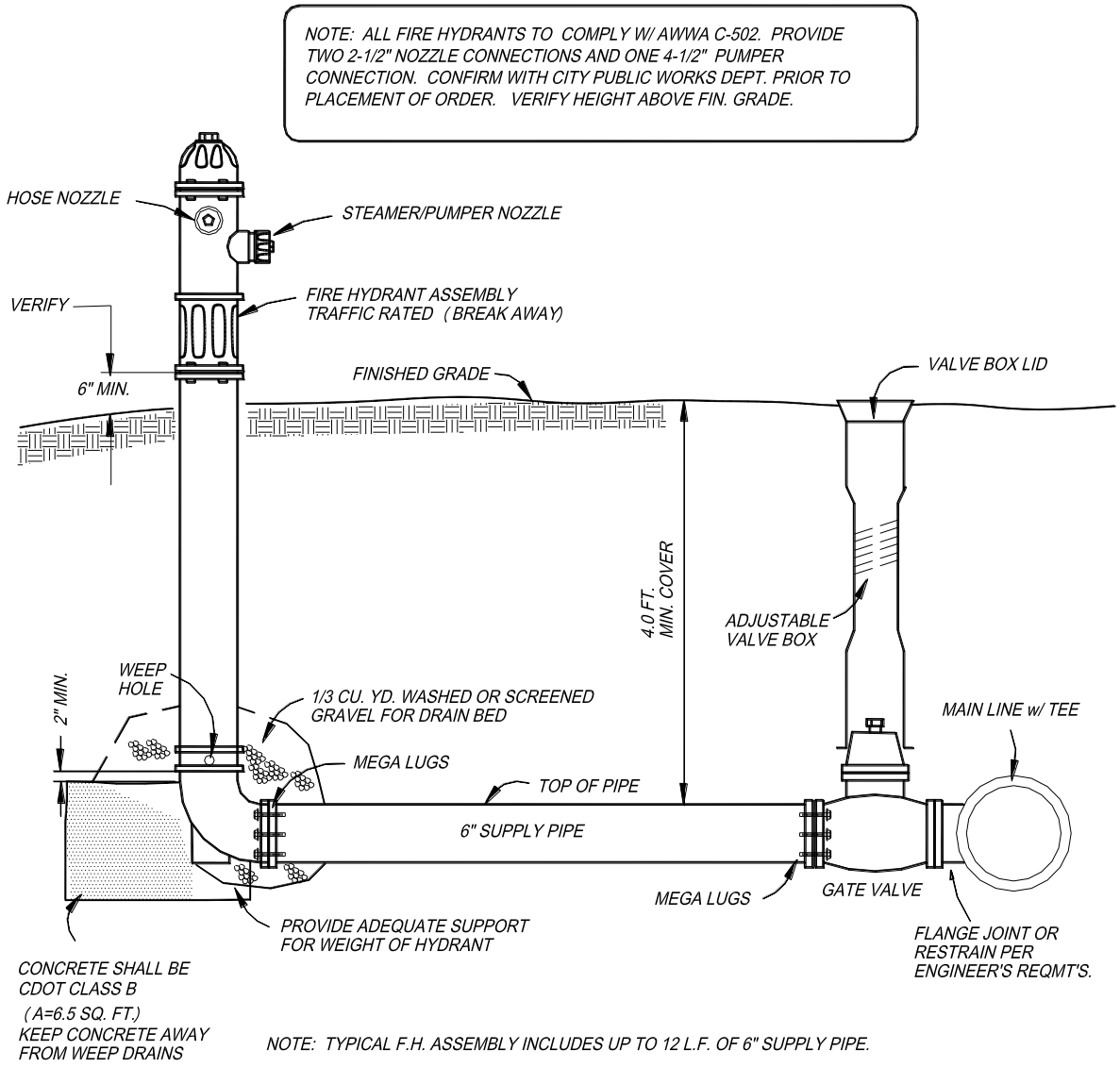
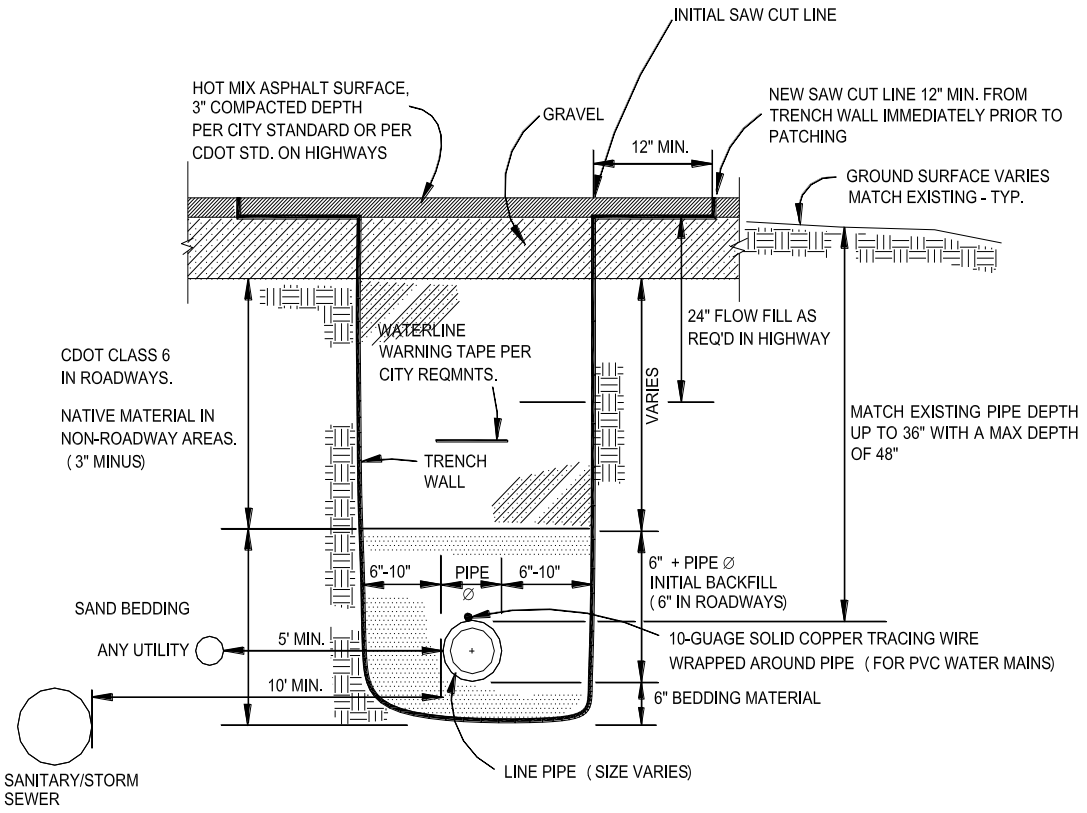



**FIGURE 4.3 FIRE HYDRANT**




NOTE:

- ALL BACKFILL SHALL BE COMPACTED TO 95% MAX. DENSITY UNDER CITY STREETS. ( MOD. PROCTOR METHOD, ASTM D1557)
- TRENCHES THAT ARE OVEREXCAVATED BEYOND THE MAX DEPTH SHALL BE BROUGHT BACK UP TO GRADE WITH CDOT CLASS 6 ROAD BASE COMPACTED TO 95% OF ASTM D1557. ONLY THEN SHALL SAND BEDDING MATERIAL BE PLACED FOLLOWED BY WATER LINE INSTALLATION.
- TRENCH PAVING FOR AREAS WITH 14-INCH AND 16-INCH WATERLINES SHALL BE 8-FEET WIDE AND MUST BE COMPLETED WITH AN ASPHALT LAY-DOWN MACHINE.
- ALL ASPHALT EDGES SHALL BE FULY COATED WITH EMULSIFIED ASPHALT PRIOR TO PATCHING.

## FIGURE 4.4 TRENCH DETAIL

# 4.4 – CONSTRUCTION METHODS:

## 4.4.1 – Trench Excavation:

*A – General:*

Trench Excavation, Backfill, and Restoration shall be in accordance with Section 2.4 and these specifications. The contractor shall perform all excavations of every description and of whatever substance encountered, to the depths indicated on the drawings (See Figure 4.4).

*B –: Excavation:*

Excavations shall be done with safety in mind for the general public and the workers. OSHA rules and regulations pertaining to trench excavations shall be complied with during construction. All excavations shall be open cut unless otherwise shown on the drawings or approved by the Engineer. Excavations shall be made at least six (6) inches deeper than the bottom of the pipe to provide space for sand bedding to be placed beneath the water line.

*C – Trench Widths:*

Minimum trench widths for a line will be the size of the pipe plus six (6) inches on each side of the pipe. Maximum width of a trench shall be the size of the pipe plus ten (10) inches on each side of the pipe except as otherwise specified by OSHA trenching/shoring rules. Variations may be approved provided there is legitimate reasoning.

*D – Over-Excavation:*

Whenever wet or unsuitable soil/rock, incapable of properly supporting the pipe is encountered in the trench bottom, such material shall be removed to a depth and length designated by the City Engineer, and the trench backfilled with bedding material compacted as specified below (Section 4.4.2B) to provide a proper bedding for the new pipe line.

The bottom of the trench shall be accurately graded to provide uniform bearing and support for each section of the pipe, except for portions of the pipe where it is necessary to excavate for bells and for the proper sealing of pipe joints.

*E – Pavement Cutting:*

Where trenches lie within the Portland Cement Concrete section of streets, alleys, driveways, or sidewalks, etc., such concrete shall be saw-cut (to a depth of not less than 2”) to neat, vertical, true lines in such a manner that the adjoining surface will not be damaged

Asphalt pavement shall be clean-cut, with approved equipment. No ripping or rooting will be permitted outside limits of cuts. Surfacing materials removed shall be hauled from the jobsite immediately, and will not be permitted in the backfill.

All trenching shall conform to OSHA standards.

## 4.4.2 – Backfilling and Compaction:

*A – General:*

After the main or section of pipe is installed, it shall be inspected before any backfill is placed. The trench shall then be backfilled with material in accordance with Section 2.4.2. Protection of pipe during construction shall be the Contractor’s responsibility. Any damage to the pipe due to Contractor’s operations shall be repaired or replaced at the Contractor’s expense. Trenches in existing streets, except streets which are to be closed or abandoned, shall be resurfaced as soon as practicable with the type and thickness of bases and pavement shown in the Contract or as designated herein.

*B – Bedding and Backfill:*

Bedding shall be placed such that the pipe will not be displaced or damaged. Bedding material shall be placed to a minimum depth of six (6) inches below and one (1) foot above the pipe. The depth of bedding above the pipe may be reduced to six (6) inches when the trench is to be backfilled with A.B.C. Class 6. All water main pipes shall be bedded with approved fine sand. Sand bedding shall be of granular material with no more than 15% passing a #200 sieve and at least 90% passing a #4 sieve.

The bedding material, as specified above, shall be placed uniformly on each side to a depth of one (1) foot over the top of the pipe by clam shell, hand shoveling, or other method which will insure protection of the pipe from compaction equipment. It shall be thoroughly worked under the pipe haunches.

*C – Compaction:*

Backfill material within street or alley right-of ways shall be deposited in layers not to exceed six inches (6") and compacted to a minimum of ninety-five percent (95%) of maximum density, as determined by Modified Proctor tests (ASTM D1557). Moisture content of the backfill material shall be plus or minus two percent (2%) of the optimum.

Backfill material in trenches outside of the City street improvements shall be compacted to ninety percent (90%) of maximum density, Maximum density shall be defined by ASTM D1557, Modified Proctor.

## 4.4.3 – Pipe Installation:

*A – General:*

All installations will be in accordance with the manufacturer's recommendation for the particular pipe being installed. The pipe shall be laid accurately to line and grade as designated in the plans.

*B – Product Handling:*

Handling - All pipe and fittings shall be carefully lowered into the trench by means of a hoist, ropes or other suitable tools or equipment in such a manner as to prevent damage to the materials and protective coatings and linings. Under no circumstances and especially in freezing temperatures, shall water main materials be dropped or dumped into the trench. All pipe and fittings shall be carefully examined for cracks or other defects immediately before installation in final position.

*C – Cleaning:*

Cleaning - Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. Spigot and bell ends of pipe and gaskets shall be cleaned and lubricated according to manufacturer's instructions. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. As each length of pipe is placed in the trench, the spigot end shall be centered in the bell and the pipe forced on and brought to correct line and grade. Precautions shall be taken to prevent dirt from entering the joint space. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the City Engineer. If water is in the trench, the plug shall remain in place until the trench is pumped completely dry.

*D – Installation:*

Cutting & Laying Pipe – All pipes shall be laid with bell ends facing in the direction of laying unless otherwise authorized by the City Engineer. Where pipe is laid on a grade of 10 percent (10%) or greater, the laying shall start at the bottom and shall proceed upward with the bell ends of the pipe upgrade. The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damages to the pipe or cement lining and so as to leave a smooth end at right angles to the axis of the pipe. Cutting shall be done by means of approved type of mechanical cutters. Wheel cutters shall be used when practical. Flame cutting of pipe by means of an oxygen-acetylene torch shall not be allowed. No pipe shall be laid when in the opinion of the City Engineer or his representative trench conditions are unsuitable.

*E – Joining Pipe:*

1. Joining Mechanical-Joint Pipe – The last eight (8) inches outside of the spigot and inside of the bell of mechanical-joint pipe shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter from the joint and then painted with gasket lubricant. The cast-iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the socket, or bell, end. The rubber gasket shall be placed on the spigot end with the thick edges toward the gland. The entire section of the pipe shall be pushed forward to seat the spigot in the bell. The gasket shall then be pressed into place within the bell; cast-iron gland shall be removed along the pipe into position for bolting, all of the bolts inserted, and nuts screwed up tightly with the fingers. All nuts shall be tightened with a suitable torque-limiting wrench. The torque for various sizes of bolts shall be as follows:

| Size – Inches | Range of Torque – Ft-Lb |
|---|---|
| 5/8 | 45-60 |
| 3/4 | 75-90 |
| 1 | 100-120 |
| 1 1/4 | 120-150 |

   Nuts spaced 180 degrees apart shall be tightened alternately in order to produce an equal pressure on all parts of the gland. Maximum allowable deflection of mechanical-joint pipe shall be as specified for ductile iron pipe in AWWA C600.

2. Joining Push-On Joint Pipe- -Inside of the bell, the outside of the spigot end and the rubber ring shall be thoroughly cleaned to remove oil, grit, excess coating, and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket. A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the spigot end of the pipe or both. Gasket lubricant shall be as supplied by the pipe manufacturer.

   The spigot end of the pipe shall be entered into the socket with care used to keep the joint from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack-type tool or other device approved by the City Engineer. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field-cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured. Complete assembly instructions are available from the pipe manufacturer.

3. Flanged Joints – Where flanged joints are used, they shall be installed by skilled workman in accordance with the best standard practice. Bolts shall be tightened so as to evenly distribute the joint stress and insure proper alignment. A thin film of gasket lubricant shall be applied to the inside surface of the gasket and flange. Gasket lubricant shall be supplied by the pipe manufacturer.

4. Anchorage – Pressure pipe lines shall be protected against pulling or thrust damage by suitable anchors or bracing installed at all critical points where direction changes as a result of fittings. Concrete thrust blocking shall be of the size indicated in Figure 4.1 and shall bear on solid undisturbed earth. Restraining joints shall be installed per manufacturer's instructions.

5. Deflection of Joints – Maximum offset deflection in inches for pressure pipe joints shall be per manufacturer's recommendations.

   Flexible pipe may be curved in the trench to the limits shown. Do not deflect PVC pipe in joints. Joints must be secured laterally in the trench and deflection must be taken in the barrel of the pipe. Where these specifications conflict with the manufactures recommendations, the more stringent shall apply.

## 4.4.4 – Hydrant Installation:

*A. General:*

Hydrants shall be installed at locations shown on the drawings. Hydrants shall be set to proper elevation and plumb with the hose nozzles parallel to the roadway and with the pumper nozzle facing the roadway. The hydrant shall be connected to the main with a six (6) inch branch controlled by an independent gate valve attached to the flanged end of the tee coming off of the main.

*B. Drainage:*

Hydrant drainage shall be provided at the base of the hydrant by placing a minimum of half a cubic yard of washed coarse gravel in a drainage pit two feet in diameter and three feet deep excavated below the hydrant and filled at least six (6) inches above the waste opening in the hydrant.

## 4.4.5 – Testing and Inspection:

*A. General:*

In addition to any other testing or inspection requirements set forth elsewhere in these specifications, testing, inspection and acceptance of the completed work will be as specified below.

*B. Water Tie-Ins:*

The contractor shall be responsible for all shutdowns and isolation of the existing mains, cutting pipe for the connection, dewatering the excavation, customer notification of the shutdown, and all other requirements as required by the Engineer to provide a complete connection in a safe and secure manner.

The planned shut down and tie-in shall be coordinated through and approved by the City to be accomplished at a time that will be the least inconvenience to the customers.

At all tie-in locations to existing mains, and after successful completion of the leakage test, the dead-ended portions of the new line shall be fitted with temporary thrust blocks provided

by the contractor. These thrust blocks shall be of sufficient strength to withstand required test pressures.

*C. Disinfection, Filling and Flushing:*

Before being placed in service, all new mains shall be chlorinated so that a chlorine residual of not less than fifty (50) ppm remains in the water after twenty-four (24) hours standing in the pipe. Chlorination of the lines shall be performed in accordance with AWWA C601. In the process of chlorinating newly laid pipe, all valves or other appurtenances shall be operated while the line is filled with the chlorinating agent.

Before any filling operations can begin, all main installation shall be complete as shown on the plans. Compaction of backfill material shall be completed and approved. All necessary blow-offs shall have been provided and temporary thrust blocks installed. All permanent concrete thrust blocks must be in place at least seventy-two (72) hours prior to filling the main. The City will fill the pipe with water expelling as much air as is possible through hydrants and blow-offs. At no time will a contractor be allowed to fill the main. The contractor shall provide all necessary help the City may require. When the pipe is full, all valves feeding the system will be closed by the City and the system left in this static condition for a period of not less than twenty-four (24) hours to allow for disinfection of the pipe from the chlorinated water.

After chlorinated water has been left in the main for a period of twenty-four (24) hours, the City Engineer may take samples of the water from blow-offs and fire hydrants. These samples will be tested and must show chlorine residual of not less than 50 ppm. If a chlorine residual of less than 50 ppm is found in the test samples, the main shall be re-chlorinated by the contractor and left in a static condition for an additional twenty-four (24) hours. This process is to be repeated as necessary until chlorine residual requirement is met.

Following chlorination, all treated water shall be thoroughly flushed from the pipeline at its extremities until the replacement water throughout its length shall, upon test by the City, be proved comparable in quality to the water served the public from the existing water supply system and approved by the City Engineer. All flushing operations will be performed by the City Engineer with any necessary help provided by the contractor. At no time shall a contractor initiate flushing operations without the City Engineer in attendance.

*D. Acceptance:*

Pressure and Leakage tests, using AWWA C600 and Section 4 and C605 Section 7 testing procedures shall be required by the City Engineer for lines. Pressure and leakage tests may be performed simultaneously but not until all thrust blocks have been placed and cured for adequate restraint, and the pipeline backfilled to prevent any movement or lifting of the pipe. Pavement or other permanent surface improvements shall not be placed until all pressure and leakage tests are satisfactorily completed. The test shall be of at least two-hour duration and in no case shall the test pressure exceed the design pressure for the pipe, fittings or thrust restraints. Unless otherwise specified, the minimum test pressure for all pipes shall be 1.5 times the working pressure of the segment tested but not less than 150 psi. The working pressure is defined as the maximum anticipated sustained operating pressure. The pressure shall not vary by more than 5 psi for the duration of the test and the allowable leakage shall not exceed the recommended values in accordance with AWWA C600 and C605.

*E. Warranty:*

The pipeline system may be placed in operation after all required cleaning, testing, and inspection have been completed and written permission has been granted by the City Engineer. However, final acceptance of the system by the City will not take place for a period of one (1) year from the date written permission is granted. During this one year period, any defects in the system resulting from defective materials, poor workmanship, or any other cause attributable to the contractor responsible for the construction of the system shall be corrected at his expense, and to the satisfaction of the City Engineer.

## 4.4.6 – Separation of Water and Sewer Lines:

General – Water lines shall be separated from the sanitary sewer horizontally by a distance of 10 feet. This distance shall be measured edge to edge. When local conditions prevent a horizontal separation of 10 feet, the bottom of the water line shall be at least 18 inches above the top of the sewer. Where this vertical separation cannot be obtained, protection of the water line is required by a method of preventing sewer leakage. The sanitary sewer shall be constructed of an approved AWWA pressure rated, leak proof pipe with mechanical restraints located at joints located within 10 feet of the waterline. Where these standards deviate from Colorado Department of Public Health and Environment the more stringent shall apply. No water line shall be located within ten (10) feet of, pass through, or come in contact with any portion of a sewer manhole.

## 4.4.6 – Separation of Water and Other Utility Lines:

This section shall apply to service laterals and main lines. Water lines shall have 5 feet of horizontal separation from any adjacent utility and 18 inches of vertical separation. When conditions prevent horizontal or vertical separation, it will be necessary to obtain a mutually agreeable solution between the affected utility companies.

# SECTION V

# STORM WATER MANAGEMENT

# 5.0 – STORM WATER MANAGEMENT:

SECTION V – GENERAL; DESIGN CRITERIA; DISCHARGE CONTROLS; CULVERT DESIGN; PEAK FLOWS

## *5.1 – GENERAL*

Storm water management and public storm sewer systems shall be designed in accordance with the Construction Design Standards and the Cortez Storm Drainage Criteria Manual.

A – *Storm Drainage System:*

The City Street system in most cases is the primary component of the storm drainage collection system of developed areas. If major drainage ways exist in an area proposed for development, the storm runoff shall be routed to that drainage way in order to protect the natural process of the terrain. When work performed by the developer interferes with the existing drainage system of any street, provision shall be made by the developer to provide proper drainage to the satisfaction of the City Engineer. The purpose of Best Management Practices (BMP's) is to mitigate the adverse impacts of development activity and shall be employed for erosion control, storm water control benefits, and/or pollutant removal capabilities. The various mitigation measures include:

1. Detention Ponds – basins that temporarily store a portion of the stormwater runoff following a storm event. The extended detention time of the stormwater in the basin provides an opportunity for urban surface pollutants carried by the flow to settle out.

2. Retention (wet) Ponds – facilities that provide the dual functions of stormwater quantity and quality control by controlling the volume of stormwater runoff and treating the runoff for pollutant removal through gravity settling, biological stabilization of solubles and infiltration.

3. Infiltration Trenches/Basins – excavated areas which have been backfilled with a course stone media allowing for the formation of a reservoir which collects stormwater runoff and exfiltrates it to permeable subsoil. Reduction of peak flows due to development occurs as a result of routing the flow through the basin.

4. Sand Filters – Structure with bed of sand that provides stormwater treatment where runoff is strained before being returned to a stream of channel. General use is for stream or groundwater protection where infiltration into soils is not feasible.

5. Water Quality Inlets – pre-cast storm drain inlets (oil and grit separators) that remove sediment, oil and grease pollutants, and large particulates from surface runoff before entering other storm drainage systems.

6. Vegetative Practices – non structural BMP's that may be used in conjunction with structural BMP's as a means of pre-treating and reducing runoff peak flows due to development. Several types of vegetative practices can be applied to convey and filter runoff and include grassed swales, filter strips, adsorption, and biological uptake as runoff flow over and through vegetation.

7. Temporary Erosion and Sediment control Practices – applied during the construction process, and final stabilization, unless deemed necessary for permanent stabilization.

8. Porous Pavement – provides for quick transport of stormwater runoff from a paved surface to an underlying stone reservoir before entering other storm drainage systems. Infiltration into the underlying soil may also be provided.

*B – Primary Objective:*

The primary objective of drainage design shall be for the provision of public safety, while minimizing the possible flood damage to surrounding properties and structures. It should be emphasized that good drainage is one of the most important factors in design. It preserves the good appearance as well as the level of service of the street and adjoining property while at the same time minimizing the cost of maintenance.

*C – Civil Law Rule of Natural Drainage:*

The general criteria for drainage systems are based on the Civil Law Rule of Natural Drainage. The development of property must not interfere with natural conditions such as to cause surface water to be discharged in greater quantity or in a different manner upon the downstream adjoining properties. Storm water runoff from a project site shall flow directly into a natural water course, street or storm sewer system, or onto adjacent properties in a manner similar to the runoff characteristics of the predevelopment flow. Said action requires that the following be necessary:

To assure that the maximum rate of stormwater runoff is no greater after development than prior to development activities; or

To manage the quantity, veloCity and direction of resulting stormwater runoff in a manner which otherwise adequately protects the public health and property from possible injury.

*D – Planning Requirements*:

Stormwater facilities that may impact a state highway shall be subject to the approval of the Colorado Department of Transportation (CDOT). Stormwater management design and construction should conform to other applicable recognized federal and state laws.

In the design of stormwater facilities, it is important that consideration be given to the possibility that children or other persons may be attracted to the sight and that the design and construction of such facilities include safety precautions such as the following:

1. Fences should be needed to enclose ponds or depressions with steep side slopes along the periphery.

2. Outflow structures should be designed to limit flow velocities where people could be drawn into the discharge stream.

3. Removable grates and bars should be used for pipes where they present a safety hazard.

4. All structures should be easily and safely accessible. All-weather road access should be provided around aboveground facilities as close to the shoreline as possible for application of mosquito larvicides. Vegetation or other obstacles that might obstruct the path of larvicides to the water should be controlled (removal, thinning, or mowing) periodically.

It should be noted that the location and type of stormwater management facility is very important as it relates to the effectiveness of these facilities to control downstream flooding. Small facilities will only have minimal flood control benefits and will quickly diminish as the flood travels downstream. Multiple storage facilities located in the same drainage basin will affect the timing of the runoff through the City conveyance system which could decrease or increase flood peaks in different downstream locations. Thus it is important for the designer to plan and construct facilities both as drainage structures controlling runoff from the defined area and as a facility that will interact with other drainage structures with the entire basin.

*E – Subsurface Drainage:*

Subgrades subject to poor drainage, underground seepage or a high water table must be adequately drained for stabilization. Drains must be installed to control or prevent the high ground water level from coming to within the roadway pavement, structure or building.

## *5.2 – DESIGN CRITERIA:*

*A – Sizing Storm Drain Systems:*

- The Rational equation is the simplest method to determine peak discharge and shall be used for the design of storm sewer systems form small areas (less than 200 acres).
- For drainage basins over 200 acres and with a time of concentration from 0.1 to 2 hours, calculations similar or equivalent to that identified as the Soil Conservation Service (now known as the Natural Resources Conservation Service) TR-55 method shall be used as presented in the "Urban Storm Drainage Criteria Manual". The NRCS has supplemented the manual for Colorado due to its unique drainage conditions and is presented in "Procedures for Determining Peak Flows in Colorado". In addition, USGS Regression Equations for Southwest Colorado can also be used for estimating peak flows in ungaged streams.

*B –System Design Requirements:*

- Inlets, pipes and other storm sewer systems draining the street surface and adjacent properties shall be designed at a minimum to accommodate the 10-year peak storm runoff.
- Acceptable designs for inlet structures will be permitted on approval by the City Engineer. Curb openings with protection bars are preferred. Grates are not permitted where pedestrians, bicycles, or debris laden flows are anticipated.
- All drainage installations shall also be designed to permit free unobstructed passage of debris and silt, or provide for their deflection and/or collection at a point upstream in such a manner as not to create an expensive maintenance problem or environmental problem.

*C – Detention/Retention Design Requirements:*

- Detention facilities shall be designed to accommodate the storage resulting from a change in runoff due to conversion of an undeveloped site to a developed site. Outlet structures shall be designed to provide discharge that is less than or equal to the pre-development 10-year, 24-hour storm event. The structure must also be designed and sized to safely pass the 100 year, 24-hour post-development event.
- Retention facilities shall be designed to accommodate storage resulting from a change in runoff due to conversion of an undeveloped site to a developed site. Design shall be based on 100-year, 24-hour precipitation frequency.

- Detention/retention facilities shall be employed for developments that have a change in runoff volume that is greater than 0.1 acre-feet, or drainage area of 1 acre or more.
- For developments that have a change in runoff storage volume that is less than 0.1 acre-feet, or a drainage area less than 1 acres, vegetative practices and landscape areas shall be used as a means of controlling runoff.
- Detention/retention facilities shall have grassed swales or landscaped areas designed in developments as an alternative to curb and gutter drainage systems and should provide a transition to channels, inlets, or other receiving drainage systems.

## *5.3 – DISCHARGE CONTROLS:*

*A – Quantity Controls:*

- A reduction in stormwater runoff quantity can be achieved by the storage of runoff in detention/retention basins, storm drainage pipes, swales or channels, and other storage facilities. Outlet controls on these facilities shall be used to reduce the rate of stormwater discharge where existing downstream receiving channels are inadequate to handle peak flow rates from the proposed project, where the development would contribute to increased peak flow rates and aggravate downstream flooding problems, or to reduce the size and associated cost of outfalls from storm drainage facilities.
- The primary function of detention facilities is to store and gradually release or attenuate stormwater runoff by way of an outlet structure or release mechanism. Detention facilities shall be dry and release all the runoff temporarily detained during the storm. The flow channel or bottom of the detention facility must ensure complete removal of water so as not to provide a nuisance.
- Structures shall be designed such that they do not hold standing water for more than 72 hours to prevent mosquito development. Provisions to prevent or reduce the possibility of clogged discharge orifices (e.g., debris screens) should be incorporated into the design. The use of weep holes is not recommended due to rapid clogging.
- Distribution piping and containment basins shall be designed with adequate slopes to drain fully and prevent standing water. The design slope should take into consideration buildup of sediment between maintenance periods.

*B – Quality Controls:*

- Regulatory control for storm water quality BMP's are driven by National Pollution Discharge Elimination System (NPDES) requirements under the Clean Water Act Amendments. Water quality controls include multiple detention ponds, wet ponds, infiltration trenches and basins, porous pavements, sand filters, water quality inlet structures (oil and grit separators), vegetative practices, erosion control practices, and wetlands. Pollutants typically associated with urban runoff include suspended solids, heavy metals, nutrients, and organics. Water quality controls shall be used where predictions indicate that stormwater runoff may significantly impact the water quality of receiving waters or streams.
- The primary function of true retention facilities shall provide for storage of stormwater runoff. The release of stormwater shall be via evaporation and infiltration only. Retention facilities may also be used for irrigation supply, recreation, pollutant removal, and groundwater recharge.
- Permanent ponds shall be designed with appropriate pumping, piping, valves, or other necessary equipment to allow for easy dewatering of the basin when needed.
- Infiltration of stormwater is a zero discharge BMP that infiltrates the entire design volume of stormwater to the surrounding soil and should only be used for relatively rapid permeable soils. The soil shall have a minimum saturated hydraulic conductivity (Ksat) value of 0.5 in/hr for infiltration to be considered feasible.

## *5.4 – CULVERT DESIGN:*

*A – Subdivision Features:*

1. Culverts across City streets are to be designed to accommodate the 24-hour, 50-year frequency storm runoff, utilizing the maximum available head. The maximum available head shall be determined by the uppermost ponding elevation, so chosen as not to cause flood damage to upstream properties. Culverts are to be located at each natural draw or water course as conditions warrant to prevent excessive accumulation of flow in street-side ditches or along the toe of slopes. Draws and water courses are to be cleared of debris for a distance of 100 feet upstream from all culvert inlets.

2. Inverts at the inlet should be slightly elevated above the normal flow line in steep natural draws to avoid plugging by debris. Excessive ponding shall be avoided.

3. The culvert should slope downward in the direction of natural flow and designed to be self-cleaning wherever possible. The outlet should be designed so as not to discharge on unprotected fills or unstable material or at adverse angles to streams or open channels. Headwalls, rip-rap, or other means of protection are required at inlets or outlets where erosion may occur.

*B – Size:*

Minimum diameter for round pipe culverts across driveways and streets shall be 12 inches unless otherwise approved by the City Engineer. The minimum rise of arch pipes and box culverts shall be 12 inches unless otherwise approved by the City Engineer.

## *5.5 – PEAK FLOWS:*

*A – Design Parameters:*

- Storm drain design parameters must be coordinated with the City Storm Drainage Master Plan. Peak flows shall be used for design and analysis of conveyance systems such as storm drains or open channels.
- However, if the design or analysis must include flood routing (e.g. detention or retention storage basins) a flood hydrograph is required The final design of detention/retention facilities requires routing of hydrographs through the facility to provide the desired storage and discharge relationship to the depth of water (stage): . In all cases, calculation sheets shall be submitted clearly showing all assumptions and computations made.
- Calculation of peak flows for small basins, under 200 acres, the Rational Method (Q=cia) shall be used in conjunction with the IDF graph presented in Figure 5.1 that is applicable to the City of Cortez. Table 5.2 presents runoff coefficients that may be used for the calculations.
- The time of concentration may be calculated using acceptable methods as approved by the City Engineer. Calculation sheets clearly showing the method used must be submitted. Computed times of concentration shorter than ten minutes should be rounded upward to ten minutes. TR-55 is valid for drainage areas that have a time of concentration from 0.1 to 2 hours.

**FIGURE 5.1 CITY OF CORTEZ INTENSITY-DURATION-FREQUENCY CURVES**

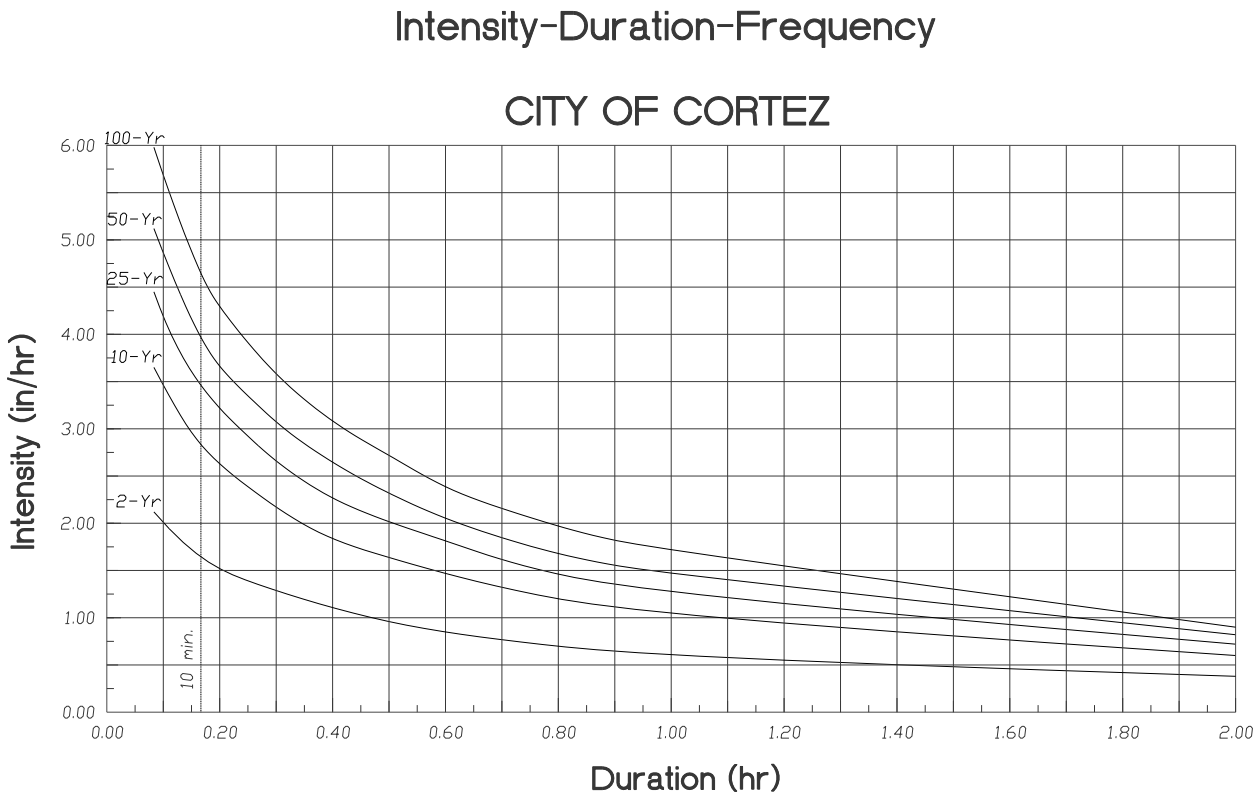



**TABLE 5.2 RUNOFF COEFFICIENTS, "C" VALUES FOR RATIONAL METHOD**

| **Runoff Coefficients** | |
|---|---|
| | |
| Flat or Rolling Terrain | |
| | |
| Farmland | 0.20 to 0.40 |
| Barren | 0.40 to 0.60 |
| Irrigated | 0.60 to 0.70 |
| | |
| Streets and Parking Lots | |
| | |
| Unpaved | 0.60 to 0.80 |
| Paved | 0.70 to 0.95 |
| | |
| Improvements | |
| | |
| Buildings | 0.75 to 0.95 |
| Lawns | 0.10 to 0.40 |
| | |

For flat slopes or permeable soil, use the lower value. For steep slopes or impermeable soil, use the higher value.

## 5.6 Storm Runoff Estimates:

*A – Design Parameters:*

An estimate of required storage volume for detention/retention impoundments can be based on the additional runoff associated with the proposed development and the storm frequency precipitation shown in Table 5.3. The change in stormwater storage volume from developing a site into impermeable surfaces such as roads, parking lots, sidewalks, and rooftops can be estimated using the Rational or NRCS method.

**TABLE 5.3 PRECIPITATION-FREQUENCY – NOAA ATLAS 2, VOLUME III COLORADO**

| STORM FREQUENCY | TOTAL RAINFALL DEPTH (inches) | | | | |
|---|---|---|---|---|---|
| DURATION | 1 Hour | 2 Hour | 6 hour | 12 Hour | 24 Hour |
| 2 Year | 0.61 | 0.75 | 0.95 | 1.16 | 1.36 |
| 10 Year | 1.05 | 1.20 | 1.47 | 1.76 | 2.05 |
| 25 Year | 1.28 | 1.43 | 1.78 | 2.12 | 2.46 |
| 50 Year | 1.47 | 1.64 | 1.99 | 2.38 | 2.76 |
| 100 Year | 1.72 | 1.80 | 2.15 | 2.55 | 2.95 |

*B – Best Management Practices, BMP's:*

Several factors must be considered in determining the suitability of a particular BMP. They include physical site conditions, the drainage basin served, stormwater objectives, and water quality objectives. Table 2.4 presents a matrix that shows site selection criteria for BMP's.

## TABLE 5.4 STORMWATER MANAGEMENT FEASIBILITY CRITERIA

| Best Management Practices (BMP's) | % Impervious Area of Developed Property | Minimum Area Served (Acres) | Soil Type, Hydrologic group, and Minimum Infiltration Rate (in/hr) | | | | | | | | | Overall Pollutant Removal Capability |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Loamy Sand A 2.0 | Sandy Loam B 1.0 | Loam B 0.5 | Silt Loam B 0.27 | Sandy Clay C 0.16 | Clay Loam C 0.08 | Silty Clay Loam D 0.04 | Silt Clay D 0.04 | Clay D 0.02 | |
| Vegetated Filter Strip Grassed Swales | 0-19 | 0-5 | x | x | x | | | | | | | Low |
| Water Quality Inlet Structure | 0-19 | 0-5 | x | x | x | X | x | x | x | x | x | Low |
| Biofiltration / Filter Strips | 0-19 | 0-5 | x | x | x | x | x | | | | | Low to Moderate |
| Porous Pavement | 20-49 | 0-5 | x | x | x | x | x | | | | | Moderate to High |
| Infiltration Trench/Basin | 20-49 | 0-5 | x | x | x | | | | | | | Moderate to High |
| Detention Basins | 50-90 | 5+ | x | x | x | x | x | x | x | | | Moderate |
| Retention Basins | 50-90 | 5+ | | x | x | x | x | x | x | x | x | Moderate |
| Wetlands | 50-90 | 10+ | x | x | x | x | x | x | x | | | Moderate to High |

An X indicates that the type of BMP is feasible. Other restrictions that should be considered are slope, depth of ground water, depth to bedrock, and proximity to buildings, infrastructures, wells, etc.

# SECTION VI

# PUBLIC STORM SEWER SYSTEM SPECIFICATIONS

# 6.0 – PUBLIC STORM SEWER SYSTEM SPECIFICATIONS

SECTION VI – GENERAL: DESIGN CRITERIA: CONSTRUCTION MATERIALS: AND CONSTRUCTION METHODS

## *6.1 – GENERAL*

### 6.1.1 – Description:

This work consists of the construction of culverts, storm drains, and storm sewers hereinafter referred to pipe, conduit, and/or semicircular pipe for encasement in accordance with these specifications and in conformity with the lines and grades shown on the plans or established.

All storm sewer collection systems within easements or the public right-of-way shall be constructed in accordance with these standard drawings and construction specifications of the City. In general, storm sewers or surface drainage channels and culverts shall be installed to direct runoff when the carrying capacity of the street is exceeded such that the spread of flow from the ten-year storm will leave at least one ten-foot lane in each direction. All storm drainage system construction plans shall be approved by the City Engineer prior to beginning of any construction.

The provisions stipulated in this section are general in nature and shall be considered as applicable to all other parts of the specifications, including any supplements and revisions. All storm sewer systems and appurtenances shall be designed by a Registered Professional Engineer, licensed to practice in the State of Colorado.

The requirements of the Cortez Storm Drainage Criteria (CSDC), all Colorado State Agency's specifications, and the Department of Public Health and Environment – Water Quality Control Division shall be followed. The current edition of the Urban Storm Drainage Criteria Manual (USDCM) Volumes 1, 2, and 3 as maintained by the Urban Drainage and Flood Control District shall be regarded as part of these specifications. When any of these specifications are in conflict, the most stringent shall apply.

The "City of Cortez Storm Drainage Criteria," consisting of: (1) the Denver, Colorado, Urban Drainage & Flood Control District's "Urban Storm Drainage Criteria Manual," Volume 1, Volume 2, and Volume 3, Best Management Practices; and (2) the City of Cortez Addendum to the Urban Storm Drainage Criteria Manuals Volumes 1, 2, and 3 (May 8, 2007)," are hereby adopted by reference as the "City of Cortez Storm Drainage Criteria." All facilities for storm drainage, whether public or private, shall be designed and constructed in accordance with such criteria. Any and all amendments to the "City of Cortez Storm Drainage Criteria," including amendments thatadopt codes by reference, shall be reviewed and either adopted or denied by resolution of the City Council.

### 6.1.2 – Related Work:

*A. Maintenance of Existing Utilities: Section 2.1.5*
*B. Excavation, Trench Widths, Pipe Bedding, Shoring-Sheeting-Bracing: Section 2.4.1*
*C. Backfill and Restoration: Section 2.4.2 – 2.4.3*

*D. Concrete Work: Section 3.3*
*E. Quality Assurance: Section 2.2*
*F. Product Assurance: Section 2.3*
*G. Drainage Design: Section 5.0*

## *6.2 – DESIGN CRITERIA:*

### 6.2.1 – Storm Sewer system:

*A – Minor System:*

The complete drainage of stormwater in the City includes both major and minor systems. The minor system consists of the components that have been historically considered as part of the street drainage system. The components of minor storm drainage systems can be categorized by their function as those that collect stormwater runoff from the roadway surface and right-of-way, convey it along and through the right-of-way, and discharge it to an adequate receiving body without causing adverse on-and off-site impacts. These components include streets, curbs, gutters, ditches, and inlets, access holes, pipes, and other conduits, open channels, detention basins, and water quality control facilities. The 10-year frequency storm shall be used for the design or check storm of the minor system components.

*B – Major System:*

The major system provides overland relief for stormwater flows exceeding the capacity of the minor system. The function of major storm drainage systems is to provide flood water relief. This usually occurs during more infrequent storm events such as the 25-, 50-, and 100 year storms. The major system is composed of pathways that are provided for the runoff to flow to the natural receiving streams or creeks. The 100-year frequency storm shall be used for the design or check storm of the major system components.

### 6.2.2: – Location and Cover:

*A – Alignment:*

1. Storm sewer lines, generally, are to be placed along street curb lines in dedicated street rights-of-way or easements and shall be located a minimum of seven (7) feet horizontally from existing or proposed water mains. Furthermore, storm sewers shall be located five (5) feet horizontally and one (1) foot vertically from electric lines.

2. The City shall maintain only storm sewer systems located in public parks, street rights-of-way or easements. Storm drainage systems located on private property shall be maintained by the property owner(s).

3. Storm sewers shall be straight between manholes or inlet structures. Where curves are necessary to conform to the design layout or avoid obstructions, the minimum radius of curvature shall not exceed the maximum deflection recommended by the pipe manufacturer for the type of material being used. The deflection shall be uniform to produce a smooth curve for the finished installation.

4. Pipes, drains, flumes or other concentrated stormwater devices shall not discharge across a sidewalk, but rather shall be piped or channeled through the sidewalk to the gutter flow line.

5. Storm sewer laterals shall connect at manholes, catch basins, curb inlets, or at locations approved by the City Engineer or designated representative.

*B – Cover:*

The minimum cover for all storm sewer pipes shall be 2 feet to finished grade under roads. Depth of storm sewers may be a minimum of one (1) foot measured from the top of the pipe to the proposed surface grade under non-load bearing areas or as approved by the City Engineer. Where possible, storm sewers shall be installed deep enough to accommodate all future extensions and connections that can be foreseen.

## 6.2.3 – Sizing and Design:

*A – Pipe Size:*

1. All storm sewer mains shall be constructed using a pipe with a minimum nominal inside diameter of eighteen (18) inches.

2. Where not covered in the master plan, storm drain pipe shall be sized to transport the flow of a 10-year peak discharge from the fully developed sub-basin in which the development lies.

3. Pipe shall be sized in accordance with the Manning Equation.

$V = (K_v/n) * D^{0.67} * S^{0.5}$ or $Q = (K_q/n) * D^{2.67} * S^{0.5}$

Where:
- $V$ = mean velocity, (ft/s)
- $Q$ = rate of flow, (ft/s)
- $K_v$ = 0.59
- $K_q$ = 0.46
- $n$ = Manning coefficient
- $D$ = storm drain pipe diameter, (ft)
- $S$ = slope of the hydraulic grade line, (ft/ft)

*B – Discharge Design:*

- Peak runoff rates shall be calculated by the Rational Method, NRCS Method, or other suitable procedure. Runoff computations shall be based on rainfall data published by the National Weather Service for this area.(See Figure 5.1)
- Time of concentration (Tc) shall be appropriate for the drainage area in question.

*C – Slope:*

- To prevent deposition of sediments in the system, storm sewers should be designed and constructed to provide velocities of 3.0 feet per second at full flow condition using the minimum design pipe slope. Also, the maximum velocity is not to exceed ten (10) feet per second in the storm sewer lines.
- The minimum slope of storm sewers with smooth interiors shall not be less than 0.5%. The minimum slope of cmp culverts or storm drains shall not be less than 1.5% (12-inch minimum pipe).
- Between Manholes – The slope between manholes or catch basins must be uniform.
- Storm sewer laterals – Service laterals shall have a minimum of one percent (1%) slope.

## 6.2.4 – Manholes and Inlets:

*A – General:*

- The primary function of a manhole or inlet structure is to allow surface water to enter the storm drainage system and to provide convenient access to the system for maintenance, cleaning, and inspection. As secondary functions, manholes and inlets serve as flow junctions and can provide ventilation and pressure relief for storm drainage systems (See Figure 6.1).
- Pipe shall not project into a drainage structure but shall be finished flush with the inside of the structure.
- Cleanout access shall be provided at least every 400 feet for pipes 24 inches in diameter or less, and at least every 600 feet for larger pipes. Cleanout accesses shall also be required at each angle point and at each change in grade.

*B – Location and Spacing:*

- Manholes and/or inlet structures shall be installed at all low points in the gutter grade, changes in grade, size, or alignment; at all intersections of two or more storm sewers; and at distances not greater than 400 feet for storm sewers 24 inches or less, and not greater than 600 feet for larger storm sewers.

- Inlets must be constructed at all necessary locations where side drainage enters streets. The inlets shall be located to intercept the channelized flow and prevent drainage from crossing street improvements.

- Inlets should be located at intersections to prevent street cross flow which could cause pedestrian or vehicular hazards. Intersection inlets should be placed on the tangent curb sections near corners and not located within walkway areas.

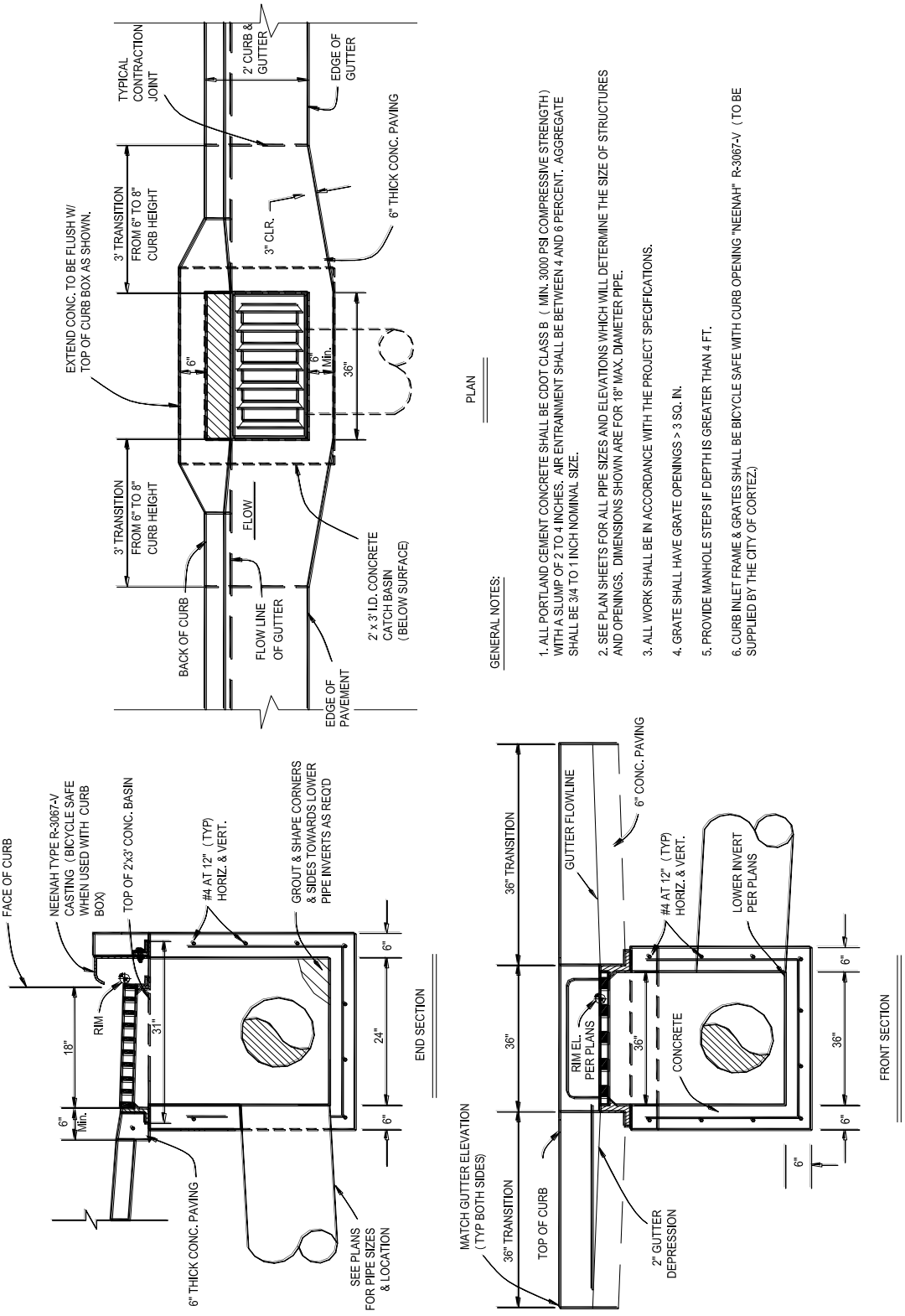



FIGURE 6.1 CURB INLET

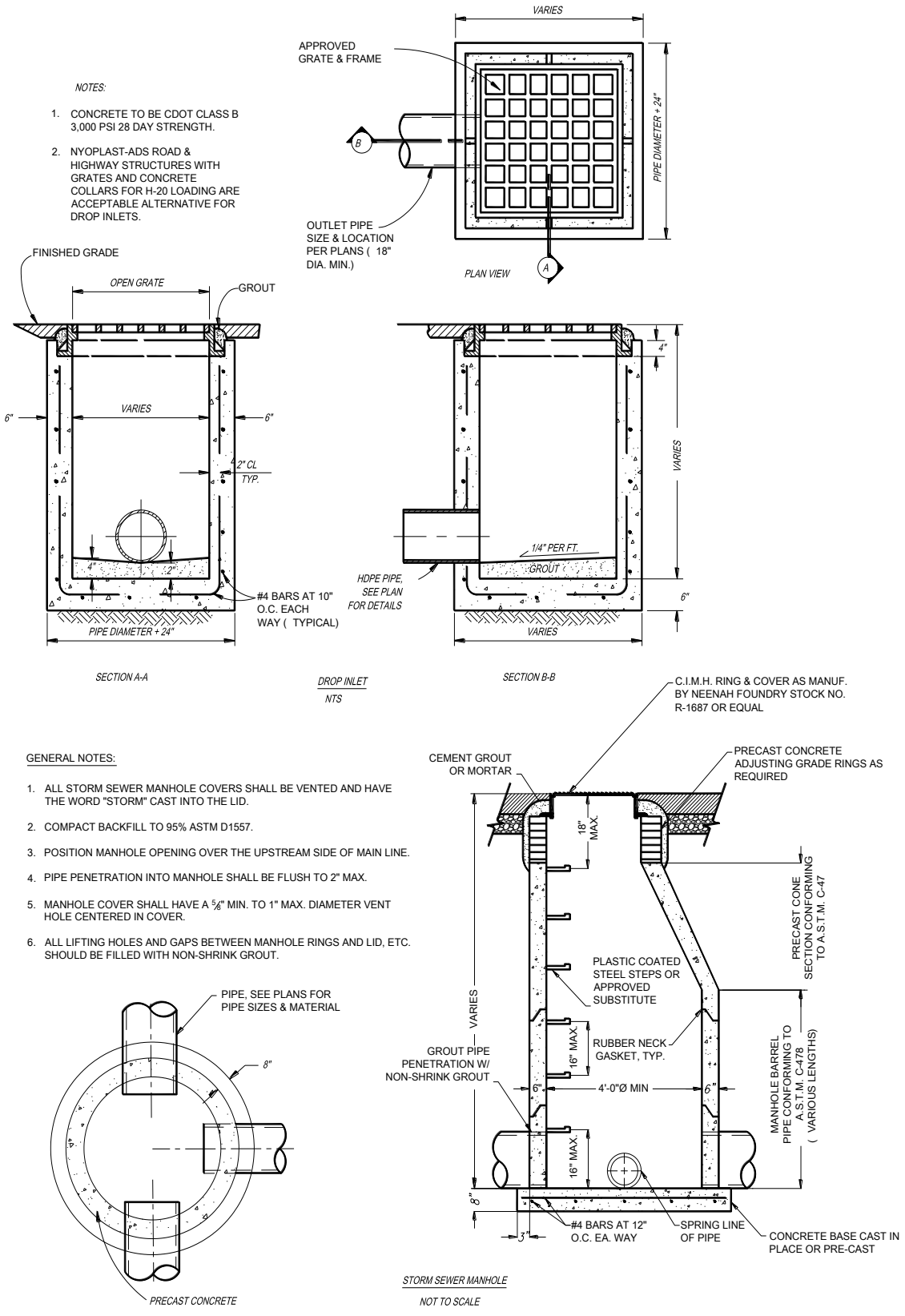



**FIGURE 6.2 STORM DRAIN MANHOLE/CATCH BASIN**

### 6.2.5 – Outlets and Discharge Controls:

- Outlets to the major drainage system shall be located above the 10-year flood level and shall provide protection against scour or erosion.

- Several aspects of the outfall design must be given serious consideration. These include the flowline or invert (inside bottom) of the proposed storm drain outlet, tailwater elevations, the need for energy dissipation, and the orientation of the outlet structure.

- Flared end sections shall be installed on single pipe culverts up to and including 60 inches in diameter, and on multiple pipe culverts up to and including 36 inches in diameter.

- Headwalls and endwalls shall be installed on single pipe culverts greater than 60 inches in diameter, and on multiple pipe culverts greater than 36 inches in diameter.

## *6.3 – CONSTRUCTION MATERIALS:*

### 6.3.1 – Joining System:

The requirements of this specification are intended to provide pipe and fittings for gravity flow underground use in non-pressure storm drainage applications. Couplings and fittings for use with non-pressure pipe shall be of the same materials and in compliance with the requirements specified for the pipe. Couplings and fittings for use with all pipes shall provide for soil tight, silt tight, and water tight joints meeting ASTM D-3212. Gaskets shall conform to ASTM F-477 to effectively reduce infiltration and exfiltration. Solvent welded joints shall not be permitted.

The use of plastic pipe in low cover with heavy wheel loads and high cover applications shall not be allowed without approval from the Engineer. For culvert and/or storm drain applications, the exposed ends of some types of plastic pipes need protection from exposure to ultraviolet, thermal cycles, etc. Concrete or metal end sections, headwalls, or other end protection is required.

### 6.3.2 – Pipe:

The actual depth of cover, live loads, and field conditions may require structurally stronger or more durable pipe than the minimums stated here. Materials that are allowed for use in public right-of-way are as follows:

*A – Metal Pipe:*

1. Spiral rib and corrugated metal pipe (cmp) shall be zinc (galvanized) or aluminum (Type II) coated conforming to ASTM A-760 (AASHTO M-36).
2. Corrugated and spiral rib aluminum alloy pipe shall conform to ASTM B-745 (AASHTO M-196).
3. Polymeric pre-coated cmp shall conform to ASTM A-762 (AASHTO M-245).
4. Corrugated steel structural plate for field-bolted pipe, pipe-arches and arches shall conform to ASTM A-761 (AASHTO M-167).

*B – Polyvinyl Chloride (PVC) Pipe:*

1. Type PSM PVC for pipes 8 to 15 inches in diameter shall conform to ASTM D-3034 specifications with a SDR rating of 35. Pipe shall have the words “STORM DRAIN”

repeatedly marked along the outside with permanent ink so as not to conflict with sanitary sewers.
2. Solid Wall PVC for pipes 18 to 36 inches in diameter shall conform to ASTM F-679 with a SDR rating of 26.
3. Ribbed PVC pipe for sizes 8 to 48 inches in diameter shall conform to ASTM F-794 (AASHTO M-304)
4. Corrugated PVC pipe for 8 to 18 inches in diameter shall conform to ASTM F-949

*C – High Density Polyethylene (HDPE) Pipe:*

1. Corrugated PE pipe shall be smooth interior, conforming to ASTM F-892 or AASHTO M294 Type S for twelve (12) inches up to forty-eight (48) inches in diameter
2. Corrugated (PE) Pipe larger than forty-eight (48) inches in diameter up to sixty (60) inches shall conform to AASHTO MP-7.
3. Ribbed PE pipe larger than 18 inches in diameter shall be smooth interior conforming to ASTM F-894.

*D – Concrete Pipe:*

Concrete Box Culvert or concrete pipe shall be used with approval from the Engineer.

## 6.3.3 – Concrete Structures:

*A – Bedding:*

Pre-cast or cast-in-place concrete manholes and boxes for storm inlets and vaults shall be placed on a minimum of 6 inches compacted CDOT Class 6 granular bedding, uniformly supported, in correct alignment and at proper grade. Compaction of bedding shall be to a minimum of 90% of the maximum dry density as defined by a Modified Proctor, ASTM D1557.

*B – Manhole / Inlet Specifications:*

1. Manholes shall have inside box dimensions no less than 4 feet. Storm drain curb inlets shall have minimum inside dimensions of 2 feet wide by 3 feet across the front as referenced in Figure 5.1 Maximum pipe size for box is 36 inches and maximum pipe size for curb inlets shall be 18 inches. For larger pipes increase the inside box dimensions to the ID of the pipe plus 12 inches. Maintain a 6” clearance between the pipe and walls or top slab. Maximum allowable inside box size is 72 inches.

2. Manhole steps, plastic coated, shall be cast into the box wall at the same time the manhole section is cast. The steps shall be no more than 24 inches from the top of the manholes, nor more than 16 inches from the bench of the manhole and shall be spaced no more than 16 inches apart. Steps shall be required when the depth from the finished grade to the inlet exceeds 4 feet.

3. Manholes, inlets and catch basins shall be constructed of reinforced concrete or pre-cast reinforced concrete. Precast reinforced concrete manhole risers and sections shall conform to ASTM C-858 standards. Concrete shall be Type I/II and shall be at a minimum 4000 psi at 28-day compressive strength, with ASTM A-615 Grade 60 reinforcing steel rated for AASHTO HS-20 loading.

*C – Headwalls and Endwalls:*

1. Headwalls and endwalls shall be cast in place or precast with wingwalls and apron by an approved manufacture. Installation of headwalls and endwalls shall be as specified on the plans.

2. Flared end sections shall be by an approved manufacturer and must be compatible with the drainage pipe in accordance with the manufacturer's requirements.

### 6.3.4 – Miscellaneous:

*A – Frame and Cover:*

Frame and covers shall be 24-inch inside diameter and 350 lb. Cast iron (both) for local streets, and 400 lb. cast iron for collector streets. Manhole covers shall be of a solid construction.

*B – Concrete and Grout Mortar:*

Concrete and Grout Mortar – Concrete or cement grout shall be of Portland Cement Type II quality. The grout used to fill in cracks shall be one part Portland cement and not more than three, nor less than two, parts of fine aggregate. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 5 ½ gallons per sack of cement.

*C – Underground Marking Tape:*

See Section 2.4.5.

## *6.4 – CONSTRUCTION METHODS:*

### 6.4.1 – Trench Excavation:

*A – General:*

Trench Excavation, Backfill, and Restoration shall be in accordance with Section 2.4 and these specifications. The contractor shall perform all excavations of every description and of whatever substance encountered, to the depths indicated on the drawings. When new storm sewer facilities interfere with the existing flow of systems, the Contractor shall provide satisfactory bypass facilities at no expense to the City.

*B – Excavation:*

When pipe is to be jacked, trenching will not be permitted. Pipe must be jacked without disrupting traffic. Methods of installing pipe other than by jacking may be used only with written approval from the City Engineer. Any method that may cause damage to the embankment or roadway area will not be approved. Damage to the pipe or installation area caused by jacking operations shall be repaired or replaced at the Contractor's expense. The area around the outer surface of the pipe shall be thoroughly grouted. The grout mixture shall consist of one part Portland cement and three parts of fine aggregate by volume, or it may be determined by prior documented experience with similar materials, equipment, and field conditions. The grout shall be thoroughly mixed with the minimum quantity of water needed to obtain the proper consistency for the existing soil conditions.

*C – Trench Widths:*

Minimum trench widths for a line will be the size of the pipe plus six (6) inches on each side of the pipe. Maximum width of a trench shall be the size of the pipe plus ten (10) inches on each side of the pipe. Variations may be approved by the City Engineer provided there is legitimate reasoning.

*D – Over-Excavation:*

Whenever soil unsuitable for proper support of the conduit or rock that may damage the conduit is encountered, such material shall be removed to a depth and length designated by the City Engineer. The trench shall then be backfilled to the proper support elevation with structural fill materials compacted to 90% of a Modified Proctor, ASTM D 1557.

The bottom of the trench shall be accurately graded to provide uniform bearing and support for each section of the pipe, except for portions of the pipe where it is necessary to excavate for bells and for the proper sealing of pipe joints.

*E – Pavement Cutting:*

Where trenches lie within the Portland Cement Concrete section of streets, alleys, driveways, or sidewalks, etc., such concrete shall be saw-cut (to a depth of not less than 2") to neat, vertical, true lines in such a manner that the adjoining surface will not be damaged.

Asphalt pavement shall be clean-cut, with approved equipment. No ripping or rooting will be permitted outside limits of cuts. Surfacing materials removed shall be hauled from the jobsite immediately, and will not be permitted in the backfill.

All trenching shall conform to OSHA standards.

## 6.4.2 – Backfilling and Compaction:

*A – General:*

After the conduit or section of conduit is installed, it shall be inspected before any backfill is placed. Any conduit found to be damaged shall be replaced, and conduit found to be out of alignment or unduly settled shall be removed and properly installed to grade. The trench shall then be backfilled with material in accordance with Section 2.4.2. Special care shall be taken when backfilling around conduit to bring the backfill materials up on both sides of the conduit, evenly and simultaneously. Protection of conduits during construction shall be the Contractor's responsibility. Any damage to the conduit due to Contractor's operations shall be repaired or replaced at the Contractor's expense. Trenches in existing streets, except streets which are to be closed or abandoned, shall be resurfaced as soon as practicable with the type and thickness of bases and pavement shown in the Contract or as designated.

Backfill material shall consist of sound earth material free from frozen materials, large rocks, broken concrete, timber, and other debris. No large rocks over six (6) inches in size will be permitted as backfill in the trench.

*B – Bedding and Backfill:*

All storm conduit shall be bedded with a select material having no rocky material over one (1) inch in diameter. Bedding will be added to a minimum of one (1) foot above the top of the pipe. In street areas that require gravel backfill, the depth of bedding above the pipe may be reduced to six (6) inches.

The bed shall consist of a layer of proper bedding material not less than six (6) inches in thickness below the conduit. Recesses shall be made to accommodate the bell and-spigot pipe. Adjustments to line and grade shall be made by scraping or filling under the body of the conduit. Wedging or blocking the bell will not be permitted. Bedding for all pipes shall be so placed and compacted that the pipe will not be displaced or damaged.

The pipe shall be backfilled uniformly on each side with material to a depth of one (1) foot over the top of the pipe by clam shell, hand shoveling, or other method which will insure protection of the pipe from compaction equipment. It shall be thoroughly worked under the pipe haunches and compacted to density hereinafter specified.

In cases of unsuitable material in the trench bottom, the engineer may require over excavation, the addition of perforated drainpipe and washed rock at his/her discretion.

*C – Compaction:*

Bedding material shall be deposited in the trench bottom and proof compacted to properly support the conduit. Bedding material in excess of six (6) inches in depth shall be compacted to ninety (90%) percent of a Modified Proctor, ASTM D1557.

Backfill material within street or alley right-of ways shall be deposited in layers not to exceed eight inches (8") and compacted to 95% of maximum dry density, as determined by Modified Proctor tests (ASTM D1557). Moisture content of the backfill material shall be plus or minus two percent (2%) of the optimum.

Backfill material in trenches outside of the City street improvements shall be compacted to 90% of maximum dry density; as defined by Modified Proctor ASTM D1557.

## 6.4.3 – Pipe installation:

*A – General:*

All installations will be in accordance with the manufacturer's recommendation for the particular pipe being installed. The pipe shall be laid accurately to line and grade as designated in the plans.

*B – Product Handling:*

All pipe and fittings shall be carefully lowered into the trench by means of a hoist, ropes or other suitable tools or equipment in such a manner as to prevent damage to the materials and protective coatings and linings. Under no circumstances shall pipe be dropped or dumped into the trench. All pipe and fittings shall be carefully examined for cracks or other defects immediately before installation in final position.

Coating on corrugated steel pipe and pipe arches, and corrugated steel pipe arch shall not be damaged. Damaged pipe shall not be repaired. The Engineer will determine when the pipe is either acceptable or unacceptable in accordance with the provisions of Section 2.3. Unacceptable pipe will be removed and replaced.

*C – Cleaning:*

Storm sewers and all appurtenances shall be thoroughly cleaned before final acceptance of this work. Proper implements, tools, and facilities satisfactory to the City Engineer shall be provided and used by the contractor for the safe convenient prosecution of the work. Every precaution shall be taken to prevent foreign material from entering the pipe. If the pipe cannot be placed without getting debris in the pipe, the Engineer may require that before lowering the pipe into the trench, a heavy, tightly-woven canvas bag of suitable size be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing, or other materials shall be placed in the pipe. Water shall not be allowed in the trenches while the pipe sections are being laid nor shall water be allowed to rise around the joint until it has set. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a water-tight plug or other means

approved by the City Engineer. If water is in the trench, the plug shall remain in place until the trench is pumped completely dry.

*D – Installation:*

The laying of pipe shall commence at the lowest point and proceed upgrade so that the lower segment of the conduit shall be in contact with the prepared bedding throughout its full length.

Bell or groove ends of concrete pipe and outside circumferential laps of metal or plastic conduits shall be placed facing upstream. The pipe shall be placed in such a manner that the specified bedding provides a solid, unyielding, uniform bearing surface for the full length of the barrel.

Bell holes shall be provided at all joints. Equipment used in handling and jointing the pipe shall have adequate capacity to handle the pipe smoothly and assure proper closure of joints.

All pipes shall be carefully centered, so that when joined together they will form a conduit with a smooth, uniform invert. The pipe shall be laid accurately to the grade and alignment specified on the drawings. Blocking or wedging of the pipe to achieve proper positioning and grade will not be permitted, except where required for the proper construction of concrete cradles or easement.

When batter boards are used to determine line and grade of the pipe being installed, the maximum spacing between batter boards shall be twenty-five (25) feet. A minimum of three batter boards shall be set at all times while pipe laying is in progress.

At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the City Engineer. If water is in the trench, the plug shall remain in place until the trench is pumped completely dry.

*E – Joining Pipe:*

1. Metal Conduit. Corrugated metal pipe sections shall be placed and aligned to within 19 mm (¾ inch) of the adjacent section and shall be firmly joined with either one-piece or two-piece coupling bands. Pipe with helical corrugations shall be joined with the corrugations matched across the joints and with all corrugations of the pipe completely engaged by the corrugations or dimples of the coupling band.

   Where existing corrugated metal pipe culverts are to be extended, damaged ends shall be cut off or repaired in an approved manner. All ends of pipes requiring extensions shall be cleaned within the area necessary for proper installation of connecting bands.

   Arch culverts shall be extended with pipe having a compatible arch shape.

   When special joint treatment is called for on the plans to prevent infiltration or exfiltration, the joints shall be made using a sealing compound conforming to manufactures recommendations, with the connecting band.

2. Plastic Conduit. Couplings shall be as recommended by the conduit manufacturer.

## 6.4.4 – Waterline Protection:

Should the condition exist where a storm sewer main, electric line, gas line, or telecommunication line must be constructed crossing above or below a water main, the minimum clear distance vertically shall be eighteen (18) inches. When sewer lines cross above water mains or within a vertical clear distance of eighteen (18) inches below water mains, the crossing must be so designated on the plans and must be constructed so as to protect the water main. Minimum water main protection under these conditions shall consist of the installation of an impervious and structural storm sewer (e.g. ductile iron pipe) for a distance of ten (10) feet each side of the water main. In all cases, suitable backfill or other structural protection shall be provided to preclude settling, freezing, and/or failure of the higher pipe.

## 6.4.5 – Manhole / Inlet Construction:

*A – General:*

- Manholes shall be constructed at the locations and to the elevations indicated on the drawings. Manholes shall be constructed so as to form a circle in a horizontal plane. The internal diameter for four (4) foot manhole barrels shall be maintained to a distance of not more than four (4) feet below finished grade. From that point the manhole barrel shall be tapered to the 24-inch internal diameter for four (4) foot diameter manholes.
- The cone section shall not extend closer than eight (8) inches and not more than 16 inches from the top of the manhole cover. Precast concrete adjustment rings shall be used on top of the cone to support and adjust the manhole frame to the required final grade.
- The horizontal joints between precast manhole sections above the water table shall be plastered and troweled smooth, inside and outside, with Portland cement mortar. The mortar shall be not less than five-eighths (5/8) of an inch in thickness over the joint, and shall extend at least four (4) inches either side of the joint. The joint between the manhole base and the lowest precast selection shall be grouted, inside and outside.
- Where the storm sewer main enters the manhole, necessary measures shall be taken to prevent any infiltration of groundwater into the system. The manholes shall be constructed to insure watertight construction.

*B – Manhole Bases:*

Except as otherwise approved by the City Engineer, the manhole bases shall be constructed as shown on Figure 6.2. Changes in direction of the flow through the manhole shall be made with a smooth curved channel having as large a radius as possible. The change in size of channels shall be made gradually and evenly and shall be formed directly in the concrete. The floor of the manhole outside of the channel shall be finished to a smooth surface and shall slope to the channel. The minimum thickness of the base shall not be less than six (6) inches under the invert of the manhole channel.

The conduit should be laid continuously through manhole locations wherever grade and alignment permit, and the manhole built later. In such cases, the foundation shall be laid and carried up approximately to the center of the pipe. After the manholes are built, the upper half of the pipe shall be cut out and the bottom finished.

*C – Inlets:*

Where inlets are placed in existing curbs or gutters, the Contractor shall carefully remove sections of present curb and/or gutter. All damage to sections to remain in place shall be repaired at the Contractor's expense. The top portion of inlets shall be constructed concurrently with the adjacent curb and gutter to insure proper alignment of grades unless otherwise permitted in writing.

*D – Existing Manhole Tie-Ins:*

Pipe connections to existing manholes or inlets, where there is no existing pipe stubbed out, shall be made in such a manner that the finished work will conform as nearly as practicable to the essential requirements specified for new work. The contractor shall core drill an opening in the existing structure as necessary to insert the new conduit. The existing concrete foundation bench shall core drilled to the cross-section of the new pipe in order to form a smooth continuous invert similar to what would be formed in a new concrete base. Cement grout shall be used to smoothly finish the new invert and to seal the new line so the junction is watertight.

*E – Backfill and Surface Replacement:*

Unless otherwise directed, all excavations shall be backfilled immediately after the structures are built. Backfilling shall conform with Section 5.4.2 and as shown on the plans.

Surface Replacement - Excavations in existing streets shall be replaced as per Section 2.4.3 – Pavement and Surface Replacement.

Cleaning - The structures and all appurtenances shall be thoroughly cleaned before final acceptance of the work.

## 6.4.6 – Testing and Inspection:

*A – Inspections:*

Inspections required during construction will be as follows:

- After the trench has been dug and is ready for the pipe to be laid.
- When the line is laid and bedding added to two-thirds (2/3) the height of the pipe.
- After backfill is placed and test have been performed.
- Inspect manhole base after concrete placement.
- Inspect the Manhole or Inlet prior to backfill.

Obstruction Inspection – After compaction of fill material has been completed the City Engineer will flash a light through the installed pipe between manholes to check for true alignment, obstructions, and to see that no pipes are broken. All storm sewer mains must be cleaned and free of obstructions before acceptance by the City. Any obstructions shall be removed and unsatisfactory construction replaced as required by the Engineer at the contractor's expense

*B – Acceptance:*

Acceptance – Acceptance of line will take place upon the satisfactory completion of all requirements of these specifications. The contractor or developer will be responsible for any defects in workmanship or materials occurring within one year from date of acceptance.

## 6.4.7 – Miscellaneous Drains:

*A – General:*

This work consists of constructing under drains, edge drains, geo-composite drains, and French drains, in accordance with these specifications and in conformity with the lines and grades shown on the plans or established.

*B – Materials:*

Pipe for subsurface drains shall be any type of pipe material listed above. Subsurface drain outlet pipe may be perforated or non-perforated, and shall meet the requirements specified herein.

The trench shall be excavated to the dimensions and grade shown on the plans. Sufficient Geo-textile shall be placed along the bottom and sides of the trench as shown on the plans to provide the required overlap over the top of the filter material. Filter material of the class designated on the plans shall be placed in the bottom of the trench for its full width and length. Perforated pipe shall be placed with the perforations oriented to allow the lowest adjacent water level to drain into the pipe, and positively drain out of the pipe without exiting back through the perforations. Joining shall conform to the applicable requirements of Subsection 6.4.3 except as noted above.

After the pipe installation has been inspected and approved, the designated filter material shall be placed to a height of 300 mm (12 inches) above the top of pipe. Care shall be taken not to displace the pipe or the covering at open joints. The remainder of the filter material shall then be placed to the required height, the drainage geo-textile folded over the top of the filter material, and the remainder of the trench backfilled.

*C – Geo-composite Drains:*

The geo-composite drain for subsurface drainage behind a retaining wall shall be placed along the full length of the wall. It shall be attached to the wall with an approved adhesive or in accordance with the manufacturer's recommendations. The trench for geo-composite under drain and geo-composite edge drain, for subsurface drainage at pavement edge and elsewhere as specified on the plans, shall be excavated to the dimensions and grade shown on the plans. The geo-composite drain material shall then be placed along the downhill side, or the pavement side, of the trench and secured to the trench side. Backfill shall be placed so as to avoid damage to the geo-composite drain material.

*D – French Drain:*

The trench for French drain shall be excavated to the width and depth shown on the plans. The trench shall be lined with Geo-textile and filled with the designated filter material to the depth shown on the plans. The drainage geo-textile shall be folded over the top of the filter material. Any remaining unfilled upper portion of trench shall be backfilled with embankment material.

*E – Subsurface Drain Outlet:*

The trench for subsurface drain outlet shall be excavated to the width and depth necessary to place the pipe on a drainable grade, as shown on the plans or as directed. Pipe shall be laid in the trench with all ends joined securely with the appropriate couplings, fittings or bands. After inspection and approval of the pipe installation, the trench shall be backfilled and compacted in accordance with Subsection 6.4.2. Where the outlet pipe ends on a slope or ditch, it shall be constructed with an erosion control pad, and an animal guard as required by the Engineer. The animal guard screen shall be held securely in place with a coupling or fastening band or by another approved method.

# SECTION VII

# SITE CONSTRUCTION STANDARDS

# 7.0 – SITE CONSTRUCTION STANDARDS

SECTION VII – GENERAL; DESIGN CRITERIA; CONSTRUCTION MATERIALS; AND CONSTRUCTION METHODS

## *7.1 – GENERAL*

### 7.1.1 – Description:

All site work for commercial, industrial, and institutional projects within the City shall be constructed in accordance with these standard drawings and construction specifications. In general, uses that require a site plan pursuant to Section 6.14 of the Cortez Land Use Code shall be developed to comply with local building codes, provide structural integrity, comply with barrier free accessibility, include adequate means of egress, and protect the health, safety, and welfare of the general public. All plans for site work of commercial/industrial or institutional projects shall be approved by the City Engineer prior to beginning of any construction.

### 7.1.2 – Related Work:

*A. Maintenance of Existing Utilities: Section 2.1.5*
*B. Excavation, Trench Widths, Pipe Bedding, Shoring-Sheeting-Bracing: Section 2.4.1*
*C. Grading, Backfill and Restoration: Section 2.4.2 – 2.4.3*
*D. Concrete Work: Section 3.3*
*E. Quality Assurance: Section 2.2*
*F. Product Assurance: Section 2.3*
*G. Drainage Design: Section 2.6*

## *7.2 – DESIGN CRITERIA:*

### 7.2.1 – Requirements:

The provisions stipulated in this section are general in nature and shall be considered as applicable to all other parts of the specifications, including any supplements and revisions. All site construction documents shall be designed by a Registered Professional Architect or Engineer, licensed to practice in the State of Colorado unless the project is exempt under the Colorado Architect / Engineer Practice Act.

*A – Construction Documents:*

The required construction documents for most projects shall be based on the following general design guidelines pursuant to the Cortez Land Use Code:

1. Occupancy group or load
2. Type of Construction classification
3. Location of property
4. Geological / Environmental Hazards
5. Design loads
6. Structural / Mechanical systems
7. Square footage / Allowable floor area
8. Fire protection requirement

9. Height and number of stories
10. Land use zone

*B. Access to Buildings*

Access must be provided for fire department apparatus by way of an approved access road with an all-weather driving surface capable of supporting the imposed load of fire apparatus weighing at least 75,000 pounds.

*C. ADA Requirements*

Projects shall comply for newly constructed public spaces, buildings and facilities and/or comply for altered portions of existing public spaces, buildings and facilities unless otherwise exempt as specified under the current ADA regulations.

*D. Street Parking*

On-street parking for street right-of-way shall be parallel only. Off-street parking shall be provided as determined in the Land Use Code. Any proposed variation from the standard on-street parking provisions must be approved by the City.

*E. Landscaping*

Landscape areas must be planned to contribute to safety and on-site drainage. Landscaping must not create visual obstructions to motorists or pedestrians, particularly at intersections and access points. The planning of landscaping adjacent to City streets shall give consideration to the location of existing or proposed underground utilities and surface improvements. No street trees shall be planted closer than twenty (20) feet from any street corner, measured from the point of nearest intersection curbs or curb lines. No street trees shall be planted closer than ten (10) feet from any fire hydrant.

*F. Sewage Disposal*

Sanitary sewage disposal shall comply with Colorado Department of Public Health & Environment regulations.

*G – Driveways and Curb Cuts:*

1. A maximum of 3 curb cuts per dwelling unit is allowed in Residential zones. The minimum width shall be 16 feet for residential driveways. Driveway cuts shall not exceed 50% of the lot frontage. Driveways must not be located within 30 feet of an intersection as measured from the street outside curb line. Driveways shall be a maximum of a 10% grade differential.

2. Commercial driveway cuts shall not exceed 50% of the lot frontage. The minimum width shall be 16 feet for one-way commercial driveways and 25 feet for two-way commercial driveways. Widths of 25 feet to 35 feet shall be used for two-way accesses when any of the following occur:

    a. Vehicle volume exceeds 5 DHV – (all highways in Cortez are at 10 DHV or greater)
    b. Multi-unit vehicles will use the access
    c. Vehicles that exceed 30 feet in length will use the access
    d. Special Equipment using the access will exceed 16 feet in width

3. One-way accesses shall be 16 feet to 24 feet wide. If two one-way accesses are parallel to each other, they will be separated by a median 4 feet to 25 feet wide. Access to

properties adjacent to state highways shall comply with CDOT access category requirements based on the National Highway Functional Classification.

*I – Site Demolition:*

1. The demolition and removal of structures and disconnection, capping, and removal of affected utilities shall conform to the applicable building code. Procedures shall ensure the safety of the public and adjacent structures, dust control, stormwater runoff control, disposal and requirements for hazardous or contaminated materials. Demolition, removal sequence, location of salvageable items, location of barricades, fences and temporary work shall be indicated on the plans. Buildings indicated to be demolished will be vacated before start of work. The City shall be notified upon discovery of hazardous materials.

2. Abandoned utilities shall be removed from the site to termination points shown on the drawings.

## *7.3 –CONSTRUCTION MATERIALS:*

### 7.3.1 – Site Grading:

Construction materials shall conform to Section 2.4.2.

*A – Topsoil and Subsoil:*

Topsoil and subsoil material used for fill and grading purposes shall be classified in accordance with ASTM D2487 and should reference the subsurface soil conditions outlined in the project Geotechnical Report. Gradation shall be in accordance to ASTM C136. Subgrade soil types may be excavated reconditioned soil material, native to the project, imported soil material, or well-graded structural material.

### 7.3.2 – Cast-In-Place Concrete:

*A – Cement:*

Portland type in conformance to ASTM C150. A Type II sulfate resistant Portland cement shall be used unless project requirements specify a different type cement.

*B – Aggregate:*

Aggregates shall be a blend of local coarse and fine concrete aggregate Fine aggregate for concrete shall conform to the requirements of AASHTO M6 or ASTM C33. Coarse aggregate for concrete shall conform to the requirements of AASHTO M80 or ASTM C33.

*C – Water:*

Water shall be clean and not detrimental to concrete.

*D – Admixtures:*

Admixtures for air entrainment, workability properties, setting time, and corrosion resistance shall be furnished in accordance with CDOT standards for the intended type and use of concrete. Admixtures shall conform to ASTM standards.

*E – Reinforcing Fibers:*

High strength industrial-grade fibers in conformance with ASTM C1116 specifically engineered for secondary reinforcement of concrete shall be furnished for the intended type and use of concrete.

*F – Concrete Mix:*

Concrete mix design shall be in accordance with ACI 301 and delivered in accordance with ASTM C94. Concrete shall be tested at the point of discharge.

## 7.3.3 – Manholes and Utility Structures:

*A – Manhole & Sections:*

Precast Manhole and structure sections shall be reinforced concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.

*B – Cast-In-Place Manhole & Sections:*

Manhole and structure sections shall be reinforced cast-in-place concrete as specified in Section 6.3.3.

*C – Polyethylene Manholes:*

Polyethylene manholes and accessories may be used where corrosive wastewater or chemicals are to be transported.

*D – Frames and Covers:*

Frames and covers for public storm sewer systems shall be supplied by the City, and shall be from the Neenah Foundry. Covers shall be pedestrian and bicycle safe, and shall be in accordance with ASTM A48, cast iron construction, or ASTM A536 for ductile iron castings, meeting the required loading designated for the intended use.

## 7.3.4 – Retaining Walls:

*A – Manufactured Modular Block:*

Includes manufactured modular walls for industrial and commercial landscaping, erosion control, and other transportation, site, or waterfront applications. It addresses a heavy-duty interlocking retaining wall system to form a combination gravity and semi-crib wall. It features standard modular facing units, and coping units, on a footing, and requires no mortar, geogrid, or steel reinforcement. Together with a free draining, compacted backfill with a subdrain and spread footing type foundation system, this system may form walls to a height of approximately four (4) feet. The stability of the site may require that the retaining wall system be designed by a Colorado Registered Professional Engineer.

*B – Engineered Walls:*

Mechanically Stabilized Earth or Concrete retaining walls and other applicable retaining structures shall be designed by a registered Architect or Engineer. Architect/Engineer shall be responsible for indicating that the retaining wall system considers allowable soil bearing capacity, local and global stability of the entire wall system and adjacent sloped surfaces, and total and differential settlement.

## 7.3.5 – On-Site Sewers and Storm Drains:

Construction materials shall conform to Section 6.3.

## 7.3.6 – Parking Lot Pavement:

Off-street parking areas shall be properly drained, shall have a durable dust-free, all weather surface, and shall be maintained in a usable condition at all times. Acceptable surface materials are those that are resistant to deterioration from weather and traffic such as

concrete, asphalt, sealed pavers, or bricks. Loose gravel material is not suitable for parking lot pavement.

## *7.4 –CONSTRUCTION METHODS:*

### 7.4.1 – Site Grading:

Construction requirements shall conform to Section 2.4.2.

### 7.4.2 – Cast-In-Place Concrete:

Construction requirements shall conform to Section 3.5.4

### 7.4.3 – Manholes and Utility Structures:

*A – Preparation:*

Over-excavations shall be corrected with CDOT Class 6 A.B.C. material. Large stones or other hard or unsuitable matter impeding consistent backfilling or compaction shall be removed.

*B – Bedding:*

CDOT Class 6 A.B.C. material or a crushed ¾ inch gravel product shall be placed level below manholes and structures in a continuous layer not less than 6 inches. To attain required compaction, the bedding material shall be maintained at optimum moisture content.

*C – Installation:*

Excavation for manholes shall be in accordance with Section 2.4.1. The bottom of the excavation shall be formed to the correct elevation.

*D – Frames and Covers:*

Frames and covers shall be in accordance with ASTM A48, cast iron construction, or ASTM A536 for ductile iron castings, meeting the required loading designated for the intended use.

### 7.4.4 – Retaining Walls:

*A – Manufactured Modular Block Walls:*

Section includes manufactured modular walls for industrial and commercial landscaping, erosion control, and other transportation, site, or waterfront applications. Shall be installed per manufacturer's recommendations.

*B – MSE Walls:*

Construct in accordance to the plans and specifications shown.

*C – Concrete Walls:*

Construct in accordance to the plans and specifications shown.

### 7.4.5 – On Site Sewers and Storm Drains:

Construction requirements shall conform to Section 6.4.