

CITY OF CENTRAL

STANDARDS AND SPECIFICATION FOR DESIGN AND CONSTRUCTION



April 1, 2013

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FORMS

Right-of-Way Use/Street Closure Permit

Right-of-Way Use/Street Cut Permit

Driveway Permit

Grading Permit

Single Family/Duplex Dwelling Deposit Agreement

CHECKLISTS

Preliminary Plat Checklist

Final Plat Checklist

Construction Checklist

Preliminary and Final Acceptance Checklist

CHAPTER 1:INTRODUCTION

1.1 SHORT TITLE

These regulations, together with all future amendments shall be known as the City of Central Standards and Specifications for Design and Construction (hereinafter called Standards) shall be codified and incorporated by reference in a new Chapter 12 titled “City of Central Standards and Specifications for Design and Construction” of the Central City Municipal Code.

1.2 PURPOSE AND APPLICATION

These Standards are the minimum design and technical criteria that shall apply to all condominium, commercial development, resubdivisions, planned unit developments, or any other proposed construction submitted for approval under the provisions of Chapter 16, Zoning, or Chapter 17, Subdivision, of the Central City Municipal Code. Alternative design options to the requirements of these Standards may be suggested by the Applicant. It shall be the responsibility of the Applicant to demonstrate that the proposed alternative design meets or exceeds the minimum criteria contained herein through the variance procedures set forth herein. Policies and technical criteria not specifically addressed in this document shall follow the provisions of the American Association of State Highway and Transportation Officials’ *Policy on Geometric Design of Highways and Streets, 2011*, and the Standard Construction Specifications of the Colorado Department of Transportation. All design and construction of these items, commencing after May 1, 2012, shall meet or exceed the criteria set forth herein, unless a variance is granted in accordance with Section 8.1.

1.3 AUTHORITY

The Standards have been adopted pursuant to the authority conferred pursuant to the Central City Home Rule Charter.

1.4 JURISDICTION

These Standards shall apply to all land within the City of Central (City) except where superseded by State of Colorado (Department of Transportation) jurisdiction. The requirements of these Standards shall apply to all development permits, as that term is defined under C.R.S. §29-20-103 and §13-51.5-102, and further upon all subdividers, building permit applicants, applicants, developers, or other landowners, and their employees, agents and contractors, designing and constructing of any public or private improvement, street, road, driveway, or vehicular access of any kind or duration, as such are subject to review and approval by the City, pursuant to the City Land Use Regulations and requirements. The Land Use Regulations shall include the City Subdivision Regulations, Zoning Regulations, and adopted Building Codes.

1.5 AMENDMENT AND REVISIONS

These Standards may be amended as new technology is developed and/or experience gained in the use of these Standards which indicates a need for revision. The City Council, following the

recommendations of the City Engineer, and the Community Development Department, may consider amendments to these Standards.

1.6 REVIEW AND APPROVAL

The City Engineer will review all submittals for general compliance with these Standards in a timely manner. Any approval by the City does not relieve the owner, engineer, or designer from responsibility of ensuring that the calculations, plans, specifications and construction are in compliance with the Standards and accepted engineering practices.

1.7 INTERPRETATION

In its interpretation and application, these Standards shall be regarded as the minimum requirements for the protection of public health, safety, comfort, morals, convenience, prosperity, and welfare of the residents and visitors of the City. These Standards shall therefore be regarded as remedial and shall be liberally construed to further its underlying purpose.

Whenever a provision of these Standards and any other provision(s) of the City or any provision in any law, ordinance, resolution, rule, or regulation of any kind, contain any restrictions covering any of the same subject matter, whichever restrictions are more restrictive or impose higher standards or requirements shall govern.

These Standards shall not modify or alter any permits or approved reports, construction plans, easements, or covenants issued before the effective date of these Standards. This exception shall be subject to the conditions and limitations under which the City accepted said plans.

1.7.1 MEANINGS OF “SHALL”, “SHOULD”, AND “MAY”

The definitions below explain the use and intent for the words “shall”, “should”, and “may”.

Shall – A mandatory condition. Any Standard or Specification using the term “shall” must meet or exceed the requirement for which the term is used.

Should – An advisory condition. The word “should” is used as a suggested condition for a particular Standard or Specification. The usage of “should” is not a requirement, but a recommended condition to aid design.

May – A permissive condition. The use of the word “may” does not imply a Standard or Specification requirement. May is considered optional in design.

1.8 RELATIONSHIP TO OTHER STANDARDS

Since the City is the approval authority for land use changes, these Standards which stipulate certain minimum conditions for land use changes, shall apply. If a state, federal government or special district imposes more stringent criteria than that in these Standards, this difference is not

considered a conflict and the more stringent standard shall apply. If the State or Federal Government imposes stricter criteria, standards, or requirements, these may be incorporated into the City's requirements in accordance with the amendment process for text amendments to the Zoning Regulations set forth in Chapter 16 of the Central City Municipal Code.

1.9 REGULATORY COMPLIANCE

All work shall comply with all applicable federal, state, county, and local regulations.

CHAPTER 2: DRAWING AND DEVELOPMENT SUBMITTAL REQUIREMENTS

2.1 CONSTRUCTION PLANS

All construction plans, drainage reports, soils reports and pavement designs shall be prepared by, or under the direction of, a Colorado Licensed Professional Engineer, and shall be part of the submittal process, as defined per the applicable Land Use Regulations. Throughout the preliminary and final plat review process, any of the documents listed above that are submitted to the City shall contain the date, the seal, and signature of the Engineer. If the signed and sealed documents are not final, they can be identified as “preliminary”, “for review” or “not for construction”. The engineer should be aware that whenever unusual or serious problems are anticipated in conjunction with a proposed design or construction, additional information and analysis beyond the minimum requirements of these specifications and criteria shall be required.

The City is not responsible for the accuracy and adequacy of the design or dimensions and elevations on the plans. The City, through the acceptance of the construction plans, assumes no responsibility for the completeness and/or accuracy of the construction plan.

Each drawing shall be 24" x 36" and shall contain a title block, sheet number, scale, north arrow, date and the seal and signature of the Colorado Licensed Professional Engineer responsible for plan preparation. In addition, an electronic copy (.pdf format) shall be provided on a CD or other acceptable electronic format.

Existing and proposed contours shall be at one foot (1') minimum intervals. Other intervals may be allowed or required by the City, in developments with flat or steep terrain.

The drawing shall be based or transformed to a known coordinate system, not an assumed local coordinate system. If GPS Lat/Long is not used for this reference, the Geographic Coordinate Data Base should be used to obtain relative coordinates available from the BLM at www.BLM.gov/GCDB. A permanent survey benchmark shall be shown on the plans.

2.1.1 COVER

The plans must include a statement on the cover sheet:

“These construction plans for (name of development or project) were prepared by me (or under my direct supervision) in accordance with the requirements of the City of Central Standards and Specifications for Design and Construction.”

Name of Engineer

Name of Firm

The statement shall be signed and stamped by the Colorado Licensed Professional Engineer who prepared or directed preparation of the construction plans.

A vicinity map, at the appropriate scale, which shows the location and

name of all arterial streets/roads within one mile of the proposed development and all streets/roads within the proposed development.

Index of sheets.

Agency List.

A Utilities Notification Center note with phone number shall be on the plans.

2.1.2 GENERAL NOTES

The following general notes shall appear on the construction plans for all submittals containing roadway plans:

The City signature affixed to this document indicates the City has reviewed the document and found it in general conformance with the City of Central Standards and Specifications for Design and Construction or approved variances to those regulations. The City, through acceptance of this document, assumes no responsibility, other than stated above, for the completeness and/or accuracy of these documents. The owner and engineer understand that the responsibility for the engineering adequacy of the facilities depicted in this document lies solely with the Licensed Professional Engineer whose stamp and signature is affixed to this document.

All roadway construction shall conform to City of Central Standards and Specifications for Design and Construction.

All materials and workmanship shall be subject to inspection by the City. The City reserves the right to accept or reject any such materials and workmanship that does not conform to its Standards and Specifications. This may result in a “stop work order” that will remain in effect until appropriate corrections are made to the satisfaction of the City of Central.

The contractor prior to actual construction shall verify the location of existing utilities.

The contractor shall provide all lights, signs, barricades, flagmen, or other devices necessary to provide for the safety in accordance with the Manual of Uniform Traffic Control Devices.

The contractor shall be solely and completely responsible for conditions at and adjacent to the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours.

The City’s right to conduct construction inspections and review of the contractor’s performance is not intended to include review of the contractor’s safety measures in, on, or near the construction site.

It shall be the contractor’s responsibility to notify the owner/applicant of any problem in conforming to the approved plans for any element of the proposed improvements prior to its construction.

If construction has not commenced within two (2) years of approval, the

construction plans may be considered invalid. These plans may be subject to re-review and re-approval by the City.

Paving shall not start until a soils report and pavement design is accepted by the City and subgrade compaction tests are taken and accepted by the geotechnical engineer.

If dewatering is used to install utilities, culverts, etc., then a State Construction Dewatering Wastewater Discharge Permit is required for discharge into a storm sewer, channel irrigation ditch, or any water of the United States. A copy of the permit shall be kept on site and filed with the Community Development Department.

2.1.3 PLAN

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

The scale shall be a minimum of 1" = 100'.

Locations and dimensions of existing and proposed property lines, setbacks, easements, and Right-of-Way.

Names of streets / roads (existing and proposed).

Survey line ties to Section or Quarter corners. Survey shall utilize the State Plan Coordinate System, Colorado North Zone (3451), North American Datum 1983 (NAD83).

Survey lines, including the chord bearing and distances for all line and curve data, and centerline stationing/coordinates. Curb and gutter stationing/coordinates shall be equated to flowline stationing/coordinates at horizontal radius curves, cul-de-sacs, and other departures from normal roadway cross-sections.

Centerline stations/coordinates for all intersecting roadways and commercial driveways.

Existing and proposed street / road improvements, including shared driveways (sidewalk, curb, gutter, pavement limits, bridges, culverts, guardrails, handicap ramps, etc.). A dashed line shall depict existing improvements and a solid line shall depict proposed improvements.

Elevations and station/coordinates shall be noted for all curb returns, points of curvature, and points of tangency, high or low point of all vertical curves.

The rate of superelevation and all pertinent superelevation information shall be shown on the construction plans, as applicable.

Typical template(s) for streets / roads.

Match lines and consecutive sheet numbers.

Key map.

A legend to identify existing (dashed) and proposed (solid) utilities and structures, including but not limited to (include: size, type, height, and location, as applicable):

water

fence line

fire hydrants	ditches or swales
sanitary sewer	gas
storm sewer	electric
telephone	cable television
mailboxes	trash enclosures
snow storage	signs

Stations/coordinates and critical elevations of all utility and drainage appurtenances.

Major road intersection design at a scale of 1" = 20'. This shall depict all pertinent information including sight triangles (See Section 3.7.6). When a new road intersects an existing road, the existing road data (grades, width, etc.) shall be shown within 500' of the intersection.

All existing curbs, gutters, sidewalks, and asphalt or gravel roads adjacent to the proposed design. Basis for existing grades shall be spot elevations at intervals not to exceed 50'. Previously approved designs are not an acceptable means of establishing existing grades.

All on-site slopes greater than 30% shall be shown on plans.

All proposed driveway centerlines will be shown on plans. The driveway length shall extend to the center of the building envelope or actual building location.

The design speed for all roads within the development.

Snow storage areas (dimensions, area, etc.) See Section 3.11.

2.1.4 PROFILE

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

The vertical scale shall be a minimum of 1" = 5' for roadway profiles.

Existing (dashed) and proposed (solid) grades.

Continuous stationing/coordinates for the entire portion of the roadway shown in the plan view with the centerline station/coordinates for all intersecting roadways and commercial driveways clearly labeled.

Vertical curve data including length of curve, P.V.C., P.V.T., P.V.I., beginning and end grades. All vertical curves shall be symmetrical.

Separate flowline or top of curb profiles shall be provided for design of cul-de-sacs and any other departure from normal roadway cross slope.

Existing (dashed) and proposed (solid) utilities.

A profile will be required for all driveways when grades exceed five percent (5%).

2.1.5 GRADING AND DRAINAGE PLAN

The grading plan should include supporting data and a construction sequence outlining the grading and revegetation (See Chapter 6 and 7). The plans shall contain the following

information:

Property Limits, accurate contours of existing ground, details of existing terrain, and existing drainage patterns.

Location of all natural features, such as watercourses and wetlands, on the proposed site or within 100' of the disturbed grading area.

Location and size of all existing utilities and easements on the proposed site.

Limits of disturbance.

Final elevations (including spot elevations when applicable) and contours to be achieved by the proposed grading, to include all drainage way information and details (including cross-sections, detention ponds, outlet structures, etc).

Location and final elevations of any buildings or structures on the property where the work is to be performed and the location of any buildings or structures on adjacent land that are within 15' of the property or that may be affected by the proposed grading operations.

All recommendations included in the soils engineering report that are related to, or directly affect grading operations, shall be incorporated in the grading plans and specifications.

2.1.6 WATER PLAN

The water plan(s) should include water line layout and appurtenances in compliance with these Standards (See Chapter 5). Water profile(s) may be required for steep terrain and utility crossings. The plans shall contain the following information:

- Pipe size and material
- Fittings
- Valves
- Service taps
- Fire hydrants
- Elevation/depth of cover

2.1.7 REVEGETATION, EROSION AND SEDIMENT CONTROL PLAN

A construction sheet shall contain the following:

- Detention Pond/Water Quality Pond (See Section 6.2.12)
- Erosion Control: size, type, location (See Section 7.3.1).
- Sediment Control: size, type, location (See Section 7.3.2).
- Revegetation: type, location (See Section 7.4).

See Chapter 7 for all Revegetation, Erosion, and Sediment Control Plan requirements.

2.1.8 SIGNAGE AND STRIPING PLAN

A construction sheet shall contain the following (See Section 3.8):

Existing and proposed striping: size, type, color, location

2.2 PRELIMINARY PLAT

The construction plans submitted at the preliminary plat stage must contain sufficient information to determine that all Standards can be satisfied.

Construction plans must be submitted as part of the preliminary plat submittal and process, as defined per the applicable Land Use Regulations. The submittal and all re-submittals shall be submitted to the Community Development Department. Each submittal shall, at a minimum, contain the following information, although more information may be required at the discretion of the City:

2.2.1 CONSTRUCTION PLANS

See Section 2.1 for requirements.

2.2.2 COST ESTIMATE

This shall include an overall cost estimate for all proposed construction as required by these Standards and a separate cost estimate for each phase of construction. The cost estimate shall include a 20% contingency. The *CDOT Standard Specifications for Road and Bridge Construction* shall be used as a guide for all cost estimates. This shall include, but is not limited to, individual line descriptions and measurement of qualities shown in these CDOT specifications.

This cost estimate shall be used to determine the security required as part of the Development Improvements Agreement.

2.2.3 REQUESTED VARIANCES

Each variance shall be numbered sequentially and address the requirements in Chapter 11.

2.2.4 SURVEY PLAT

A survey plat shall be submitted along with the construction plans. The survey plat shall be reviewed by the City to verify proper correlation between construction plans and the plat.

2.2.5 LANDSCAPE / REVEGETATION PLAN

See Chapter 8 of these Standards and the City of Central Landscape Design Regulations and

Guidelines for requirements.

2.2.6 PRELIMINARY GEOTECHNICAL REPORT

The preliminary geotechnical report shall address and recommend the maximum allowable slopes, pavement cross section design, and any other pertinent information for site construction. The geotechnical report shall include data regarding recommendations for grading procedures, design and opinion on adequacy for the intended use of site to be developed by the proposed grading as affected by soils engineering factors, including the stability of slopes.

2.2.7 TRAFFIC IMPACT STUDY (T.I.S.)

Shall be required for all developments proposing ADT's ≥ 400 .

The City, at its discretion, may require a T.I.S. (see Section 3.13).

2.2.8 PHASING PLAN

A phasing plan shall be required for all projects utilizing phased construction or projects that cannot be completed within one construction season. The cost estimate shall reflect the phases of construction.

2.3 FINAL PLAT

The final plat submittal and process shall address the applicable Land Use Regulations. The submittal and all re-submittals shall be submitted to the Community Development Department. Each submittal, at a minimum, shall contain the following information:

1. All material required at preliminary plat. Any changes to the approved preliminary plat construction plans shall be reviewed, before the final plat review, by the City. If in the opinion of the City, the change has significant impact upon the approved preliminary plat, the change will be sent back to the Community Development Department and City council for review and approval.
2. Final geotechnical report shall include final sub-grade structure, resulting road structure design, slope stability and retaining wall design.
3. A stormwater management plan (if applicable).

All materials submitted for final plat shall be signed, stamped, and sealed by the Colorado Registered Professional Engineer.

After final plat acceptance, the following shall be required after the appropriate changes, if any, are made:

1. A complete copy of the final plat and construction drawings shall be

submitted to the City using electronic media in AutoCAD format (.dwg or .dxf file) that contains the physical features and property boundary information of the development required. The drawing shall follow the format as found in - City of Central Requirements for Submittal of Digital Final Plat.

2. Two (2) hard copy sets of the entire final plat submittal.
3. An electronic copy (.pdf, word, excel) of the entire final plat submittal in the appropriate format, as determined by the Community Development Department.

2.4 CONSTRUCTION

The Applicant is responsible and shall obtain all necessary permits (local, state, and/or federal) for construction.

Prior to utility or roadway installation, the applicant shall install necessary erosion control measures including functioning detention ponds.

Stormwater maintenance checks will be made weekly by the city during construction.

Prior to winter shut-down, the applicant shall contact the City to perform a walkthrough of the construction site to verify erosion control measures are in place for spring runoff.

Before Preliminary or Final Acceptance, the City may review the construction. The City should be notified of any significant deviation from the approved construction plans and the Applicant shall file the following form with the City – Request for Change to Approved Construction Plans.

The City shall approve any change to the construction plans approved at final plat that will result in a variance, prior to starting any construction that will be impacted by the change.

2.5 POST CONSTRUCTION

The City shall review and compare all construction with the construction plans approved at final plat and any design revisions made during construction. A request for construction review shall not be submitted between October 1st and April 1st due to variable weather conditions in the City. A request for review may be denied if snow accumulation is present.

2.5.1 PRELIMINARY ACCEPTANCE

Security releases will only occur if improvements associated with construction plans are 100% complete (unless phased with the approval of the City) with the exception of utilities.

Utilities are permitted three releases:

1. Water

2. Sewer
3. Dry utilities

Prior to Preliminary Acceptance the following items shall be supplied to the City:

1. A letter requesting Preliminary Acceptance from engineer/landscape architect/geotechnical engineer(see Section 2.6.3)
2. Record drawings for the improvements shall be submitted at the time the letter requesting monies release is submitted. Release of monies shall not occur if the City determines deviations are present which have not received prior approval.
3. A letter or letters of acceptance and responsibility for maintenance of the improvements by the appropriate utility company, special district, or town for all utilities and roads.
4. A letter from the Central City Fire Department stating that fire hydrants are in place, in accordance with the approved plans. The letter shall also state that the fire hydrants are operational and provide the results of the fire flow tests.
5. Quality control test results shall be submitted for all phases of the project in accordance with the schedule for minimum materials sampling, testing and inspection as found in CDOT's Materials Test Procedure Module.
6. Photos (if applicable)
7. Field Notes (if applicable)
8. Any addendums/changes to the final plat submittal.
9. Any other pertinent information associated with the construction.

If any substantial variations or discrepancies are discovered between the approved construction plans and the improvements actually constructed, the Applicants engineer shall propose and recommend a solution or alternative solutions to the City for review and approval. If no proposed alternative will satisfy the requirements of these Standards, the engineer shall submit a variance request or the Applicant shall reconstruct the deficient public improvements to comply with the approved construction plans.

The release of monies shall be contingent on City review and acceptance as outlined in the Subdivision Improvement Agreement.

2.5.2 FINAL ACCEPTANCE

Consideration of Final Acceptance shall be no less than two (2) years from Preliminary Acceptance. Prior to Final Acceptance the following items shall be supplied to the City:

1. A letter or letters stating that the improvements have been free of defects for the past two years by the appropriate utility company, special district, or town for all utilities and roads.
2. A letter from the Central City Fire Department stating that fire hydrants are still operational.

3. A letter requesting Final Acceptance from engineer/landscape architect/geotechnical engineer shall be signed, stamped and sealed (see Section 2.6.3).

If upon final inspection of the improvements, the City finds the improvements are not substantially free of defects in materials and workmanship or have not been repaired or maintained as required under the Development Improvements Agreement, the City shall issue a written notice of noncompliance within 14 days after the final inspection specifying the respects in which the improvements are not substantially free of defects in materials and workmanship or have not been repaired and maintained as required under the Developments Improvements Agreement.

The Applicant shall thereupon take such action as is necessary to cure any noncompliance and, upon curing the same, shall request a new final re-inspection from the City. A re-inspection fee shall apply.

The release of monies shall be contingent on City review and acceptance as outlined in the Developments Improvement Agreement.

2.5.3 CERTIFICATIONS

The following certifications shall be required on letterhead with stamp, seal, and date and shall address the appropriate construction plans / documents that the professional is approving. Such certifications shall be submitted to the City upon request for Preliminary and Final Acceptance.

ENGINEER

The licensed engineer of record shall review the information required above and state that the actual construction and materials used are in substantial compliance with the City accepted construction design plans.

“I _____, A DULY LICENSED PROFESSIONAL ENGINEER IN THE STATE OF COLORADO, STATE THAT CONSTRUCTION HAS BEEN COMPLETED IN SUBSTANTIAL COMPLIANCE WITH THE CONSTRUCTION PLANS APPROVED BY THE CITY OF CENTRAL, AS DETERMINED BY REVIEW OF THE RECORD DRAWINGS AND DURING PERIODIC ON-SITE OBSERVATIONS DURING AND AFTER THE COURSE OF CONSTRUCTION AS DETERMINED BY ME OR UNDER MY DIRECT SUPERVISION. DATE: _____.”

GEOTECHNICAL ENGINEER

The geotechnical engineer of record shall supply the City with a letter stating that, based on the results of the quality control test results; construction was completed in substantial compliance with the pavement design and geotechnical recommendations approved by the City.

“I _____, A DULY LICENSED PROFESSIONAL ENGINEER IN THE STATE OF COLORADO, STATE THAT CONSTRUCTION HAS BEEN COMPLETED IN

SUBSTANTIAL COMPLIANCE WITH THE FINAL GEOTECHNICAL REPORT APPROVED BY THE CITY OF CENTRAL, AS DETERMINED BY COMPLETION AND REVIEW OF THE QUALITY CONTROL TEST RESULTS AND DURING PERIODIC ON-SITE OBSERVATIONS DURING AND AFTER THE COURSE OF CONSTRUCTION AS DETERMINED BY ME OR UNDER MY DIRECT SUPERVISION. DATE:_____.”

LANDSCAPE ARCHITECT

The Landscape Architect of record will supply the City with a letter stating that, based on the actual landscaped plans on site; the landscape was in substantial compliance with the City accepted construction design plans.

“I _____, A DULY LICENSED LANDSCAPE ARCHITECT IN THE STATE OF COLORADO, STATE THAT CONSTRUCTION HAS BEEN COMPLETED IN SUBSTANTIAL COMPLIANCE WITH THE LANDSCAPE PLANS APPROVED BY THE CITY OF CENTRAL, AS DETERMINED BY PERIODIC ON-SITE OBSERVATIONS DURING AND AFTER THE COURSE OF CONSTRUCTION AS DETERMINED BY ME OR UNDER BY DIRECT SUPERVISION. DATE:_____.”

2.6 RECORD DRAWINGS

The record drawing submittal shall accompany the request for Preliminary Acceptance of the construction improvements.

Identify and show on the "Record Drawings" all existing or abandoned utilities that were encountered during construction that were not shown on the design plans or that were shown on the design plans incorrectly.

The method to show locations (both for proposed construction and Record drawings) is by the use of centerline stations/coordinates as depicted on the construction plans with suitable distances and offsets given relative to these lines.

All elevation information shall be based upon an existing on-site benchmark as depicted on the approved construction plans.

Record drawings are to be provided by a State of Colorado Licensed Professional Surveyor. All required record drawing information shall be clearly shown with the original approved design information and all field design revisions made during the construction process (design information should be shaded back). A stamped hardcopy of the Record Drawings shall be submitted along with an electronic copy in ACAD format. Each sheet of the Record Drawings shall include the following statement along with the licensed professional surveyor's stamp and date of execution.

"I, _____, A DULY LICENSED PROFESSIONAL LAND SURVEYOR IN THE STATE OF COLORADO, STATE THAT THE INFORMATION CONTAINED IN THESE RECORD DRAWINGS ARE THE RESULTS OF A FIELD SURVEY AND ARE TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE AND BELIEF, AS DETERMINED BY ME OR UNDER MY

DIRECT SUPERVISION ON THIS DATE: _____."

The following information shall be shown/corrected on the Record Drawings:

2.6.1 ROADWAY PROJECTS

4. Road locations: Locations of road centerline, intersection radii, edge of asphalt, edge of gravel shoulder, and flowline of ditch, at 200-foot maximum intervals, and at all beginning and end of horizontal curves. Vertical information should be included in order to determine centerline grades, cross-slope grades, superelevation rates, flowline grades, and side slopes.
5. All existing infrastructure in road including, but not limited to: drainage appurtenances, vaults, manholes, inlets, catch basins, water valves, fire hydrants, etc. (see below for further requirements).
6. Guardrail: locations, types, alignment.
7. Retaining Walls: locations, type, height, alignment.
8. Clear Zone obstructions: location, type, alignment.
9. All signage within the RIGHT-OF-WAY: location, type, alignment.
10. Verification of snow storage areas, per the plans, has been met.
11. Public Utility Easements/RIGHT-OF-WAY: locations, widths, and location of road appurtenances within the Easement/RIGHT-OF-WAY

2.6.2 WATERLINE PROJECTS

1. Location/alignment
2. Lengths
3. Pipe size and material
4. Fittings
5. Valves
6. Service taps
7. Fire hydrants
8. Elevation/depth of cover

2.6.3 SANITARY SEWER PROJECTS

Refer to Black Hawk/Central City Sanitation District for specifications. At a minimum, include the following:

1. Location/alignment
2. Lengths
3. Pipe size and material
4. Manholes
5. Inverts
6. Slopes

2.6.4 STORM DRAINAGE PROJECTS

- A. Manholes/Inlets/Catch Basins: locations, types, rims & invert elevations.
- B. Storm Lines: locations, materials, lengths, slopes, diameter, location of catch basins and side sewer tees, and invert elevations.
- C. Public Utility Easements: locations, widths, and location of storm drainage appurtenances within the easements.
- D. Retention/Detention Systems: volume of constructed system, pond storage and construction limits, overflow elevations and locations, discharge orifice diameters and locations.
- E. Drainage Swales: location, width, depth, side slopes, lengths, elevations of inlet and outlet locations.

2.6.5 DRY UTILITY PROJECTS

- A. Public Utilities including gas, electric, cable, etc. and the associated easements: locations, widths, and location of appurtenances within the easements.

NOTE: IN ACCORDANCE WITH THE CITY OF CENTRAL CODE, THE APPLICANT SHALL BE RESPONSIBLE FOR THE CITY ENGINEER'S COST FOR PLAN REVIEW AND SITE INSPECTIONS.

CHAPTER 3: ROADWAY DESIGN STANDARDS

3.1 BASIC DESIGN POLICIES

All new road designs (public and private) and related information must meet the minimum standards within the City of Central Standards and Specifications for Design and Construction. Any design standards not included within the Standards will be subject to the minimum standards set forth in the most up to date publications found in Chapter 16 of these Standards.

All road construction in other jurisdictions must meet the minimum standards set forth by that jurisdiction, including but not limited to Gilpin County and the Colorado Department of Transportation.

The design speed of any road shall not be less than 20 mph (C.R.S. §42-4-1101), or such minimum speed as set forth in Chapter 8, Vehicles and Traffic, of the Municipal Code.

3.2 TRIP GENERATION

Trip generations for proposed development should be based on the type of occupancy for which the development is designed and shall be formulated from the following:

DEVELOPMENT TYPE TRIPS GENERATED

Single Family	8 ADT/Unit
Multifamily	5 ADT/Unit

Other uses not listed above shall use the *ITE Trip Generation Manual* for trip generation. Other acceptable data sources may be acceptable in cases where the *ITE Manual* does not provide the information necessary.

3.3 ROAD CLASSIFICATIONS

City roads are classified according to function and ADT's. Functional classifications shall be established by the City. The City has the authority to determine which classification applies to any given road. The Applicant may be required to conduct existing traffic counts at the direction of the City to establish existing roadway classifications.

The minimum road design standards are based on the following road classifications and can be found in Table 3.3.

3.3.1 COLLECTOR ROAD SYSTEM

Collector roads provide a link between arterials and local roads and therefore serve travel from developments to towns. More moderate speeds may be typical on collector roads.

3.3.2 LOCAL ROAD SYSTEM

The local road system, in comparison to collectors and arterial systems, primarily provides access to land adjacent and provides travel through developments. A local road is a road whose primary function is to provide access to residences, businesses, or abutting property, rather than to serve through traffic.

3.3.3 LOW-VOLUME ROAD SYSTEM

A low-volume road has the same characteristics of a local road, in that its primary use is as an access road, not a through road, and it primarily serves drivers who are familiar with the roadway.

TABLE 3.3 – ROADWAY CLASSIFICATION AND MINIMUM DESIGN CRITERIA

CLASS	# LANES	ADT LEVELS	DESIGN SPEED (mph)	LANE WIDTH	CLEAR ZONE	RIGHT-OF-WAY
MAJOR COLLECTOR	2	>2500	30 – 35	12'	12'	80'
MINOR COLLECTOR	2	1000 – 2500	30 - 35	12'	10'	60'
LOCAL	2	450 - 1000	20 - 30	12'	8'	60'
LOW VOLUME	2	< 450	20 - 30	12'	N/A	60'
DRIVEWAY	1	≤ 20	15	12'	N/A	N/A

NOTE: The minimum Right-of-Way/Easement widths may be increased by the City to accommodate for drainage improvements, excessive cut/fill slopes, intersections, clear zones, or snow storage.

Typical cross-sections for local and collector roads can be found in Figures 1-3.

3.4 HORIZONTAL ALIGNMENT

3.4.1 CENTERLINE CURVE RADIUS

Superelevation is not required on local or low volume roads if the minimum requirements in Table 3.4.1 can be met. The minimum curve radius is ultimately determined by the stopping sight distance.

TABLE 3.4.1 – MINIMUM CENTERLINE CURVE RADIUS AND TANGENT LENGTH WITHOUT SUPERELEVATION

Based on Chapter 2 in A Policy on Geometric Design of Highways and Streets (2011)

Design Speed (mph)	Radius (ft)	Tangent Length (ft)
20	107	75

25	198	100
30	333	150
35	510	200

This table shall be applicable for local and low volume roads.

3.4.2 ACCESS

Roadway systems shall provide at least two (2) access points to the development. All edges of roads (measured from edge of shoulder) must be a minimum of seven feet (7') from the adjacent property line. All single-family and multi-family developments may not be required to provide two (2) points of access if all of the following conditions are met.

1. The total development is < 9 units.
2. The dead end street is no more than 500' (may be increased to 1000' with Fire Department approval).
3. A turnaround is provided as shown in Figure 5.

Lane widening may be necessary on sharper curves and where large vehicle traffic is expected, and should satisfy the requirements within *A Policy of Geometric Design of Highways and Streets*. At the discretion of the City, turning templates may be required for roads and/or parking lot designs (See Table 3.4.2).

Any access that is proposed to multiple lots shall be constructed by the land developer (i.e. a proposed shared driveway to two lots will require that the driveway be constructed through the first lot and in conjunction with the adjacent site improvements).

TABLE 3.4.2 – DESIGN VEHICLE TURNING TEMPLATE
Based on Chapter 2 in A Policy on Geometric Design of Highways and Streets (2011)

Vehicle	AASHTO Designation	Minimum Design Radius (ft)
Passenger Car	Passenger Vehicle (P)	24
Fire Truck	Fire Department Standard	
Garbage Truck	Single Unit Truck (SU)	42
Intercity Bus	Motor Coach (BUS-40)	45
Semi-Trailer	Intermediate Semi-Trailer (WB-50)	45

3.4.3 DEAD-ENDS AND TURNAROUNDS

Dead end roads exceeding 200' that do not have turnarounds are not allowed in the City. Using cul-de-sac streets shall be avoided. Where cul-de-sac streets are the only alternative, turnarounds shall be provided per Figure 5. All turnarounds shall provide ten feet (10') of flat, treeless ground around the perimeter and within the island. The internal island may not be used as part

of the open space calculation and shall not be used for utilities. All turnarounds shall be signed accordingly (to restrict parking, dead-end, etc.).

The maximum length of roads ending in turnarounds shall be 500'. With the approval from the Fire Department, the maximum distance may be increased to 1000'. When a variance from this standard is requested, approval from appropriate Fire Department is required and may include the following:

1. Central water service.
2. An alternative water supply acceptable to the appropriate Fire Department.
3. Additional turnouts to be installed.

All turnarounds shall be subject to Fire Department review and approval.

3.4.4 SWITCHBACKS

A switchback is defined as a curve with a delta greater than 120° and a radius $\leq 100'$. On all roadways when other alternatives may cause significant adverse impacts, the use of switchbacks may be allowed on a case-by-case basis, with approval from the City. Switchbacks shall be designed with a minimum centerline radius of 60'. Maximum centerline grades within 25' of a switchback curve and throughout the curve shall not exceed four percent (4%). Special attention should be given to provide adequate snow storage and sight distance. Widening of the roadway around the curve may be necessary to allow for wide turning vehicles (i.e. fire trucks, snow plows, trash trucks, etc.).

3.5 CROSS SECTIONS

Typical cross-sections can be found in Figures 1-3.

3.5.1 SURFACING REQUIREMENTS

All roads in a development shall be asphalt / concrete paved in accordance with the Specifications.

3.5.2 CROWN / SUPERELEVATION

The maximum desirable superelevation rate is 0.060 foot per foot, but 0.080 can be used where the grade of the road is less than five percent (5%). Where superelevation is used, the minimum tangent lengths between curves shall be consistent with the design guidelines outlined in *A Policy of Geometric Design of Highways and Streets*.

3.5.3 CLEAR ZONE

The minimum clear zone required for City roads are shown in Table 3.3, the clear zone required should be based on ADT's, speed, horizontal and vertical alignments. Slopes of 3:1 or steeper

are considered critical slopes, on which a vehicle is likely to overturn. Therefore, all newly constructed roads shall provide a minimum clear zone with a maximum 4:1 slope as defined in Table 3.3. The clear zone is measured from the outside edge of the adjacent driving lane.

The clear zone width should be increased on the outside of curves to accommodate the path of an errant vehicle. Determination of the width of the clear zone should take into consideration right-of-way availability, environmental concerns, economic factors, safety needs, and accident histories. If these minimum clear zone widths are not feasible, guardrail installation may be necessary.

3.5.4 GUARDRAIL

The use of guardrail is discouraged within the City and should not be used when it is economically feasible to remove the obstruction, correct the hazardous condition, or where it is determined that the guardrail would create a more serious hazard than the feature it would shield. The *Roadside Design Guide* shall be used as the most recent guide to guardrail implementation. The use of guardrail may be necessary if any of the following conditions exist:

1. Roadside hazards are present within the “clear zone”.
2. A road built to Standards contains an isolated sharp curve in conjunction with a side slope steeper than 4:1.
3. A section of road has a history of vehicular accidents.

When guardrails are considered for installation, especially for extended lengths, provisions shall be made for adequate snow storage and removal.

3.5.5 PEDESTRIAN FACILITIES

Sidewalks, pedestrian, and bicycle paths shall be constructed in accordance with the roadway templates. Sidewalk curb ramps shall be designed in accordance with Figures 6 and 7.

3.6 VERTICAL ALIGNMENT

3.6.1 GRADES

The minimum centerline grade for all roads is one percent (1%). A minimum flowline grade of one percent (1%) shall be maintained around all full and partial cul-de-sac bulbs. If curb and gutter are proposed, the minimum flowline grade may be one half percent (0.5%).

Continuous grade changes shall not be permitted. The use of grade breaks in lieu of vertical curves is discouraged; however, if a grade break is necessary and the algebraic difference in grade (A) does not exceed one half percent (0.5%) along the street / road, the grade break will be permitted.

The maximum grade for all roads is seven percent (7%). Where roads approach intersections see

Table 3.7.4. A local or low volume road may have sections with a grade of seven percent (7%) to eight point, nine, nine percent (8.99%) provided all of the following conditions are met:

1. The section shall be no longer than 500'.
2. The section shall have a horizontal radius of 1000' or greater.
3. Grades shall not exceed seven percent (7%) for 500' on either end of the section.
4. Curves with a horizontal radius of less than 600' shall not be within 500' on either end of the section.

Each side of the road section (RIGHT-OF-WAY) must be designated with a restricted access line.

For a grade of more than nine percent (9%), (10% is the maximum) the previous conditions must be met along with the following:

1. The section of road will not serve more than 40 ADTs.
2. The design speed is 30 MPH or lower.

3.6.2 VERTICAL CURVES

The City standard for rate of vertical curvature ('k' value) and minimum lengths is controlled by standards shown in *A Policy of Geometric Design of Highways and Streets* and by stopping sight distances. (See Table 3.6.2).

TABLE 3.6.2 – DESIGN CONTROLS FOR VERTICAL CURVES AND STOPPING SIGHT DISTANCE

Based on Chapter 3 in *A Policy on Geometric Design of Highways and Streets* (2011)

SAG VERTICAL CURVES			
Design Speed (mph)	Stopping Sight Distance (ft)	Rate of vertical curvature, K ^a	
		Calculated	Design
20	115	16.5	17
25	155	25.5	26
30	200	36.4	37
35	250	49	49
CREST VERTICAL CURVES			
Design Speed (mph)	Stopping Sight Distance (ft)	Rate of vertical curvature, K ^a	
		Calculated	Design
20	115	6.1	7
25	155	11.1	12
30	200	18.5	19
35	250	29	29

^a Rate of vertical curvature, K, is the length of the curve (ft) per percent algebraic difference intersecting grades (A). $K=L/A$

See *A Policy on Geometric Design of Highways and Streets* for “k” values associated with vertical curve designs based on passing sight distance.

3.6.3 STOPPING SIGHT DISTANCE

See Table 3.6.3-A and B for stopping sight distances.

TABLE 3.6.3A – STOPPING SIGHT DISTANCE

Based on Chapter 3 in *A Policy on Geometric Design of Highways and Streets* (2011)

Design Speed (mph)	Brake Reaction Distance (ft)	Braking Distance on level (ft)	Stopping Sight Distance	
			Calculated (ft)	Design (ft)
20	73.5	38.4	111.9	115
25	91.9	60.0	151.9	155
30	110.3	86.4	196.7	200
35	128.6	117.6	246.2	250

Note: Brake reaction distance predicated on a time of 2.5s: deceleration rate of 11.2 ft/s² used to determine calculated sight distance

TABLE 3.6.3B – STOPPING SIGHT DISTANCE ON GRADES

Based on Chapter 3 in *A Policy on Geometric Design of Highways and Streets* (2004)

Design Speed (mph)	Stopping Sight Distance (ft)					
	Downgrades			Upgrades		
	3%	6%	9%	3%	6%	9%
20	116	120	126	109	107	104
25	158	165	173	147	143	140
30	205	215	227	200	184	179
35	257	271	287	237	229	222

See *A Policy on Geometric Design of Highways and Streets* for Decision Sight Distance where unexpected vehicular maneuvers are required. (i.e. intersections, changes in cross section, etc.)

3.7 INTERSECTIONS

All connections to existing asphalt roads will require an asphalt sawcut and be paved according to Section 3.5.1.

3.7.1 SKEW ANGLES

All new road/driveway connections shall intersect existing roads at 90°. Where this is not possible the following maximum skew angles and distances (measured from edge of shoulder)

must be met:

1. a maximum skew angle of 10° for 20' on local/low volume roads
2. a maximum skew angle of 10° for 50' on collector roads.
3. a maximum skew angle of 25° for 20' on driveways.

3.7.2 EDGE OF SHOULDER RADII

All new road/driveway connections shall meet the minimum design standards for intersection edge of shoulder radii (Table 3.7.2). The width of intersection should be limited to accommodate the turning radii of vehicles anticipated to use the intersection. Oversized intersections are discouraged.

The maximum fall, in feet, around the radii return shall be equal to the steepest grade coming into or out of the return multiplied by the return length plus 0.2'.

TABLE 3.7.2 – MINIMUM EDGE OF SHOULDER RADII FOR INTERSECTING ROADWAYS

E X I S T I N G A C C E S S		NEW ACCESS					
		ARTERIAL	MAJOR COLLECTOR	MINOR COLLECTOR	LOCAL	LOW VOL.	DRIVE
	HIGHWAY	See <u>State Highway Access Code</u> (CDOT) for design requirements					
	MAJOR COLLECTOR	-----	50'	50'	30'	*	*
	MINOR COLLECTOR	-----	-----	50'	25'	20'	10'
	LOCAL	-----	-----	-----	20'	20'	10'
	LOW VOL.	-----	-----	-----	-----	20'	10'

* Access is discouraged. Variances will be required.

3.7.3 HORIZONTAL OFFSET

All new road/driveway connections shall meet the minimum design standards for intersection offsets (measured centerline to centerline) to existing roads/driveways (Table 3.7.3).

TABLE 3.7.3 – MINIMUM INTERSECTION OFFSETS

		NEW ACCESS			
		MAJOR COLLECTOR	MINOR COLLECTOR	LOCAL/ LOW VOL.	DRIVE
E X I S T I N G I N T E R S E C T I O N S	MAJOR COLLECTOR				
	⊥ MINOR COLLECTOR	1000'	800'	500'	*
	⊥ LOCAL/LOW VOL.	800'	500'	500'	*
	⊥ DRIVE	500'	200'	200'	*
	MINOR COLLECTOR				
	⊥ MINOR COLLECTOR	-	N/A	500'	200'
	⊥ LOCAL/LOW VOL.	-	500'	200'	125'
	⊥ DRIVE	-	200'	125'	100'
	LOCAL/ LOW VOL.				
	⊥ LOCAL/LOW VOL.	-	-	200'	125'
	⊥ DRIVE	-	-	125'	50'

* Access is discouraged. Variances will be required unless there is only one point of access and no other roads adjacent to property.

When a new development can access two different roads, access shall always be to the road with the lowest classification.

3.7.4 GRADES

All intersections shall utilize vertical curves unless Section 3.6.1 is met. The minimum design speed for all vertical curves (See Table 3.6.2) at intersections shall be 20 MPH.

TABLE 3.7.4 – MAXIMUM GRADE AT INTERSECTIONS

T H R O U G H S T R E E T		MAJOR COLLECTOR	MINOR COLLECTOR	LOCAL	LOW VOL.	DRIVE
	MAJOR COLLECTOR	3% - 150'	3% - 150'	3% - 100'	3% - 100'	*
	MINOR COLLECTOR	-----	3% - 100'	3% - 100'	3% - 100'	5% - 50'
	LOCAL	-----	-----	3% - 50'	3% - 50'	5% - 50'
	LOW VOLUME	-----	-----	-----	3% - 50'	5% - 50'

NOTE: Distance Measurement starts from edge of shoulder of the through street. The vertical curve may be included if the maximum values shown above are not exceeded.

* Access is discouraged. Variances will be required unless there is only one point of access and no other roads adjacent to property.

3.7.5 CORNER SIGHT DISTANCE

The minimum corner sight distance is defined in Figure 8. Using the plan and profile of the intersection the design engineer shall verify these minimum sight distances can be attained.

When the criteria for sight distance cannot be met, the City may deny the access, prohibit right or left turns by vehicles entering the road, or require speed change lanes.

3.7.6 SIGHT TRIANGLE

For safety and visibility purposes, a sight distance triangle shall be maintained at street intersections and where driveways intersect streets. Development layouts shall pay particular attention to the size and shape of their corner lots in order to maintain these minimum sight triangles. Any object within the sight triangle that is greater than 12" in diameter between three feet (3') and eight feet (8') above the roadway elevation of the adjacent street shall constitute a sight obstruction, and shall be removed. Such objects include: snow, buildings, cut slopes, hedges, trees, bushes, utility cabinets or tall crops. This criteria also requires the elimination of parking within the sight triangle and applies whether the intersecting roads are level or on grades.

All intersections within a proposed roadway shall depict the necessary sight triangles on the intersection plan sheet and the plat (Figure 8).

3.8 SIGNAGE AND STRIPING

Refer to the Specifications for additional information.

3.9 PARKING REQUIREMENTS

3.9.1 GENERAL

Parking on City roads or within the Right-of-Way is legal except where specifically posted as prohibited. The backing of parked vehicles onto City roads is discouraged; exceptions may be made on Local and Low Volume Roads. The number of parking stalls required shall conform to Section 3.9.3 of these Standards.

Typical Parking Stall Dimensions	Maximum Grade in Parking Area	Minimum Grade in Parking Area
10' x 20'*	5% parallel to parking stalls 5% for cross slope**	1%

* Special Design will be needed for parallel parking. Underground/covered parking may use 9' x 18'.

** Minimum/Maximum grade requirements are considered to be average grades at the middle of the parking area.

3.9.2 AMERICANS WITH DISABILITIES ACT (A.D.A) COMPLIANCE

A.D.A parking shall provide an additional four feet (4') in unobstructed width to accommodate the operation of wheel chairs between vehicles and must be clearly signed. Two (2) adjacent stalls may utilize the same additional width. The maximum grade in designated A.D.A areas shall not exceed five percent (5%) in one direction or two percent (2%) in the cross direction. All parking shall comply with A.D.A. requirements then in effect.

3.9.3 OFF-STREET PARKING AND LOADING SPACE REQUIREMENTS

- A. See Section 16-132 of the Central City Municipal Code for parking requirements.
- B. Except as may be provided for compact cars, minimum size of off-street parking space and parking lot drives shall be in accordance with Figure 9.
- C. No parking shall be permitted in side yard or front yard setbacks.

- D. Required parking spaces must be provided on the same property as the principal building or use.
1. In multi-family developments, parking shall be within two hundred (200) feet of the principal use. Details regarding ownership of the parking areas shall be based on the homeowner's association covenants.
 2. In commercial or industrial developments, the parking area shall be within six hundred (600') feet of the principal building or use, provided (in either case) the zoning for the parking area is the same as the principal use or a more intensive classification.
 3. All parking areas shall be owned by the owner of the principal use for which parking spaces are being provided or said owners shall have a long-term lease on the land so that all required parking will be provided for any particular development.
- E. All parking areas shall be surfaced with asphalt, or concrete.
- F. Where a surface parking area of five (5) spaces or more is situated such that less than one half (1/2) the perimeter of the total area abuts a required yard that can be used for snow storage, then the total size of the parking area shall be increased by five (5%) percent.
- G. All parking areas shall be properly maintained and be completely free of snow so as to not reduce the required number of parking spaces.
- H. Refer to the Landscape Design Guidelines and Regulations for landscape requirements for parking areas.
- I. Parking areas shall be designed to manage stormwater drainage that will result from increase runoff from the site, designed to prevent non-point source pollution.
- J. A land owner with access to a state highway will be required to contact the Colorado Department of Transportation regarding specific permit and design requirements.
- K. Parking shall comply with all applicable federal and state accessibility requirements.
- L. All parking areas shall be separated from adjacent property by the use of open space areas of a minimum dimension of seven feet (7) and setback fifteen feet (15) from all rights-of-way. Such open space areas shall define the parking area and help define traffic flow so as to allow snow removal from parking areas without trespass upon or interference with adjacent property owners. The open

space shall comply with the Landscape Design Regulations and Guidelines.

3.9.4 PERMITTED REDUCTIONS IN OFF-STREET PARKING REQUIREMENTS

It is the intent of this Section to establish parking requirements based on the differing parking demands and time use characteristics in cases where commercial, residential, cultural or civic uses are intermixed on the same lot. The end product shall be a more efficient use of surface area with less land area devoted to parking.

- A. In districts where multiple-family dwellings, hotel or similar residential uses are erected above or on the same lot as commercial uses of any kind permitted without a use permit, the off-street parking requirements for said retail and service uses may be reduced by the City Council but not less than one space for each eight (8) fixed seats or one space for each one hundred (100) square feet of gross floor area of auditoriums, churches, and theaters, whichever is appropriate.

Type of Development	Minimum Spaces Unit
Offices	One (1) space for each eight hundred (800) square feet gross floor area
Eating and drinking establishments	One (1) space for each two hundred (200) square feet gross area
Retail Sales	One (1) space for every eight hundred (800) square feet of gross floor area excluding areas devoted exclusively to storage and building maintenance
Auditorium, churches, theaters	One (1) space for every eight (8) seats if fixed seating, or one (1) space for each one hundred (100) square feet of floor room in the seating area

- B. In considering the amount of deduction it should permit, the City Council shall take into account the magnitudes and times of operation of all uses proposed, availability of other public or private parking structures or areas at reasonable distances within the district, availability of remote employee parking in this or other districts where permitted, and other factors as the City Council deems pertinent. The City Council may request of any Applicant a plan showing all planned or proposed parking spaces and an analysis of the parking demand for the specific uses proposed.
- C. Any reduction in parking requirements as provided for in this Section shall be granted upon the adoption of a resolution by the City Council.

3.9.5 OFF-STREET LOADING AREA REQUIREMENTS

In all applicable districts, the following off-street loading requirements shall apply. All

loading spaces must be snow-plowed and permanently maintained.

Type of Development	Loading Requirements
Residential uses	None required
Commercial use less than 25,000 gross square feet.	One (1) space (may be eliminated if off-street loading space for the handling of all materials and equipment is provided)
Commercial use greater than 25,000 gross square feet	One (1) space for each 25,000 gross square feet plus one space for any portion exceeding a multiple of 25,000 (i.e., 60,000 gross square feet requires three loading spaces)

3.10 MULTI-FAMILY DEVELOPMENT

Multi-family development shall meet the requirements of all applicable sections of the Land Use Regulations and within these Standards.

Limited deviation in design requirements may be permitted based on urban design sections within AASHTO *Geometric Design of Very Low-Volume Local Roads*. The minimum design speed for all internal roadways shall be 20 mph. Particular attention should be made to meet the minimum stopping sight distance requirements. All structures within multi-family development (i.e. buildings, garages, dumpsters, etc.) shall be located at least ten (10') feet from the edge of all driving surfaces, or as determined by the City based on setback requirements.

3.10.1 RIGHT-OF-WAY / EASEMENT

The minimum Right-of-Way/Easement width should comply with Table 3.3. The road Right-of-Way/Easement shall accommodate all utilities, roads, drainage, and snow storage requirements or separate easements shall be required.

3.10.2 INTERSECTIONS

At the discretion of the City, driveway offsets to roads may be reduced to fifty (50') feet (measured centerline to centerline) on internal roadways which are classified Local or Low Volume. This design criteria does not reduce other design criteria required in these Standards (i.e. site triangles, intersection site distance, setbacks, etc.). See Sections 3.7.3 and 3.7.4 for requirements.

3.10.3 REVEGETATION, EROSION AND SEDIMENT CONTROL

See Chapter 7 for requirements.

3.10.4 PARKING

See Section 3.9 for requirements.

3.10.5 LIGHTING

All lighting requirements shall be according to appropriate Land Use Regulations.

3.10.6 PEDESTRIAN FACILITIES

See Section 3.5.5 for requirements.

3.10.7 SNOW OPERATIONS

See Section 3.11 for requirements.

3.11 SNOW OPERATIONS

All sites shall provide snow storage on-site. The use of the City Right-of-Way for a development's snow storage shall not be permitted (C.R.S. §43-5-301, §43-5-303).

Driving surfaces (including gravel shoulders), parking areas, and pedestrian walkways shall be required to provide snow storage. The snow storage area required is 25% of the total area as mentioned in the previous sentence and shall be a minimum of four feet (4') measured from the edge of road. Shoulders, cut slopes exceeding 3:1, center islands and private land not maintained by a homeowners association shall not be used as snow storage. Snow storage shall not be shown within three feet (3') of all surface utilities. Designated snow storage areas shall be placed in practical locations (as determined by the City) throughout the site and shall not interfere with the intersection site triangle (See Figure 8). Designated snow storage areas should be located to ensure that runoff from these areas will drain to the appropriate drainage facility (inlets, detention ponds, etc.).

If the 25% snow storage requirement cannot be met, a variance may be granted for heated hard surfaces or sites with a long-term maintenance program for hauling snow to predetermined offsite locations. Both of these options may be required to meet current water quality and drainage detention standards.

The City shall not be responsible for any snow removal required to gain access to any utility or other infrastructure within the City Right-of-Way.

3.12 TRAFFIC IMPACT ANALYSIS (TIA)

TIA shall be based on the projected traffic needs twenty (20) years after construction and shall encompass the needs from existing development, future development, and the proposed development.

Trip generations from future development over the design period shall be based on zoning, existing land use, proximity to developed areas, historic growth, and other factors expected to

influence development. See Sections 3.2 and 3.3 for vehicle trip calculations and road classifications. The TIA shall be prepared by a Colorado Licensed Professional Engineer and should contain, but not be limited to:

1. A description of the proposed land use, a site plan and an overall plan view of proposed roads within the development and all accesses to City roads with offset distances to other intersections (including driveways) within 1,500'.
2. A determination stating if the proposed increase in traffic will result in a road classification change. All costs associated with the road improvements required by the change in road classification, including acceleration/deceleration lanes and signalization may be the responsibility of the developer.
3. On-site issues including number and location of driveways, parking needs/layout, circulation, pedestrians, truck access and operations, transit and safety.
4. Description of and maps depicting existing roadway/transportation conditions affected by the development.
5. Identification of traffic congestion, roadways classifications, safety issues, and possible deficiencies of the existing transportation system affected by the development. This should address and anticipate “seasonal” traffic volumes, effects of phased construction, and opening day/planned special events.
6. Anticipated nearby land development (planned or under construction) and associated traffic, along with the anticipated trip generation, and daily and peak-hour traffic volumes of the proposed development at full build and at any interim construction phase.
7. The impacts of the development on the existing road and transportation system and the need for potential improvements to existing roads, in order for these roads to be in compliance with the City of Central Standards and Specifications for Design and Construction, including, but not limited to horizontal alignment, vertical alignment. All costs associated with any improvements may be the responsibility of the developer.
8. Based on the results of this analysis, a Traffic Impact Study (TIS) including traffic counts may be required by the City at its discretion. Coordination with CDOT may be required, see State Highway Access Code for more information.

3.13 TRAFFIC IMPACT STUDY (TIS)

See Sections 3.2 and 3.3 for vehicle trip calculations and road classifications. When a T.I.S. is required, a Colorado Licensed Professional Engineer shall prepare the T.I.S. and it should include but not be limited to the following information:

1. A scaled map of the vicinity showing all roadways and highways adjacent

to the site, a scaled map of the study area including land uses, and a map of the immediate access area, a plan showing on-site anticipated vehicular circulation patterns.

2. Map identification and textual consideration of all accesses that are existing and possible future access locations including signal locations for at least one half (½) mile in each direction along the roadway as well as all potential roadway and signal improvements.
3. Evaluation of current daily and peak hour traffic data and 20th year projections including turning movements at all intersections and any key year midpoints assuming a build out of the study area based upon zoning, comprehensive plans and growth estimates.
4. A determination stating if the proposed increase in traffic will result in a road classification change. All costs associated with a change in road classifications may be the responsibility of the developer.
5. An evaluation of the level of service and capacity for all design and traffic operation elements including mainline roadway and affected intersections.
6. An analysis of the clear zone and the horizontal and vertical sight distances.
7. Accurate and understandable diagrams.
8. All assumptions and adjustment factors.
9. An analysis of all reasonable alternatives including no build or alternative roadway access.
10. Current and projected travel speed, travel time and delay time within the study area that will be impacted by the access proposal.
11. Site traffic generation rate estimates and resulting trip generation distribution and assignments.
12. Analysis of queue lengths for all turn lanes affected to the 20th year.
13. A safety analysis including conflict points, turning movements and three (3) years of accident history.
14. A conceptual design showing all geometric elements and their approximate dimensions with analysis of any element of the access that will be below Standard.
15. Sources of information, data and references.
16. The existence of any current traffic problems in the local area such as a high accident location, confusing intersection or an intersection in need of a traffic signal.
17. The current projected level of service of the roadway system adjacent to the development, which will be significantly affected.
18. The sensitivity of the adjacent neighborhoods or other areas that may be perceived as impacted.
19. The proximity of the site driveways to the other access points or intersections.
20. The ability of the adjacent existing or planned roadway system to handle increased traffic or the feasibility of improving the roadway system to handle increased traffic.

21. Other specific problems or deficiencies that may be affected by the proposed development or affect the ability of the development to be satisfactorily accommodated (seasonal traffic volumes, phased construction, opening day/special events).

3.14 PAVEMENT DESIGN

See Chapter 10 for pavement design requirements.

3.15 BRIDGE DESIGN

Vehicular bridges are to conform to the AASHTO *Standard Specifications for Highway Bridges (2012)* requirements and specifications. All bridges shall satisfy HS20 load design ratings as minimum requirements. Plans are to be prepared by a Colorado Licensed Professional Engineer and are to be submitted to the City for review and approval.

Clear deck width must accommodate the full width of the traveled lanes and shoulders of approach roads. Pedestrian walkways and railings shall be required as warranted. Guardrail end sections shall be provided on the approach and opposing sides of traffic flow and shall comply with the CDOT *M&S Standards*. All bridges shall be designed and provide conduits for all shallow utilities (gas, electric, cable, etc...). The waterway area shall accommodate the 100-year storm. A minimum of one foot (1') freeboard is required. Additional freeboard shall be required when debris laden flow is anticipated.

CHAPTER 4: DRIVEWAY DESIGN STANDARDS

4.1 BASIC DESIGN POLICY AND PERMITTING

A driveway shall be designed to provide safe ingress and egress to structures and is defined as an access serving ≤ 20 ADT's (See Section 3.2). Driveway policy and permitting shall be managed by the City.

If an access serves more than 20 ADT's, it shall be classified as a roadway rather than a driveway and must meet the City's standards and requirements for roadway construction (See Chapter 3). A variance request must be submitted to allow more than 20 ADT's to utilize a driveway if it minimizes road cuts and/or site disturbance.

If driveway designs meet or exceed these current Driveway Design Standards, a Colorado Licensed Professional Engineers stamp may not be necessary.

All driveways shall be a minimum of 12' in width.

No driveway shall be built to allow the flow of water to drain onto a City Right-of-Way.

All driveways shall submit a Driveway Access Permit to the City (See attached Driveway/Access permit requirements and instructions).

4.2 DRIVEWAY PERMITS

Application for a Driveway Permit:

1. One (1) application must be completed for each driveway.
2. Applications must be completed and signed, incomplete applications will be denied.
3. This application must be submitted to the City before or simultaneously with a building permit application.
4. A deposit of \$1,000.00 shall be submitted with the application to insure completion of the driveway in accordance with approved plans. The deposit will be returned once the driveway has been completed by the Applicant and inspected by the City.
5. A detailed sketch of the work site must accompany the application and must show the placement of the driveway in relation to the property. The driveway shall conform with the stabilized construction access plan (See Figure 10).
6. A driveway profile will be required. If profile shows that the driveway meets standards, the permit may be issued. If the profile shows that the driveway does not meet standards, a variance may be required.
7. A permit fee is required with the submittal of this application.
8. Once a completed application is received by the City, a site inspection will be conducted within 5 business days.
9. No work shall begin until an approved permit has been issued by the City:

this application is not a valid permit and is not a guarantee that a permit will be issued. Any construction started prior to permit issuance, will result in a penalty to the property owner (Refer to Chapter 10).

10. All construction must comply with the City of Central Standards and Specifications for Design and Construction and all requirements listed in the “Requirements” section of the application.
11. Variance requests must be engineered and stamped by a professional engineer. All requests must include written approval from the local emergency responders (IE. fire, EMS and/or law enforcement). Once variance requests have been received and reviewed by the City Engineer they will be forwarded to the City Manager for variance approval.
12. The approved permit must accompany all building permit applications for new construction.
13. All permits expire one (1) year from date of issuance.
14. No Certificate of Occupancy will be issued by the City without a constructed driveway meeting Design Standards, including all permits, variances, fees, and any other requirements set forth in the Standards.

Requirements for a Driveway Permit:

1. Applicant must mark the centerline of the driveway prior to submitting the application.
2. Applicant is required to call for all utility locates from the appropriate agency.
3. A copy of this approved permit application shall be available for inspection at the work site at all times.
4. If work site fails inspection upon completion of construction, the property owner has ten (10) calendar days after notification to repair the work site to City Standards.
5. Photo Documentation may be required.
6. Consideration shall be given to placement of construction items such as dumpsters, portable toilets, equipment, building materials, etc. These items shall not be placed within a City Right-of-Way.

4.3 ACCESS

4.3.1 NUMBER OF ACCESS POINTS

Single family and duplex residences may only have one access point onto the City road system. Multi-family residential access shall be determined by information provided by the owner/developer in the Traffic Impact Study and by comments generated during the City of Central’s review and acceptance of that study. Commercial property having less than one hundred fifty (150’) feet of frontage and located midblock shall be limited to one access point to the street. An exception to this rule may be where a building is constructed in the middle of a lot and parking is provided on each side of the building. A second access point may be allowed for commercial property having more than 150 feet of frontage. For commercial property located on

a corner, one access to each street may be permitted.

4.3.2 DRIVEWAY SETBACK FROM PROPERTY LINE

All edges of driveways shall be a minimum of seven feet (7') from the adjacent property line. The seven foot (7') minimum does not apply if two adjacent lots share the same driveway. The portion of the driveway located within the side yard setback cannot be used to meet the parking requirement. Multi-family and commercial projects are encouraged to use shared driveways. Single family and duplex driveways may be placed in the side yard setback.

4.3.3 DRIVEWAY LOCATION AND APPROACH

Driveways shall not access roads that are greater than seven percent (> 7%) in grade. When a lot can access two different roads, driveway access shall always be onto the road with the lowest classification. Driveways connecting onto a major collector are considered a detriment to the safety and capacity of the road and will require a variance from the City. Backing onto City roads for access shall not be permitted on arterials or collector roads and is discouraged on other road classification based on site restrictions.

Driveway approaches, where the driveway is to serve as an entrance only or as an exit only, shall be appropriately signed and maintained by and at the expense of the property owner. The property owner shall be required to provide some means of ensuring that the motorists will use the driveway as either an entrance only or an exit only but not both.

4.3.4 STATE HIGHWAY ACCESS

Access to state highways is governed by the Colorado Department of Transportation through State Highway Access Code.

4.3.5 ACCESS ROADWAYS FOR EMERGENCY VEHICLES

Driveway design shall accommodate emergency vehicle access. Emergency access for large vehicles may be restricted if proper widening, overhead clearances, and surfacing are not considered in the design.

4.4 ALIGNMENT

The entrance of the driveway shall have an edge of shoulder radii in accordance with (Table 3.7.2) and entrance grades in accordance with (Table 3.7.4). The access design shall provide: minimum corner sight distance (Figure 8), minimum offset distances to other intersections (Table 3.7.3), and the maximum skew angle (Section 3.7.1).

Unless otherwise required by the City Subdivision Process, the first twenty four feet (24') shall not exceed 5% and after the first twenty four feet (24') the following is required for all driveways (see Figure 11):

1. A ten foot (10') transition zone from five percent (5%) to ten percent (10%).
2. A minimum horizontal curve radius of 35' at centerline.
3. A maximum grade of ten percent (10%) on straight sections and a maximum grade of eight percent (8%) for curves with radius of < 50' at centerline.
4. If the length of the driveway exceeds 200', a turn-around shall be provided in accordance with (Figure 5).
5. When a horizontal curve turns greater than 120° the maximum centerline grade within 25' and through this section will not exceed six percent (6%).
6. Driveway intersections shall comply with (Section 3.7.3).

4.5 STRUCTURES

All driveways that utilize a bridge or box culvert to cross a waterway shall be designed and signed by a Colorado Licensed Professional Engineer and shall conform to the AASHTO *Standard Specifications for Highway Bridges*.

4.6 SURFACING

All driveways shall be paved. It is recommended that a geotechnical engineer should be used to recommend minimum surface depths to accommodate heavy truck access (i.e. fire trucks) or normal vehicle traffic. Driveway entrance width shall be minimized whenever possible.

Prior to a foundation inspection being performed by the Building Department, the Applicant shall install a stabilized construction entrance in conformance with the construction stabilized access plan (See Figure 10). The stabilized construction entrance shall be maintained throughout the construction period. Failure to maintain the entrance will result in the Building Department no longer performing inspection until such entrance is repaired.

4.7 DRIVEWAY CULVERTS

See Section 6.2.10 for culvert requirements. Driveway culverts shall be installed prior to on-site construction. The property owner shall be responsible for the maintenance and replacement of driveway culverts.

4.8 GRADING

See Chapter 6 for grading requirements.

4.9 REVEGETATION, EROSION AND SEDIMENT CONTROL

See Chapter 7 for requirements and the Erosion and Sediment Control for Construction Activities Guidance Handbook.

4.10 SNOW OPERATIONS

Snow storage for driveways shall be provided onsite and not permitted on City Right-of-Way (See Section 3.11). Driveway intersections should be designed and constructed with gradual side slopes when intersecting a City roadway to allow for sufficient on-site snow storage.

4.11 ABANDONED DRIVEWAYS

Any driveway which has been abandoned shall be restored by the property owner except where such abandonment has been made at the request or the convenience of the City.

4.12 UTILITY REPLACEMENT

Adjustments which must be made to utility poles, street lights, fire hydrants, catch basins or intakes, traffic signs and signals, or other public improvements or installations which are necessary as the result of the driveway location shall be accomplished without any cost to the City of Central.

CHAPTER 5: UTILITIES

All utility installation within the City Right-of-Way shall require a Right-of-Way Permit prior to any installation activity. See Chapter 9 for Road Cut Standards, Regulations and Right-of-Way Permit.

All utility installation outside of the City Right-of-Way (private property) shall require a Grading Permit prior to any installation activity. See Chapter 6 for Grading Standards, Regulations and Grading Permit.

All utility lines shall be designed according to the governing utility company or district standards. All utilities must be clearly labeled on the plans and include the type, size, height, etc. Whenever possible, utilities shall be designed according to the typical utility layout plan (Figure 12).

5.1 WATER

This section pertains to all components of the water distribution system. Designs are intended to provide safe, reliable water supplies to customers and provide fire flow. Additional requirements are provided in the water utility details, Figures 12 and 21-35.

5.1.1 REVIEW PROCESS

All water distribution plans, construction drawings, specifications and record drawing information shall be submitted, reviewed, and approved as required by the Municipal Code, including Chapter 13, Municipal Utilities. All submitted information shall be in a clear, concise and legible form. Incomplete or absent information may result in the report being rejected. Plans shall be submitted in accordance with Section 2.1.6. Water profiles may be required by the City for steep terrain and utility crossings.

5.1.2 BASIC DESIGN GUIDELINES

D. DESIGN CRITERIA

1. GENERAL

- a. Water mains shall be 6-, 8-, or 12-inch pipe as described in this section.
- b. Maximum velocity shall be less than 7 feet per second at the peak hour flow.
- c. Maximum velocity shall be less than 10 feet per second during peak day flow and needed fire flow demand.
- d. Maximum head loss for water mains shall be less than 2 feet per 1,000 feet of pipe at the peak hour flow.

2. PRESSURE

- a. Minimum pressure during peak hour flow shall be 40 pounds per square inch.
- b. Minimum pressure during peak day flow and needed fire flow

demand shall be 20 pounds per square inch.

- c. Maximum static pressure shall be 110 pounds per square inch. Where pressures exceed the above limit, pressure regulating valves may be required and shall be coordinated with the City.

3. FIRE HYDRANTS

- a. Fire hydrant locations shall be coordinated with the City and Central City Fire Department.
- b. Fire hydrants shall be located in the northeast corner of intersections.
- c. Fire hydrants shall be located at intervals of 500 feet or less.

E. TRENCH

1. DEPTH

- a. Minimum bury depth for all water mains is 6 feet, from final grade to top of pipe. Preferred bury depth is 7 feet.
- b. Insulation is required for all water mains not meeting the above bury depth, and design must be reviewed and approved by City.
 - Insulation must be applied to each side of the trench (top, both sides, bottom) that does not meet the minimum depth from grade.
 - Insulation shall be two layers of 2-inch rigid Styrofoam insulation board, with seams staggered.
 - Minimum cover where insulation is used is 4 feet, from grade to top of pipe.

2. PROHIBITIONS

- a. The use of horizontal directional drilling is not permitted unless reviewed and approved by the City and all affected parties.
- b. The use of pipe bursting is not permitted unless reviewed and approved by the City.

5.1.3 WATER DISTRIBUTION SYSTEM LAYOUT

A. LOCATION

1. PUBLIC RIGHT-OF-WAY

- a. Water mains in streets and other public right-of-ways shall be parallel to the right-of-way lines and placed on the north or east side of the road.

2. EASEMENTS

- a. Water mains in easements shall be parallel to the easement lines and placed in the center of the easement.

3. ALLEYS

- a. Water mains are not allowed in alleys.

B. SEPARATION

1. HORIZONTAL

- a. Water mains shall be separated a minimum of 10 feet horizontally from sanitary sewer and storm sewer lines.
- b. Water mains shall be separated a minimum of 5 feet horizontally from all other utilities.

2. VERTICAL

- a. Water mains shall be separated a minimum of 18 inches vertically from sanitary sewer and storm sewer lines, and all other utilities.

3. CROSSINGS

- a. Water mains shall be separated a minimum of 18 inches vertically from sanitary sewer and storm sewer lines, and all other utilities.
- b. Water mains shall be above sanitary sewer mains.
- c. Water mains less than 18 inches above sanitary sewer mains or below sanitary sewer mains shall utilize a single 20 foot length of pipe centered on the crossing and encased in concrete for the entire length.

C. VALVES

1. TEES

- a. A minimum of two (2) valves shall be placed at tees in the distribution system. Valves shall be located adjacent to the tee, and placement shall be coordinated with the City.

2. CROSSES

- a. A minimum of three (3) valves shall be placed at crosses in the distribution system. Valves shall be located adjacent to the cross, and placement shall be coordinated with the City.

3. LINE

- a. Valves are required in all water mains at a minimum interval of 400 feet, and between fire hydrants.

5.1.4 WATER MAINS

A. DUCTILE-IRON PIPE

1. PURPOSE

- a. Ductile iron pipe is the standard pipe used for water mains and piping within vaults and building interiors.

2. STANDARDS

- a. Ductile iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51-09, AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast.
3. CERTIFICATIONS
- a. Ductile iron pipe shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.
4. MANUFACTURERS
- a. American Cast Iron Pipe Company
 - b. Griffin Pipe Products Company
 - c. Pacific States Cast Iron Pipe Company
 - d. United States Pipe and Foundry Company
5. DESIGN CRITERIA
- a. Size of Pipe – Ductile iron pipe shall be in the following sizes: 6-, 8-, and 12-inch nominal diameters, as required based on water distribution system hydraulic analysis.
 - b. Pressure – Ductile iron pipe 12 inches and smaller in diameter shall be Pressure Class 350.
 - c. Pipe Wall Thickness – Ductile iron pipe shall be a minimum of Thickness Class 50. Other classes with greater thicknesses may be required depending on the application.
 - d. Pipe Length – Pipe furnished under this Specification shall have a nominal laying length of 20 feet. Random lengths are not acceptable.
 - e. Joint Type – A variety of joints are used throughout the water distribution system as described below. All joints shall comply with ANSI/AWWA C111/A21.11-06, AWWA Standard for Rubber-Gasket Joints for Ductile-Iron Pipe and Fittings.
 - Flanged Joint: Flanged joints are used within vaults and building interiors.
 - Push-on Joint: Push-on joints are used for standard buried water main installations.
 - Mechanical Joint: Mechanical joints are used for all buried fittings and valves, and may need to be restrained as described later in this section.
 - f. Restraints and Thrust Blocks – Restraints and thrust blocks are addressed in Paragraph 5.1.9, Restraints.
 - g. Deflection
 - Maximum allowable deflection in ductile iron pipe push-on joints is 2 degrees.
 - Maximum allowable deflection in ductile iron pipe mechanical

joints is 3 degrees.

6. LININGS AND COATINGS

a. Linings – Ductile iron pipe shall be furnished with a shop-applied, cement-mortar lining as specified in ANSI/AWWA C104-08, AWWA Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.

b. Coatings

- For buried applications, ductile iron pipe shall be furnished with a shop-applied, asphaltic coating as specified within ANSI/AWWA C151-09, AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast.
- For exposed and interior applications, ductile iron pipe shall be furnished with a shop-applied, asphaltic coating as specified within ANSI/AWWA C151-09, AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast.

B. POLYVINYL CHLORIDE PRESSURE PIPE

1. PURPOSE

a. Polyvinyl chloride pipe is an alternate pipe used for water mains, subject to approval by the City.

2. STANDARDS

a. Polyvinyl chloride pressure pipe shall be manufactured in accordance with ANSI/AWWA C900-07, AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 through 12-inch.

3. CERTIFICATIONS

a. Polyvinyl chloride pressure pipe shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

Acceptable Manufacturers	AWWA C900-07	AWWA C905-10	AWWA C909-09
CertainTeed Corporation	X		
Diamond Plastic Corporation	X		
IPEX	X	X	

JM Eagle	X	X	X
North American Pipe Corporation	X	X	
Vinyltech Corporation	X		

5. DESIGN CRITERIA

- a. Size of Pipe – Polyvinyl chloride pressure pipe shall be in the following sizes: 6-, 8-, 12-inch nominal diameters, with cast iron equivalent outside diameters, as required based on water distribution system hydraulic analysis.
- b. Pressure – Polyvinyl chloride pipe shall have a pressure rating of 305 psi for all water mains.
- c. Pipe Wall Thickness – Polyvinyl chloride pipe shall have a Dimension Ratio of 14 for all water mains.
- d. Pipe Length – Polyvinyl chloride pipe furnished under this Specification shall have a nominal laying length of 20 feet. Random lengths are not acceptable.
- e. Joint Type – Polyvinyl chloride pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint.
- f. Restraints and Thrust Blocks – Restraints and thrust blocks are addressed in Paragraph 5.1.9, Restraints.
 - Maximum allowable deflection in PVC pipe push-on joints is 2 degrees.
 - Maximum allowable deflection in PVC pipe mechanical joints is 3 degrees.

5.1.5 JOINTS

A. BOLTED SLEEVE-TYPE COUPLINGS

1. PURPOSE

Bolted sleeve-type couplings are used to join plain end pipe and under certain circumstances as a repair sleeve.

2. STANDARDS

Bolted sleeve-type couplings shall be manufactured in accordance with ANSI/AWWA C219-11, AWWA Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe.

3. MANUFACTURERS

Manufacturers	Models
Dresser	38 and 138
Ford	Style FC1

Power Seal	3506 (Powermax)
Romac	XR501
Smith-Blair	411

4. DESIGN CRITERIA

- a. Size of Coupling – Bolted sleeve-type couplings shall be of the following sizes: 3 through 20-inch nominal diameters.
- b. Pressure – Bolted sleeve-type couplings with 3 through 12-inch nominal diameters shall be a minimum pressure rating of 260 psi.
- c. Installation – Bolted sleeve-type couplings may be installed on cast-iron, ductile-iron, and polyvinyl chloride pipe

5. LININGS AND COATINGS

- a. Coatings – End rings and the center sleeve shall be coated in accordance with ANSI/AWWA C210-08, AWWA Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines, or ANSI/AWWA C213-07, AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines, with a minimum DFT of 12 mils.

5.1.6 FITTINGS

A. DUCTILE IRON FITTINGS

1. PURPOSE

- a. Ductile iron fittings are used to join pipe at angles and to join multiple pipes at one location. Ductile iron fittings include:
 - Elbows (11.25°, 22.5°, 45°, 90°)
 - Tees
 - Crosses
 - Wyes
 - Reducers (Concentric and Eccentric)
 - Sleeves

2. STANDARDS

- a. Ductile iron waterworks fittings shall be manufactured in accordance with ANSI/AWWA C110/A21.10-12, AWWA Standard for Ductile-Iron and Gray-Iron Fittings.

3. CERTIFICATION

- a. Ductile iron waterworks fittings shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System

Components – Health Effects.

4. MANUFACTURERS
 - a. Griffin Pipe Products Company
 - b. Sigma
 - c. Star Pipe Products
 - d. Tyler Union
 - e. United States Pipe and Foundry Company

5. DESIGN CRITERIA
 - a. Pressure – Ductile iron fittings nominal size 3 through 12-inch shall be Pressure Class 350.
 - b. Joint Type – Ductile iron fittings shall be furnished with mechanical joint ends in accordance with ANSI/AWWA C111/A21.11-06, AWWA Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings. Maximum allowable deflection at joint is 3 degrees. Flanges shall be machined to a flat surface with a serrated finish in accordance with ANSI/AWWA C207-07, AWWA Standard for Steel Pipe Flanges for Waterworks Service.

6. LININGS AND COATINGS
 - a. Linings – Ductile iron pipe shall be furnished with a shop-applied, cement-mortar lining as specified in ANSI/AWWA C104-08, AWWA Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - b. Coatings – Ductile iron fittings may also be lined and coated with fusion-bonded epoxy in accordance with ANSI/AWWA C116-09, AWWA Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.

B. TAPPING SLEEVES

1. PURPOSE
 - a. Tapping sleeves are used to connect to a pipe without interruption of service.

2. STANDARDS
 - a. Ductile iron waterworks fittings shall be manufactured in accordance with ANSI/AWWA C110/A21.10-12, AWWA Standard for Ductile-Iron and Gray-Iron Fittings.

3. CERTIFICATION
 - a. Ductile iron waterworks fittings shall be suitable for use in

potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS
 - a. Griffin Pipe Products Company
 - b. Sigma
 - c. Star Pipe Products
 - d. Tyler Union
 - e. United States Pipe and Foundry Company
5. DESIGN CRITERIA
 - a. Pressure – Ductile iron fittings nominal size 3 through 12-inch shall be Pressure Class 350.
6. LININGS AND COATINGS
 - a. Linings – Ductile iron pipe shall be furnished with a shop-applied, cement-mortar lining as specified in ANSI/AWWA C104-08, AWWA Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - b. Coatings – Ductile iron fittings may also be lined and coated with fusion-bonded epoxy in accordance with ANSI/AWWA C116-09, AWWA Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.

5.1.7 VALVES

A. RESILIENT SEATED GATE VALVES

1. PURPOSE
 - a. Resilient seated gate valves are used in the water distribution system to isolate sections for maintenance and repairs.
2. STANDARDS
 - a. Resilient seated gate valves shall be designed and manufactured in accordance with ANSI/AWWA C509, AWWA Standard for Resilient-Seated Gate Valves for Water Supply Service, or ANSI/AWWA C515-09, AWWA Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
3. CERTIFICATIONS
 - a. Resilient seated gate valves shall be suitable for use in potable water distribution systems and be certified as compliant with

NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

Acceptable Manufacturers	AWWA C509	AWWA C515-09
American AVK	X	X
American Flow Control	X	X
Clow	X	
East Jordan Iron Works		X
Kennedy	X	
Mueller	X	
United States Pipe and Foundry Company	X	

5. DESIGN CRITERIA

- a. Valve Description – Resilient seated gate valves shall be iron body, with nonrising stems. Resilient seated gate valve bodies shall be designed to allow for the lifting of the valves by the bonnet flange, gland flanges, or other appurtenances.
 - b. Pressure – Resilient seated gate valves shall have a minimum working pressure of 200 psi.
 - c. Installation – Resilient seated gate valves shall be installed with the stem positioned vertically in buried horizontal water lines without gearing, bypasses, rollers, or tracks.
 - d. Valve Stems – Resilient seated gate valve stems shall be made of bronze in accordance with ASTM B763 Copper Alloy No. C99500, Standard Specification for Copper Alloy Sand Castings for Valve Applications; stainless steel in accordance with ASTM A276 Type 304, Type 316, or AISI 420, Standard Specification for Stainless Steel Bars and Shapes; or copper alloy in accordance with ASTM B98 Copper Alloy No. C66100/HO2, Standard Specification for Copper-Silicon Alloy Rod.
 - e. Bolting Material – The bonnet, gland bolts, and nuts shall be in accordance with ASTM F593 Type 304, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - f. End Connections – The following end connections shall be used with resilient seated gate valves.
- Flanges: Flanges shall be machined to a flat surface with a serrated finish in accordance with ANSI/AWWA C207-07, AWWA Standard for Steel Pipe Flanges for Waterworks Service. Flanges shall be sized and drilled in accordance with ASME/ANSI B16.1: Standards of Cast Iron Pipe Flanges and Flanged Fittings, Class 125.

- Mechanical Joint: Mechanical joint components shall be in accordance with ANSI/AWWA C111/A21.11-06, AWWA Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings. Maximum allowable deflection at joint is 3 degrees.
 - g. Testing – Each resilient seated gate valve, after shop assembly, shall be operated and hydrostatically tested in accordance with ANSI/AWWA C509, AWWA Standard for Resilient-Seated Gate Valves for Water Supply Service, or ANSI/AWWA C515-09, AWWA Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
6. LININGS AND COATINGS
- a. Coatings – Resilient seated gate valves shall have a fusion-bonded epoxy coating in accordance with ANSI/AWWA C509, AWWA Standard for Resilient-Seated Gate Valves for Water Supply Service, or ANSI/AWWA C515-09, AWWA Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service, with a minimum dry film thickness (DFT) of 10 mil. Machined flange faces shall be shop coated with a rust preventative compound.

B. RUBBER SEATED BUTTERFLY VALVES

1. PURPOSE

- a. Rubber seated butterfly valves are used where throttling of flow is required, space is limited for installation, and/or large pipes (16-inch or larger) are in the water distribution system.

2. STANDARDS

- a. Rubber seated butterfly valves shall be designed and manufactured in accordance with ANSI/AWWA C504-10, AWWA Standard for Rubber-Seated Butterfly Valves.

3. CERTIFICATIONS

- a. Rubber seated butterfly valves shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

- a. Dezurik
- b. M&H Valve Company
- c. Mueller
- d. Pratt

- e. Rodney Hunt
- f. Val-Matic

5. DESIGN CRITERIA

a. Pressure – Flanged rubber seated butterfly valves shall have a minimum working pressure of 250 psi.

b. Installation –

- Buried: Flanged rubber seated butterfly valves specified as buried shall be used for buried service in horizontal waterlines with the valve shaft positioned horizontally and the operating nut shaft positioned vertically. The body of valves shall be buried and the actuators installed in manholes.
 - In-Plant: Flanged rubber seated butterfly valves specified as in-plant shall be used for service inside buildings or other structures in a dry environment protected from weather. Valves shall be installed with the valve shaft positioned horizontally and the actuator directly coupled to the valve body.
 - Submerged: Flanged rubber seated butterfly valves specified as submerged shall be used for service inside basins and reservoirs. Valves shall be installed with the valve shaft positioned vertically and mounted to a pipe flange. Submerged valves shall be supplied with torque tubes and actuator stands.
- c. Valve Assembly – Buried and in-plant flanged rubber seated butterfly valves shall be shipped fully assembled. Submerged flanged rubber seated butterfly valves shall be assembled in the manufacturer's shop. The assembled valves shall be performance tested in accordance with ANSI/AWWA C504-10, AWWA Standard for Rubber-Seated Butterfly Valves.
- d. Valve Discs – The flanged rubber seated butterfly valve disc shall seat at 90 degrees to the pipe axis. Flanged rubber seated butterfly valve discs shall be ductile-iron in accordance to ASME/ANSI B16.1: Standards of Pipe Flanges and Flanged Fittings, Class 250B.
- e. Valve Seat – Rubber seats may be applied to the body or the disc. In either case, the mating seat surface shall be in accordance with ANSI/AWWA C504-10, AWWA Standard for Rubber-Seated Butterfly Valves.
- f. Valve Shaft – Shafts for class 250B valves shall be ASTM A564, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes, UNS Designation S17400, condition H1150.
- g. Type of Valve Ends – The dimensions and drilling of the flanged rubber seated butterfly valves shall be in accordance with ASME/ANSI B16.1: Standards of Pipe Flanges and Flanged Fittings, Class 125. Flanges shall be machined to a flat

surface with a serrated finish in accordance with ANSI/AWWA C207-07, AWWA Standard for Steel Pipe Flanges for Waterworks Service.

- h. Valve Actuators – Flanged rubber seated butterfly valves shall be furnished with manual actuators that shall be designed and sized based on the type of valve.
- Buried Valves: Actuators shall be Auma Model GS, EIM Type WD, Rotork IW, or Limitorque Type HBC that are designed to operate temporarily in a submerged condition (i.e., 10 feet of water). Actuators shall be in accordance with ANSI/AWWA C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
- In-Plant and Submerged Valves: The actuators shall be traveling nut or worm-gear type. Worm-gear actuators shall be Auma Model GS, Limitorque Type PT, Rotork IW, or EIM Type WO. Traveling nut actuators shall be manufactured by the valve manufacturer and capable of withstanding 450 foot-pounds of input torque.

6. LININGS AND COATINGS

- a. Internal Surfaces – The flanged rubber seated butterfly valve shall be prepared for coating in accordance with SSPC SP10, Standard for Near-White Blast Cleaning. These surfaces shall then be coated in accordance with ANSI/AWWA C550, AWWA Standard for Protective Interior Coatings for Valves and Hydrants.
- b. External Surfaces –
 - Buried: For buried valves, the exterior of each valve, except flange faces, shall be shop coated with two coats of asphalt varnish or prepared and coated in the same manner as the internal surfaces.
 - In-Plant: For in-plant valves, the exterior of each valve, except flange faces, shall be shop coated with one coat of polyamide anti-corrosive epoxy primer to a dry film thickness of at least 3 mils.
 - Submerged: For submerged valves, the external surfaces shall be prepared and coated in the same manner as the internal surfaces.

C. SWING CHECK VALVES

1. PURPOSE

- a. Swing check valves are used to allow flow in only one direction and prevent backflow through the valve in the other direction.

2. STANDARDS

- a. Swing check valves shall be designed and manufactured in accordance with ANSI/AWWA C508-09, AWWA Standard

for Swing-Check Valves for Waterworks Service.

3. CERTIFICATIONS

- a. Swing check valves shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. DESIGN CRITERIA

- a. Valve Description – Swing check valves shall be iron body. The disc shall be swing type.
 - b. Pressure – Swing check valves shall have a minimum working pressure of 250 psi.
 - c. Installation – Swing check valves shall be installed in a horizontal position. Some operating conditions may dictate the need for an assisted closure feature such as a counterweight or spring to reduce check valve slam.
 - d. Bolting Material – The bonnet, gland bolts, and nuts shall be in accordance with ASTM F593 Type 304, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - e. End Connections – The following end connections shall be used with swing check valves.
 - Flanges: Flanges shall be in accordance with ANSI/AWWA C207-07, AWWA Standard for Steel Pipe Flanges for Waterworks Service. Flanges shall be sized and drilled in accordance with ASME/ANSI B16.1: Standards of Cast Iron Pipe Flanges and Flanged Fittings, Class 125.
 - Mechanical Joint: Mechanical joint components shall be in accordance with ANSI/AWWA C111/A21.11-06, AWWA Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - f. Testing – Each swing check valve shall be operated and hydrostatically tested in accordance with ANSI/AWWA C508, AWWA Standard for Swing-Check Valves for Waterworks Service.
5. LININGS AND COATINGS
- a. Coatings – The flanged rubber seated butterfly valve shall be prepared for coating in accordance with SSPC SP10, Standard for Near-White Blast Cleaning. These surfaces shall then be coated in accordance with ANSI/AWWA C550, AWWA Standard for Protective Interior Coatings for Valves and Hydrants.

D. TAPPING VALVES – MECHANICAL JOINT TYPE

1. PURPOSE

- a. Tapping valves are used in conjunction with a tapping sleeve to connect to a pipe without interruption of service.

2. STANDARDS

- a. Tapping valves shall be designed and manufactured in accordance with ANSI/AWWA C509, AWWA Standard for Resilient-Seated Gate Valves for Water Supply Service, or ANSI/AWWA C515-09, AWWA Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.

3. CERTIFICATIONS

- a. Tapping valves shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

- a. American AVK
- b. American Flow Control, Series 2500 RW
- c. Clow
- d. Kennedy
- e. Mueller
- f. United States Pipe and Foundry Company

5. DESIGN CRITERIA

- a. Valve Description – Tapping valves shall be iron body, resilient seated gate valves with non-rising stems. If the resilient seats are bonded to the gates, the gates shall be completely encapsulated with the material except for the guide tabs or slots.
- b. Pressure – Tapping valves shall have a minimum working pressure of 250 psi.
- c. Installation – Tapping valves shall be installed with the stem positioned vertically in buried horizontal water lines without gearing, bypasses, rollers, or tracks.
- d. Valve Stems – Tapping valve stems shall be made of bronze in accordance with ASTM B763 Copper Alloy No. C99500, Standard Specification for Copper Alloy Sand Castings for Valve Applications; stainless steel in accordance with ASTM A276 Type 304, Type 316, or AISI 420, Standard Specification for Stainless Steel Bars and Shapes; or copper alloy in accordance with ASTM B98 Copper Alloy No. C66100/HO2, Standard Specification for Copper-Silicon Alloy Rod.
- e. Bolting Material – The bonnet, gland bolts, and nuts shall be in

accordance with ASTM F593 Type 304, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

- f. End Connections – The following end connections shall be used with tapping valves.
 - Flanges: Flanges shall be machined to a flat surface with a serrated finish in accordance with ANSI/AWWA C207-07, AWWA Standard for Steel Pipe Flanges for Waterworks Service. Flanges shall be sized and drilled in accordance with ASME/ANSI B16.1: Standards of Cast Iron Pipe Flanges and Flanged Fittings, Class 125.
 - Mechanical Joint: Mechanical joint components shall be in accordance with ANSI/AWWA C111/A21.11-06, AWWA Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- g. Seat Ring Size – The body of the tapping valve and the seat opening shall be sized large enough to accommodate the following sizes of shell cutters:

Tapping Valve Nominal Diameter (Inches)	Shell Cutter Diameter (Inches)
4	3 7/8 ± 1/32
6	5 13/16 ± 1/32
8	7 7/8 ± 1/32
10	9 3/4 ± 1/32
12	11 7/8 ± 1/32

- h. Testing – Each tapping valve, after shop assembly, shall be operated and hydrostatically tested in accordance with ANSI/AWWA C509, AWWA Standard for Resilient-Seated Gate Valves for Water Supply Service, or ANSI/AWWA C515-09, AWWA Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
6. LININGS AND COATINGS
- a. Coatings – Tapping valves shall have a fusion-bonded epoxy coating in accordance with ANSI/AWWA C509, AWWA Standard for Resilient-Seated Gate Valves for Water Supply

Service, or ANSI/AWWA C515-09, AWWA Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service, with a minimum dry film thickness (DFT) of 10 mil. Machined flange faces shall be shop coated with a rust preventative compound.

E. PRESSURE REGULATING VALVES

1. PURPOSE

- a. Pressure regulating valves are used to reduce an upstream high pressure to a preadjusted lower downstream pressure. The City will designate where pressure regulating valves are located within the distribution system in accordance with the water system master plan and pressure zones. All pressure regulating valves shall be located within a vault with access and room for operation and maintenance procedures.

2. STANDARDS

- a. Pressure regulating valves shall be designed and manufactured in accordance with ANSI/AWWA C530-07, AWWA Standard for Pilot-Operated Control Valves.

3. CERTIFICATIONS

- a. Pressure regulating valves shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

- a. Ames
- b. Bermad 700 Series Control Valve
- c. Clay-Val
- d. Golden-Anderson
- e. OCV
- f. Ross
- g. Singer

5. DESIGN CRITERIA

- a. Valve Description – Pressure regulating valves shall be hydraulically operated and pilot controlled with a diaphragm or piston activated globe or angle valve. They shall be entirely stainless steel or bronze-trimmed. An indicator rod shall be furnished as an integral part of the valve to show the valve position. The valve shall be designed to provide an access opening in the body for the removal of internal parts without the removal of the main valve body from the service line.

- b. Pressure – Pressure regulating valves shall have a minimum working pressure of 250 psi.
 - c. Installation – Pressure regulating valves shall be installed in a horizontal position in an underground concrete manhole or concrete vault as applicable.
 - d. Material – Pressure regulating valve body, flanges, and covers shall be made of cast-iron in accordance with ASTM A126 Class B, Standard Specification for Gray Iron Castings for Valves, or ASTM A48: Class 35, Standard Specification for Gray Iron Castings; of ductile-iron in accordance with ASTM A536 grade 65-45-12, Standard Specification for Ductile Iron Castings; or of AISI 300 series stainless steel. Bronze castings or parts for the internal trim shall be in accordance with ASTM B62, Standard Specification for Composition Bronze.
 - e. Valve Ends – Pressure regulating valves shall be furnished with flanged ends that are sized and drilled in accordance with ASME/ANSI B16.1: Standards of Cast Iron Pipe Flanges and Flanged Fittings, Class 125. Flanges shall be machined to a flat surface with a serrated finish in accordance with ANSI/AWWA C207-07, AWWA Standard for Steel Pipe Flanges for Waterworks Service.
 - f. Pilot Valve – The pilot valve for controlling the operation of the main valve shall be a single seated, diaphragm operated, and spring loaded type. The pilot valve shall be attached to the main valve with piping and isolation valves arranged for easy access for adjustments and for removal from the main valve while it is under pressure.
 - g. Needle Valve – The needle valve shall be bronze or stainless steel and included with the main valve to control the speed of piston travel.
 - h. Testing – The body of the pressure regulating valve shall be hydrostatically tested to 150% of the working pressure. A seat leakage test shall be made at the working pressure.
6. LININGS AND COATINGS
- a. Coatings – The pressure regulating valve shall be prepared for coating in accordance with SSPC SP10, Standard for Near-White Blast Cleaning. These surfaces shall then be coated with a two-part thermosetting polyamide epoxy in two or more uniform coats or with fusion-bonded epoxy to a minimum DFT of 12 mils. Epoxy coating shall be in accordance with ANSI/AWWA C550, AWWA Standard for Protective Interior Coatings for Valves and Hydrants.

F. COMBINATION AIR-RELEASE AND VACUUM-RELIEF VALVES

1. PURPOSE

- a. Combination air-release and vacuum-relief valves are used in vent air and relieve vacuum conditions at high points within the water distribution system. The City will designate where these valves are located. All air-release and vacuum-relief valves shall be located within a vault with access and room for operation and maintenance procedures.

2. STANDARDS

- a. Combination air-release and vacuum valves shall be designed and manufactured in accordance with ANSI/AWWA C512-07, AWWA Standard for Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.

3. CERTIFICATIONS

- a. Combination air-release and vacuum valves shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

Standard Body	
Manufacturers	Models
APCO	Series 140C
GA Industries	Figure 945
Val-Matic	Series 200
Cylindrical Body	
Manufacturer	Model
Vent-O-Mat	Series RBX

5. DESIGN CRITERIA

- a. Valve Description – Combination air-release and vacuum valves shall be of the single body, double orifice type. The large orifice shall allow air to enter during the drainage of the pipeline and escape during pipeline filling. The small orifice shall release small pockets of air after the pipeline is filled and under pressure.
- b. Pressure – Combination air-release and vacuum valves shall be Pressure Class 150.
- c. Installation – Combination air-release and vacuum valves shall be installed in a vertical position in an underground concrete manhole or concrete vault.

- d. Valve Construction –
- Standard Iron Body: The combination air-release and vacuum valve body and cover shall be cast-iron in accordance with ASTM A48 Class 35, Standard Specification for Gray Iron Castings, or ASTM A126 Grade B, Standard Specification for Gray Iron Castings for Valves; or ductile-iron in accordance with ASTM A536 Grade 65-45-12, Standard Specification for Ductile Iron Castings.
 - Cylindrical Body: The combination air-release and vacuum valve body shall be AISI Type 304 stainless steel. The ends shall be epoxy coated steel or Type 304 stainless steel secured with Type 304 stainless steel rods. The floats shall be solid cylindrical high density polyethylene. The baffle plate, nozzle seat retaining plate, small orifice nozzle, and connecting hardware shall be stainless steel.
 - Three and 4-inch valves shall be furnished with flanged inlets that conform in dimension and drilling to ASME/ANSI B16.1: Standards of Pipe Flanges and Flanged Fittings, Class 125. Each flange face shall be machined to a flat surface with a serrated finish in accordance with ANSI/AWWA C207-07, AWWA Standard for Steel Pipe Flanges for Waterworks Service.
- e. Size of Orifices – Combination air-release and vacuum valves shall be furnished with orifice sizes as tabulated

Valve Size (Inches)	Inlet (Inches)	Outlet (Inches)	Small Orifice (Inches)	
			Standard Body	Cylindrical Body
1	1	1	5/64	0.047
2	2	2	3/32	0.047
3	3	3	3/32	0.059
4	4	4	3/32	0.059

- f. Testing – Each Combination air-release and vacuum valve shall be tested in accordance with ANSI/AWWA C512-07, AWWA Standard for Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
6. LININGS AND COATINGS
- a. Coatings – Combination air-release and vacuum valves shall be prepared for coating in accordance with SSPC SP10, Standard for Near-White Blast Cleaning. These surfaces shall then be coated with a two-part thermosetting polyamide epoxy in two

or more uniform coats or with fusion-bonded epoxy to a minimum DFT of 10 mils. Epoxy coating shall be in accordance with ANSI/AWWA C550, AWWA Standard for Protective Interior Coatings for Valves and Hydrants.

7. LININGS AND COATINGS

- a. Coatings – Combination air-release and vacuum valves shall be prepared for coating in accordance with SSPC SP10, Standard for Near-White Blast Cleaning. These surfaces shall then be coated with a two-part thermosetting polyamide epoxy in two or more uniform coats or with fusion-bonded epoxy to a minimum DFT of 10 mils. Epoxy coating shall be in accordance with ANSI/AWWA C550, AWWA Standard for Protective Interior Coatings for Valves and Hydrants.

G. BACKFLOW PREVENTERS

1. PURPOSE

- a. Backflow preventers are used to protect from cross connection conditions which could allow contamination to be drawn into the water distribution system.
- b. Backflow preventers are required for the following:
 - Fire service line connections
 - Commercial/industrial service line connections where the potential for contamination is necessary as determined by the City
 - Master meter service lines that serve more than one downstream service connection (e.g. condominiums, apartments, developments, etc.)
 - Service lines where other water supplies are connected
 - Irrigation service lines
- c. Backflow preventers are generally not required for typical residential service line connections.

2. STANDARDS

- a. Backflow preventers shall be designed and manufactured in accordance with AWWA C510-07, Double Check Valve Backflow Prevention Assembly or AWWA C511-07, Reduced-Pressure Principle Backflow Prevention Assembly.
- b. Installation and selection of backflow preventers shall follow AWWA M14, Recommended Practice for Backflow Prevention & Cross-Connection Control, Third Edition.

3. CERTIFICATIONS

- a. Backflow preventers shall be suitable for use in potable water

distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

- a. Conbraco
- b. Febco
- c. Watts
- d. Wilkins

5. DESIGN CRITERIA

- a. Size – Backflow preventers shall be the same size as the service line they are installed.
- b. Pressure – The backflow preventer shall have a minimum working pressure of 250 psi.
- c. Installation – Backflow preventers shall be install horizontally in either a dedicated vault or inside the building (preferred).
- d. Testing – Backflow preventers shall be tested in accordance with AWWA M14, Recommended Practice for Backflow Prevention & Cross-Connection Control, Third Edition.

6. LININGS AND COATINGS

- a. Coatings – Backflow preventers shall be prepared for coating in accordance with SSPC SP10, Standard for Near-White Blast Cleaning. These surfaces shall then be coated with a two-part thermosetting polyamide epoxy in two or more uniform coats or with fusion-bonded epoxy to a minimum DFT of 10 mils. Epoxy coating shall be in accordance with ANSI/AWWA C550, AWWA Standard for Protective Interior Coatings for Valves and Hydrants.

5.1.8 CORROSION PROTECTION

A. POLYETHYLENE ENCASEMENT MATERIAL

1. PURPOSE

- a. Polyethylene encasement material is used to protect ductile iron pipe, fittings, and valves from corrosion due to aggressive soils.

2. STANDARDS

- a. Polyethylene encasement material shall be manufactured in accordance with ANSI/AWWA C105/A21.5-10, AWWA Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. DESIGN CRITERIA

- a. Materials – Polyethylene encasement shall be linear low-density polyethylene film with minimum thickness of 8 mils.
- b. Color – Polyethylene encasement shall be clear.
- c. Installation – Flat tube material shall be used for pipe and fitting encasement; flat sheet material shall be used for valve encasement.

B. CATHODIC PROTECTION

1. PURPOSE

- a. Cathodic protection provides additional protection from corrosion to ductile iron pipe in aggressive soils and shall be utilized as determined by the City.

2. STANDARDS

- a. Sacrificial anode cathodic protection shall comply with NACE SP0169-2007, Standard Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems.

3. DESIGN CRITERIA

- a. Design of the cathodic protection shall be based on site specific soil data in the geotechnical report.
- b. Design criteria and proposed cathodic protection system shall be reviewed and approved by the City.

5.1.9 RESTRAINTS

A. MECHANICAL JOINT RESTRAINT

1. PURPOSE

- a. Mechanical joint restraints are used on all fittings, valves, and fire hydrants assemblies in the water distribution system. Mechanical joint restraints are also required within casing pipes and in areas where thrust blocks cannot be utilized.

2. STANDARDS

- a. Mechanical joint restraints shall be manufactured of ductile-iron in accordance with ASTM A536, Standard Specification for Ductile Iron Castings. Mechanical joint restraints shall be incorporated into the design of a follower gland. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts in accordance with ANSI/AWWA C111/A21.11-06, AWWA Standard for

Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings, and ANSI/AWWA C153/A21.53-11, AWWA Standard for Ductile-Iron Compact Fittings.

3. MANUFACTURERS

Mechanical Joint Restraint – PVC Pipe		
Manufacturers	Models	Sizes (Inches)
EBAA Iron, Inc.	Megalug 2000 PV Series	4 to 20
Sigma Corporation	One-Lok SLCE Series	4 to 20
Star Pipe Products	StarGrip 4000 Series	4 to 20

Mechanical Joint Restraint – Ductile Iron Pipe		
Manufacturers	Models	Sizes (Inches)
EBAA Iron, Inc	Megalug 1100 Series	3 to 36
Romac Industries	RomaGrip	3 to 36
Sigma Corporation	One-Lok SLDE Series	3 to 12
Star Pipe Products	StarGrip 3000 Series	3 to 36
Uni-Flange (Ford)	UFR 1400 Series	3 to 36

Bell-Spigot Restraint – PVC Pipe		
Manufacturers	Models	Sizes (Inches)
EBAA Iron, Inc.	Series 1500 TD	4 to 12
	Series 1500	4 to 12
Ford Meter Box	Ford 1390	4 to 12
Star	Series 1100	4 to 12

Bell-Spigot Restraint – Ductile Iron Pipe		
Manufacturers	Models	Sizes (Inches)
American	Fastgrip Gasket	4 to 12
EBAA Iron, Inc.	Megalug 1700 Series	3 to 20
	Series 1500 TD	4 to 12
Star Pipe Products	StarGrip 3100P Series	3 to 20
U.S. Pipe	Field Lok Gasket	4 to 12

Bolt-Through Mechanical Joint Restraint		
Foster Adaptor		

Hydrants and Valve Restraint – Ductile Iron Pipe
Mueller Aquagrip Restraint Device

4. DESIGN CRITERIA

a. Pressure – The mechanical joint restraint device shall be as listed below:

Type of Pipe	Sizes (Inches)	PSI	Safety Factor
DIP	3 to 12	350	2
PVC	3 to 12	305	2

b. Material – The mechanical joint restraint gland and wedge assembly shall be manufactured from ductile-iron in accordance with ASTM A536, Standard Specification for Ductile Iron Castings. Rubber gaskets shall be manufactured in accordance with ANSI/AWWA C111/A21.11-06, AWWA Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

B. THRUST BLOCKS

1. PURPOSE

a. Thrust blocks are required on all bends, tees, wyes, reducers, dead ends, and fire hydrants assemblies in the water distribution system.

2. STANDARDS

- a. AWWA Design Manual M41, Ductile-Iron Pipe and Fittings
- b. AWWA Design Manual M23, PVC Pipe – Design and Installation

3. DESIGN CRITERIA

- a. Material – Concrete shall have a maximum water to cement ratio of 0.63 by weight and a minimum 28-day compressive strength of 3,000 pounds per square inch.
- b. Pressure – Water system pressure shall be assumed to be 150 pounds per square inch plus a water hammer of 110 pounds per square inch unless otherwise determined by the City.
- c. Soil – Soil bearing capacity shall be determined by a geotechnical engineer registered in the State of Colorado and documented in a stamped and signed geotechnical report.
- d. Installation – Thrust blocks shall be placed against undisturbed soil and utilize a bond breaker against the pipe/fitting.

5.1.10 TRACER WIRE

A. TRACING WIRE

1. PURPOSE

- a. Tracing wire is used on all water distribution system pipe to provide a convenient and more accurate way to locate buried water lines.

2. STANDARDS

- a. Tracing wire shall be installed on all water mains, regardless of pipe material.

3. DESIGN CRITERIA

- a. Description – Tracing wire shall be a standard, single strand, No. 12 American Wire Gauge (AWG), insulated solid copper wire.
- b. Installation – Test stations shall be installed at all valves/valve boxes.

5.1.11 CASING

A. CASING

1. PURPOSE

- a. Casing shall be used where water lines cross railroads, state highways, and associated right-of-ways.

2. STANDARDS

- a. Casing shall meet or exceed the requirements of the railroad or Colorado Department of Transportation, and conform to ASTM A53 and AWWA C200.

3. DESIGN CRITERIA

- a. Material – Casing shall be ASTM A139 Grade B smooth walled welded steel with a minimum thickness of 0.5 inches
- b. Size – Casing shall be a minimum of 24 inches diameter
- c. Details – Follow standard detail required by authority having jurisdiction

5.1.12 FIRE HYDRANTS

A. DRY-BARREL FIRE HYDRANTS

1. PURPOSE

a. Dry-barrel fire hydrants are used throughout the distribution for providing fire flow demands, and providing a means for flushing water mains.

2. STANDARDS

a. Dry-barrel fire hydrants shall be designed and manufactured in accordance with ANSI/AWWA C502, AWWA Standard Dry-Barrel Fire Hydrants.

3. CERTIFICATIONS

a. Dry-barrel fire hydrants shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

Manufacturers	Models
ACIP/Waterous	Pacer WB-67-250
American AVK	Series 27
Clow	Medallion F-2545
Kennedy	K-81D

5. DESIGN CRITERIA

- a. Pressure – Dry-barrel fire hydrants shall have a minimum working pressure of 250 psi.
- b. Size of Hydrant – Dry-barrel fire hydrants shall have a main valve opening size of at least 5¼ inches.
- c. Type of Hydrant – Dry-barrel fire hydrants shall be the three-way type with one pumper nozzle and two hose nozzles located on the same horizontal plane at least 18 inches above ground line.
- d. Inlet Connection – Dry-barrel fire hydrants shall be provided with a mechanical joint inlet to accommodate 6-inch ductile-iron pipe complete with plain rubber gasket, gland, bolts, and nuts in accordance with ANSI/AWWA C111/A21.11-06, AWWA Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- e. Testing – Dry-barrel fire hydrants shall be hydrostatically tested in accordance with ANSI/AWWA C502, AWWA Standard Dry-Barrel Fire Hydrants.

6. LININGS AND COATINGS

- a. Coatings - The upper exposed section of the dry-barrel fire hydrant shall be thoroughly cleaned and painted with a prime coat of a rust inhibitive primer followed by a 10 mil DFT shop coat of heavy duty alkyd enamel paint.
- b. Exposed exterior surfaces below ground line and the interior of the hydrant shall be coated with asphalt varnish in accordance with ANSI/AWWA C502, AWWA Standard Dry-Barrel Fire Hydrants.

5.1.13 WATER SERVICES

A. WATER SERVICES – GENERAL

1. WATER SERVICES

- a. Water services 2-inch and smaller consist of the following components:
 - Tapping Saddle
 - Corporation Stop
 - Curb Stop with Curb Box
 - Water Meter Pit
 - Water Meter
 - Yoke with Angle Valve
 - Water Service Line Pipe
- b. Water services larger than 2-inch and fire line services consist of the following components:
 - Tee or Tapping Sleeve
 - Two Gate Valves with Curb Boxes
 - Vault
 - Water Meter with Isolation Valves
 - Strainer
 - Bypass with Gate Valve
 - Water Service Line Pipe

2. STANDARDS

- a. Water service sizing shall comply with AWWA M22, Sizing Water Service Lines and Meters.
- b. Fire service sizing shall be completed by a mechanical engineer registered in the State of Colorado in compliance with applicable building codes and approved by the Central City Fire Department.

B. WATER SERVICE LINE PIPE – 2-INCH AND SMALLER

1. PURPOSE

a. Water service line pipe is used for service lines to residential and commercial customers.

2. STANDARDS

a. Water service line pipe shall be manufactured in accordance with ASTM B88, Standard Specification for Seamless Copper Water Tube.

3. CERTIFICATIONS

a. Water service line pipe shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

- a. Cerro Flow Products
- b. Mueller Industries

5. DESIGN CRITERIA

- a. Size of Pipe – Water service line pipe shall be the following sizes: $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, and 2-inch nominal diameters.
- b. Pipe Material – Water service line pipe shall be seamless copper water tube in accordance with ASTM B88, Standard Specification for Seamless Copper Water Tube, furnished in coils, annealed, Type K Copper UNS No. 12200.

C. WATER SERVICE LINE PIPE – LARGER THAN 2-INCH

1. PURPOSE

a. Water service line pipe is used for service lines to commercial customers.

2. STANDARDS

a. Ductile iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51-09, AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast.

3. CERTIFICATIONS

a. Water service line pipe shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

- a. American Cast Iron Pipe Company

- b. Griffin Pipe Products Company
- c. Pacific States Cast Iron Pipe Company
- d. United States Pipe and Foundry Company

5. DESIGN CRITERIA

- a. Size of Pipe – Water service line pipe shall be the following sizes: 3-, 4-, or 6-inch nominal diameters.
- b. Pipe Material – Pipe shall be ductile iron pipe in accordance with Section 5.2.3.

D. FIRE SERVICE LINE PIPE

1. PURPOSE

- a. Fire service line pipe is used for dedicated fire supply for fire suppression systems within buildings.

2. STANDARDS

- a. Ductile iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51-09, AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast.

3. CERTIFICATIONS

- a. Water service line pipe shall be suitable for use in potable water distribution systems and be certified as compliant with NSF/ANSI Standard 61 Drinking Water System Components – Health Effects.

4. MANUFACTURERS

- a. American Cast Iron Pipe Company
- b. Griffin Pipe Products Company
- c. Pacific States Cast Iron Pipe Company
- d. United States Pipe and Foundry Company

5. DESIGN CRITERIA

- a. Size of Pipe – Fire service line shall be the following sizes: 4-, 6-, or 8-inch nominal diameters.
- b. Pipe Material – Pipe shall be ductile iron pipe in accordance with Section 5.2.3.

E. WATER SERVICES – APPURTENANCES

1. GENERAL

- a. Appurtenances shall comply with AWWA C800, Standard for Underground Service Line Valves and Fittings.

2. TAPPING SADDLE
 - a. Tapping saddles shall consist of an epoxy or nylon coated ductile iron outlet casting, o-ring seal, and stainless steel straps.
 - b. Tapping saddles shall be manufactured by one of the following:
 - The Ford Meter Box Company
 - Smith-Blair
 - Mueller Company
3. CORPORATION STOP
 - a. Corporation stops shall be manufactured by one of the following:
 - The Ford Meter Box Company
 - A.Y. McDonald Manufacturing Company
 - Mueller Company
4. CURB STOP
 - a. Curb stops shall be manufactured by one of the following:
 - The Ford Meter Box Company
 - A.Y. McDonald Manufacturing Company
 - Mueller Company
5. YOKE WITH ANGLE VALVE
 - a. Yokes and angle valves shall be manufactured by one of the following:
 - The Ford Meter Box Company
 - A.Y. McDonald Manufacturing Company
 - Mueller Company

5.1.14 VAULTS, MANHOLES, AND APPURTENANCES

A. CONCRETE VAULTS

1. PURPOSE

- a. Concrete vaults are used to house specialty valves, including pressure regulating valves, air-release and vacuum-relief valves, check valves, and other valves requiring periodic inspections, adjustments, and maintenance.

2. STANDARDS

- a. Materials used to construct the vault shall be in accordance with Material Specification: Normal Weight and Precast Concrete, and Material Specification: Controlled Low Strength Backfill Material. Manholes, reducing sections, ladder rungs, and traffic lids shall be precast in accordance with ASTM

C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.

3. MANUFACTURERS
 - a. Colorado Precast Concrete
 - b. Oldcastle Precast
4. DESIGN CRITERIA
 - a. Traffic Lids and Roofs – Traffic lids and roofs shall be designed for AASHTO H2O loading. The roof slab shall be a minimum of 8 inches thick. The opening through the roof shall be 36 inches in diameter.
 - b. Walls – The minimum wall thickness shall be 5 inches with the reinforcement being at least 1 inch from the inner face of the vault.
 - c. Base Slab – Slabs shall be cast-in-place or precast unless precast base sections are shown or specified.
 - d. Joint Sealant – Joint sealant shall be a flexible plastic gasket conforming to ASTM C990-09, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants (Ram-nek or approved substitution)

B. CONCRETE MANHOLES

1. PURPOSE
 - a. Concrete manholes are may be used for specialty valves or water meters, where they provide sufficient access and room for inspections, adjustments, and maintenance.
2. STANDARDS
 - a. Manholes and reducing sections shall be precast concrete in accordance with ASTM C478.
3. MANUFACTURERS
 - a. Colorado Precast Concrete
 - b. Oldcastle Precast
4. DESIGN CRITERIA
 - a. Concrete Riser Sections – The top of the concrete manhole shall be 12 to 18 inches from the ground line. Concrete extension collars shall be used to bring the manhole ring and cover up to ground line. Meter pit vault lids should be adjusted to the finished landscape grade plus or minus 1 inch. Grade

rings shall be constructed of concrete in accordance with ASTM C478 and Material Specification: Normal Weight and Precast Concrete.

- b. Base Beams – Concrete manhole base beams shall be constructed of precast, reinforced concrete. The beams shall be 12 inches wide by 9 inches deep by 8 feet long.
- c. Base Slabs – Concrete manhole base slabs may be cast-in or precast. The minimum slab thickness shall be 6 inches.
- d. Joint Sealant – Joint sealant shall be a flexible plastic gasket conforming to ASTM C990-09, Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants (Ram-nek or approved substitution)

C. MANHOLE RINGS, COVERS, AND RISERS

1. PURPOSE

- a. Manhole rings, covers, and risers are used in conjunction with vaults and manholes and provide access to these buried structures.

2. STANDARDS

- a. Manhole rings, covers, and risers shall be made of gray iron in accordance with the requirements of ASTM A48: Class 35B, Standard Specification for Gray Iron Castings, or ductile iron in accordance with the requirements of ASTM A536, Standard Specification for Ductile Iron Castings.

3. MANUFACTURERS

- a. Composite
- b. GMI Composite Covers
- c. Cast-Iron and Ductile-Iron
- d. Castings, Inc.
- e. D&L Foundry
- f. Deeter Foundry, Inc.
- g. East Jordan Iron Works
- h. Neenah Foundry Company
- i. Saint-Gobain PAMREX

4. DESIGN CRITERIA

- a. Description – Manhole rings, covers, and risers shall be heavy duty and designed, manufactured, and tested in accordance with the American Association of State Highway and Transportation Officials (AASHTO) M306, Standard

Specification for Drainage, Sewer, Utility, and Related Castings.

5.1.15 WATER METERS

A. METER REGISTERS AND REGISTER BOXES

1. PURPOSE

- a. Meter registers and register boxes are used to record water usage by individual customers.
- b. Meter registers and register boxes must be purchase through the City.

2. STANDARDS

- a. Meters shall be compatible with the Automatic Meter Reading (AMR) radio system and furnished with registers in accordance with ANSI/AWWA C707-10, AWWA Standard for Encoder-Type, Remote-Registration Systems for Cold-Water Meters.

3. MANUFACTURERS

Manufacturers	Models
Neptune Technology Group	ProRead/AutoDetect encoder, R7 enclosure

4. DESIGN CRITERIA

- a. Register Dials – Register dials shall be in accordance with ANSI/AWWA C700-09, AWWA Standard for Cold-Water Meters – Displacement Type, Bronze Main Case, Table 4.
- b. Register Cap – Register boxes shall be equipped with a register cap that completely covers the register lens. The register cap shall be capable of being moved to another register in the event the meter is moved.

B. MAGNETIC DRIVE DISPLACEMENT TYPE WATER METERS 5/8 THROUGH 2-INCH

1. PURPOSE

- a. Magnetic drive displacement type water meters 5/8- through 2-inch are used for typical residential and commercial water customers.

2. STANDARDS

- a. Magnetic drive displacement type water meters 5/8 through 2-inch shall be manufactured in accordance with ANSI/AWWA

C700-09, AWWA Standard for Cold-Water Meters –
Displacement Type, Bronze Main Case.

3. MANUFACTURERS

Manufacturers	Models
Neptune Technology Group	T-10 Meter

C. MAGNETIC DRIVE COMPOUND TYPE WATER METERS 2 THROUGH 6-INCH

1. PURPOSE

- a. Magnetic drive compound type water meters 2- through 6-inch are used for high demand commercial water customers with variable water use.

2. STANDARDS

- a. Magnetic drive compound type water meters 2 through 6-inch shall be manufactured in accordance with ANSI/AWWA C702-10, AWWA Standard for Cold-Water Meters – Compound Type.

3. MANUFACTURERS

Manufacturers	Models
Neptune Technology Group	Tru/FLOW Compound Meter

D. MAGNETIC DRIVE TURBINE TYPE WATER METERS 1 ½ THROUGH 16-INCH

1. PURPOSE

- a. Magnetic drive turbine type water meters 1 ½ through 16-inch are used for high demand commercial water customers with steady water use.

2. STANDARDS

- a. Magnetic drive turbine type water meters 1 ½ through 16-inch shall be manufactured in accordance with ANSI/AWWA C701-12, AWWA Standard for Cold-Water Meters – Turbine Type, for Customer Service.

3. MANUFACTURERS

Manufacturers	Models
Neptune Technology Group	HP High Performance Turbine

	Meter
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E. MAGNETIC DRIVE FIRE SERVICE TYPE WATER METERS 3 THROUGH 10-INCH TURBINE TYPE

1. PURPOSE

- a. Magnetic drive fire service type water meters 3 through 10-inch are used for dedicated fire service lines.

2. STANDARDS

- a. Magnetic drive fire service type water meters 3 through 10-inch shall be manufactured in accordance with ANSI/AWWA C703-11, AWWA Standard for Cold-Water Meters – Fire-Service Type.

3. MANUFACTURERS

Manufacturers	Models
Neptune Technology Group	HP Fire Service Turbine Meter

F. FIRE HYDRANT METERS

1. PURPOSE

- a. Fire hydrant meters are used for contractors obtaining water from fire hydrants.

2. STANDARDS

- a. Fire hydrant meters shall be manufactured in accordance with ANSI/AWWA C701-12, AWWA Standard for Cold-Water Meters – Turbine Type, for Customer Service.

3. MANUFACTURERS

Manufacturer	Models
Neptune Technology Group	Fire Hydrant Meter

5.1.16 TESTING AND SAMPLING

All water mains shall be pressure tested, disinfected, sampled, and flushed in accordance with this section prior to being placed into service.

A. PRESSURE

1. PURPOSE

- a. Pressure testing of water mains is used to verify proper

installation and suitability of the system to be placed into service.

2. STANDARDS

- a. Pressure testing shall be performed in accordance with AWWA C151 and AWWA C900 requirements.
- b. Pressure testing shall be coordinated with disinfection, sampling, and flushing.

3. PROCEDURE

- a. Notify City 48 hours prior to pressure testing.
- b. Use only potable water for performance of pressure test.
- c. Bleed all air from line prior to starting test.
- d. Test all water lines at a minimum of 200 psi, and no more than the pressure rating of the pipe. Test pressure shall be measured at the lowest point in the water line segment being tested.
- e. Other pressure testing procedures and requirements shall be per the AWWA standards.

B. DISINFECTION

1. PURPOSE

- a. Disinfection of water mains is conducted to eliminate bacteriological contamination with the system and prepare the water line to be placed into service.

2. STANDARDS

- a. Disinfection shall be performed in accordance with AWWA C651, Disinfecting Water Mains.
- b. Disinfection shall be coordinated with disinfection, sampling, and flushing.

3. PROCEDURE

- a. Notify City 48 hours prior to disinfection.
- b. Use only potable water for disinfection.
- c. Perform disinfection in accordance with AWWA C651 requirements.
- d. Allow City to collect bacteriological samples, and submit for analysis to a laboratory approved by the State of Colorado.
- e. Water lines shall be placed into service only after a passing bacteriological result is confirmed and the line has been properly flushed.
- f. Chlorinated water must be dechlorinated and verified prior to discharge into the storm sewer or other location designated by the City.

5.2 SANITARY SEWER

Sanitary sewer is operated by the Black Hawk/Central City Sanitation District (BHCCSD). Service lines, mains, and appurtenances must comply with BHCCSD standards and details.

CHAPTER 6: GRADING AND DRAINAGE

6.1.1 PERMITS REQUIRED

No person shall do any grading, excavation or fill without first obtaining a grading permit from the City. A separate permit shall be obtained for each site and may cover both excavations and fills, including excavations for utility installation outside a public right-of-way.

6.1.2 EXEMPTED WORK

A grading permit is not required for an excavation below finished grade for basements and footings of a building, retaining wall or other structure authorized by a valid building permit issued by the City Building Department. This shall not exempt any fill made with the material from this excavation.

6.1.3 APPLICATION FOR A GRADING PERMIT

A grading application shall be submitted at least 5 working days prior to any grading, excavation or fills in the City of Central (See Chapter 14 for permit fees). Each application shall be accompanied by two (2) sets of plans and specifications, supporting data and the following information:

1. The address of the location of the work, the name of the owner, the name of the person who prepared the plan and the contactor performing the work.
2. A construction sequence outlining the proposed time-table for completion of the grading and revegetation.
3. General vicinity map of the proposed site.
4. Property limits and accurate contours of existing ground and details of terrain and area drainage.
5. Limiting dimensions, elevations and finished contours to be achieved by the grading, and proposed drainage channels and related construction.
6. Location of any buildings or structures on the property where the work is to be performed and the location of any buildings or structure on the land of adjacent owners that are within fifteen (15) feet of the property or that may be affected by the proposed grading operations.
7. Location, size and depth of all existing utilities and easements on the proposed site.
8. Location of all natural features, such as watercourses and wetlands, on the proposed site or within one hundred (100) feet of the disturbed graded area.
9. A soils engineering report (if required by the City). Recommendations included in the soils engineering report shall be incorporated in the grading plans and specifications.
10. A revegetation and erosion control plan (see Chapter 8).
11. A special wetlands study (if required by the City). The outcome of the study may necessitate the Applicant obtaining a Corps of Engineer permit.

The grading permit shall be issued by the City within five (5) working days unless the permit is complex and requires additional review time which could take up to two (2) weeks. The permit may have conditions placed upon it in accordance with these Standards.

6.1.4 HAZARDS

Whenever the City determines that any existing excavation or embankment or fill has become a hazard to life or limb, or endangers property, or adversely affects the safety, use or stability of a public way or drainage channel, the owner of the property upon which the excavation or fill is located, or other person or agent in control of said property, upon receipt of notice in writing from the City, shall within the period specified therein repair or eliminate such excavation or embankment to eliminate the hazard and to be in conformance with the requirements of these Standards.

6.1.5 Environmental Hazards

Offsite fill material shall be free of environmental hazardous materials. Applicants for a permit shall ensure the City that fill material hauled from an offsite location is free of environmental contaminants. The source of fill material shall be identified prior to application for a grading permit. If directed by the City, the Applicant shall have testing performed on a representative sample(s) of the fill material to determine if environmentally hazardous materials are present in the fill.

6.1.6 Fill Material

Refer to the Earthwork Specifications.

6.1.7 Erosion and Sedimentation Control

The Applicant conducting the grading activity shall install and maintain temporary and permanent erosion and sedimentation control measures in compliance with Chapter 8 of these Standards.

6.1.8 Valid Period

All grading permits shall be valid for twelve (12) months from the date the permit is issued, provided that the approved application and the conditions of its approval have not changed. No more than one (1) grading permit shall be issued for one parcel of land within a three (3) year period.

6.1.9 Display of Permit

Each permit issued shall be kept at the grading site while the work is in progress and shall be exhibited upon request to any employee of the City.

6.1.10 Surety Deposit

The City shall require a \$1,000 surety deposit in the form of cash or letter of credit for minor utility installation (service lines) or any grading less than twenty (20) cubic yards. For projects grading larger than twenty (20) cubic yards, the City may require a surety deposit in the amount of 150% of the cost estimate to complete the work. The surety deposit is required to ensure that the work, if not completed in accordance with the approved plan and specifications, will be completed or corrected to eliminate hazardous conditions. The surety deposit shall not be required if the applicant has signed a Single Family/Duplex Dwelling Deposit Agreement with the City.

6.1.11 Penalties

Every person convicted of a violation of any provision of this Chapter shall be subject to the fines and penalties set forth in Section 1-72 of the Municipal Code. Additionally, the violator may be required to replace the graded, excavated, or filled land to its original condition.

6.2 DRAINAGE

6.2.1 REVIEW PROCESS

All Drainage Reports and plans, construction drawings, specifications and record drawing information shall be submitted, reviewed and approved as required by the Municipal Code, including Chapter 16, Zoning Regulations. All submitted information shall be in a clear, concise and legible form. Drainage reports shall contain a declaration of the level of report being submitted (i.e. Phase I, Phase II or Phase III). Incomplete or absent information may result in the report being rejected.

6.2.2 PHASE I DRAINAGE REPORT

A Phase I Drainage Report is required to be submitted with all Sketch Plan submittals, as required by the Zoning Regulations. A Phase I Drainage Study may also be required with other submittals as determined by the Community Development Department.

This report will review the feasibility and design characteristics of the proposed development, at a conceptual level. The Phase I shall address the entire subdivision, not just one phase. The Phase I drainage report shall include the following:

- I. General Location and Description of Site
 - A. Location (include vicinity map in report)
 1. Section, township and range.
 2. General location in relation to towns and roads.
 3. Names of surrounding developments.
 4. Major drainage ways

- B. Description of Site
 - 1. Area in acres.
 - 2. Soil classifications.
 - 3. Existing vegetation and approximate density.
 - 4. Minor and major drainage ways.
 - 5. Existing irrigation facilities.
 - 6. Existing and proposed land uses.

II. Drainage Basins and Sub-basins

- A. Major Basin Description
 - 1. Discuss any and all major drainage basins associated with the site.
 - 2. Discuss any and all previous drainage studies associated with the site.
 - 3. Discuss the flood potential of the site and how this may affect or be affected by the proposed development.
- B. Sub-basin Description
 - 1. Discuss historic drainage patterns associated with the site.
 - 2. Discuss off-site drainage flow patterns and the impact on the development under existing and developed conditions.

II. Drainage Facility Design

- A. General Concept
 - 1. Discussion of concept and typical drainage patterns.
 - 2. Discuss minor and major recurrence of interval rainfall.
 - 3. Discuss any previous studies and/or assumptions made.
 - 4. Discuss historic and developed discharge points and effects of concentrating flows on downstream properties.
 - 5. Discuss any proposed phasing of development and how drainage infrastructure construction will be effected.
 - 6. Discuss maps, tables, charts and/or nomographs presented in report.
- B. Specific Details (optional information)
 - 1. Discussion of the maintenance aspects of the design.
 - 2. Discussion of detention storage and outlet design.
 - 3. Discussion of hydrologic and/or hydraulic calculations.

IV. Phase I Drawing Requirements

- A. General Location Map: All drawings shall be 24" x 36" in size. A map shall be provided in sufficient detail to identify drainage flows entering and leaving the development and general drainage patterns. The map should be at a scale of 1"= 1000' to 1"= 4000' and show the path of all

drainage from the upper end of any off-site basins to the defined major drainage ways.

- B. Floodplain Information: A copy of any applicable floodplain mapping shall be included with the report. If no flood plain maps are available a statement stating what sources were researched shall be provided.
- C. Drainage Plan: Map(s) of the proposed development at a scale 1" = 20' to 1" = 200' shall be included. The plan shall show the following:
 - 1. Existing topography at 5' intervals maximum. Contours shall extend a minimum of 100' beyond project limits.
 - 2. Existing drainage facilities and infrastructure.
 - 3. Approximate flooding limits, when available.
 - 4. Significant off-site features.
 - 5. Major basin and sub-basin delineation.
 - 6. Conceptual proposed drainage facilities and infrastructure including detention basins, storm sewers and flow arrows.
 - 7. Legend and title block

6.2.3 PHASE II DRAINAGE REPORT

A Phase II Drainage Report is required to be submitted with all Preliminary Plat submittals, as required by the Zoning Regulations. The purpose of the Phase II Drainage Report is to identify and/or refine conceptual solutions to the problems, which may occur on-site and off-site, as a result of the development and provide calculations that support the proposed solutions. All reports must be on 8½" x 11" paper and bound. The drawings, figures, exhibits, tables and other reference information utilized in the report shall be bound with the report or included in a pocket attached. The report shall include a statement by the professional engineer that prepared the report and shall state:

“This report was prepared by me, or under my direct supervision, in accordance with the CITY OF CENTRAL Standards and Specifications and was designed to comply with the provisions thereof. I understand that the CITY does not and will not assume liability for drainage facilities designed by others.”

Registered Professional Engineer
State of Colorado No.
Affix Seal

The report shall conform to the following outline and contain applicable information listed:

- I. General Location and Description of Site
 - A. Location
 - 1. Vicinity map.
 - 2. Section, township and range.

3. General location in relation to towns and roads.
4. Names of surrounding developments.
5. Major drainage ways

B. Description of Site

1. Area in acres.
2. General project description
3. Soil classification.
4. Existing vegetation and approximate density.
5. Minor and major drainage ways.
6. Existing irrigation facilities.

II. Drainage Basins and Sub-basins

A. Major Basin Description

1. Discuss flooding potential from major basins.
2. Discuss any and all previous drainage studies associated with the site.
3. Discuss major basin characteristics, existing and planned land uses.
4. Discuss all irrigation facilities within the basin which will influence or be influenced by the local drainage.

B. Sub-basin Description

1. Discuss historic drainage patterns of the property in question.
2. Discuss off-site drainage flow patterns and impact a development under existing and fully developed basin conditions.

III. Drainage Design Criteria

A. Regulations: Discuss any deviations from the Standards, if any, and its justification.

B. Development Criteria Reference and Constraints

1. Discuss any previous studies associated with the site.
2. Discuss impacts to adjacent developments and city.
3. Discuss constraints such as streets, utilities, etc.

C. Hydrological Criteria

1. Identify design rainfall.
2. Identify runoff calculation method.
3. Identify detention discharge and storage calculation method.
4. Identify storm recurrence interval.
5. Intensity/duration frequency curves.

D. Hydraulic Criteria: Identify capacity references used.

- E. Stormwater Quality Criteria: Identify permanent and temporary water quality measures implemented on the site.
- F. Waivers from Criteria
 - 1. Identify provisions by section number for which a waiver is requested.
 - 2. Provide justification why each waiver is being requested.

IV. Drainage Facility Design

- A. General Concept: Discuss Rationale and Methodology used to Analyze and Design the Drainage Facilities and Infrastructure On-site as well as Off-site.
- B. Specific Details
 - 1. Discuss each Sub-basin delineated.
 - a. Area.
 - b. Runoff Coefficients / Estimated Imperviousness.
 - c. Time of Concentration.
 - d. Runoff Quantity.
 - e. Conveyance.
 - 2. Discuss each Design Point delineated.
 - a. Conveyance Routing and Infrastructure requirements, Connection to Major Drainage way.
 - b. Maintenance Requirements including delineated Easements, Tracks and/or Outlots for drainage facilities.
 - 3. Discuss each Detention Facility
 - a. Allowable Release Rates.
 - b. Required Storage.
 - c. Water Surface elevations.
 - d. Downstream Conveyance, Major Drainage way.
 - e. Comparison of Historic and Developed Discharge at Critical Design Points around the periphery of the site.
 - f. Maintenance Requirements including delineated Easements, Tracks and/or Outlots for drainage facilities.

V. Conclusions

- A. Compliance with Criteria
- B. Effectiveness of Design

VI References: Cite any and all References in Bibliography format

VII Appendices

- A. Hydrologic Calculations
 - 1. Historic Coefficients, Imperviousness, Tc, Q Minor and Major.
 - 2. Developed Coefficients, Imperviousness, Tc, Q Minor and Major.
 - 3. Detention Volumes and Release Rates.

- B. Hydraulic Calculations
 - 1. Street design.
 - 2. Roadside Ditch and/or Culvert design.
 - 3. Storm Sewer and/or Inlet design.
 - 4. Open Channel design.
 - 5. Outlet Structure design.

- C. Drainage Exhibit
 - 1. Existing Topography @ 5' intervals maximum. Contours shall extend a minimum of 100' beyond project limits. Finished Floor elevations for all Structures.
 - 2. Existing Drainage Facilities and Infrastructure.
 - 3. Existing known flood limits.
 - 4. Significant off-site features.
 - 5. Major basin and Sub-basin delineation including Area, C-major and C-minor and Design Points.
 - 6. Property lines, Easements and ROW.
 - 7. Proposed Topography. Finished Floor elevations for all Structures.
 - 8. Proposed Drainage Facilities and Infrastructure.
 - 9. Detention Pond information including Required Volumes and corresponding Water Surface elevations, Freeboard elevation and design of Outlet works.
 - 10. Proposed Outfall point for each Major Basin and Downstream Conveyance capacity.
 - 11. Summary Runoff Table including Design Point, Contributing Area, Minor Runoff and Major Runoff.

6.2.4 PHASE III DRAINAGE REPORT

A Phase III Drainage Report is required to be submitted with all Final Plat submittals, as required by the Zoning Regulations. The purpose of the Phase III Drainage Report is to elaborate on the concepts, and to provide design details for the facilities and infrastructure presented with the Phase II Drainage Report. Any corrections and/or changes to the Phase II Report shall be presented as well.

In addition to the requirements set forth in Section 6.2 of these Standards, the Phase III Drainage Report shall contain a signed developer certification section as follows:

“I (Developer) hereby certify that the drainage facilities for (Name of Development) shall be constructed according to the design presented in this

report. I understand that the CITY does not and will not assume liability for drainage facilities designed or reviewed by my engineer. I also understand that the CITY relies on the representations of others to establish that drainage facilities are designed and built in compliance with applicable guidelines, standards and specifications. Review by the CITY can therefore in no way limit or diminish any liability which I or any other party may have with respect to the design or construction of such facilities.”

Name of Developer

6.2.5 DRAINAGE POLICY

The provisions for adequate drainage in urban areas are necessary to preserve and promote the general health, welfare and economic wellbeing of the City. As land use changes from agricultural and rural to urban in character the need for adequate drainage facilities becomes increasingly significant. Watersheds and corresponding watercourses know no jurisdictional boundaries and therefore affect all governmental jurisdictions and all parcels of land. This characteristic of drainage makes it necessary to formulate a program that balances both public and private involvement.

When planning drainage facilities, certain underlying principals provide direction for the effort. These principals are made operational through this set of policy statements. The application of the policy is in turn facilitated by technical criteria and data.

A. Drainage Sub-system

Planning of drainage facilities must be included in the development process. Incorporating drainage design into an overall development plan in the early stages is essential to eliminate possible conflicts and competition concerning land allocation or other necessary infrastructure improvements.

THE POLICY OF THE CITY SHALL BE TO CONSIDER STORM DRAINAGE A SUB-SYSTEM OF AN OVERALL DEVELOPMENT SYSTEM AND TO REQUIRE STORM DRAINAGE PLANNING FOR ALL DEVELOPMENT TO INCLUDE ADEQUATE ALLOCATION OF LAND FOR DRAINAGE FACILITIES.

B. Multi-Purpose Resource

Stormwater runoff and associated facilities can be considered a liability; however they have the potential for beneficial use. The drainage sub-system should be a multi-purpose system that helps satisfy the increasing demand placed on water within the environment. This system however must be compatible with adjacent land use and Colorado Water Law. Examples of beneficial uses of drainage facilities are recreation facilities, parking lots and use in landscape features. Innovative stormwater facility design is encouraged to maximize this multi-

purpose resource.

THE POLICY OF THE CITY SHALL BE TO CONSIDER STORMWATER RUNOFF AND ASSOCIATED FACILITIES AS A MULTI-PURPOSE RESOURCE AND TO ENCOURAGE MULTI-PURPOSE USE.

C. Water Rights

Drainage ways and storage facilities often interrelate with existing water rights. Drainage improvements may alter the quantity or quality available for existing water rights. When the drainage sub-system interferes with existing water rights, the value and use of the water rights are affected. Planning and design of drainage facilities must account for existing water rights.

THE POLICY OF THE CITY SHALL BE TO REQUIRE THAT ANALYSIS OF IMPACTS ON WATER RIGHTS BE INCLUDED IN THE PLANNING AND DESIGN OF PROPOSED DRAINAGE FACILITIES.

D. Major Drainage Ways

A definition of a major drainage way is necessary for clarification and implementation of these Standards.

THE POLICY OF THE CITY SHALL BE TO DEFINE A MAJOR DRAINAGE WAY AS ANY FLOWPATH WITH A TRIBUTARY AREA IN EXCESS OF 400 ACRES.

E. Post Development Flow Conditions

The development process has the potential to significantly alter predevelopment (historic) drainage conditions. During the development process, if water is allowed to flow into the development in its historic quantity and manner, and is discharged in the historic quantity and manner, the alterations are generally acceptable. When development impedes the historic flow into the development it violates the rule of Colorado law that property is subject to the historic drainage from upper lands. In addition, if the development does not return the drainage to historic conditions, then the rule that drainage water cannot be sent down to do more harm than was formerly done to lower lands, is violated. Development proposals that are in violation of either of these principles will not be approved, unless the developer can obtain approval from the affected owner(s).

THE POLICY OF THE CITY SHALL BE FOR POST DEVELOPMENT FLOW CONDITIONS TO BE IN A MANNER AND QUANTITY (FLOW RATE) AS TO NOT DO ANY MORE HARM THAN THE PREDEVELOPMENT (HISTORIC) FLOWS, UNLESS THE DEVELOPER CAN OBTAIN APPROVAL FROM THE AFFECTED OWNER(S).

F. Drainage Master Planning

Drainage design and planning is required for all development. The City

encourages Drainage Master Planning for larger or multi-phased developments. The City, at its discretion may require a Master Drainage Plan during the planning stages of large development, or those developments that substantially increase imperviousness.

THE POLICY OF THE CITY SHALL BE TO ENCOURAGE DRAINAGE MASTER PLANNING FOR LARGER OR MULTI-PHASED DEVELOPMENTS.

G. Public Improvements

Public improvements associated with drainage may include improvements to both the local drainage system and the major drainage system. The local drainage system consists of curb and gutter, inlets, storm sewers, culverts, bridges, swales, ditches, channels, detention/retention areas, and other drainage facilities required to convey the minor and major storm runoff to the major drainage way. The major drainage way system consists of channels, storm sewers, bridges, detention/retention areas, and other facilities serving more than the development or property in question that may be impacted by the development.

THE POLICY OF THE CITY SHALL BE THAT ALL DEVELOPMENT IS REQUIRED TO CONSTRUCT THE IMPROVEMENTS TO THE LOCAL AND MAJOR DRAINAGEWAY AS DEFINED BY THE APPROVED PHASE III DRAINAGE REPORT AND PLAN.

H. Basin Transfer

Colorado drainage law recognizes the inequity in transferring the burden on managing storm drainage from one location or property to another. Liability questions also arise when the historic drainage continuum is altered. The diversion of storm runoff from one basin to another should be avoided unless specific and prudent reasons justify and dictate such a transfer. Prior to selecting a solution, alternatives should be reviewed. Planning and design of stormwater drainage systems should not be based on the premise that problems can be transferred from one location to another.

THE POLICY OF THE CITY SHALL BE TO DISCOURAGE THE INTER-BASIN TRANSFER OF STORM DRAINAGE RUNOFF AND TO MAINTAIN THE HISTORIC DRAINAGE PATH WITHIN THE DRAINAGE BASIN. THE TRANSFER OF DRAINAGE FROM BASIN TO BASIN IS A VIABLE ALTERNATIVE IN CERTAIN INSTANCES AND WILL BE REVIEWED ON A CASE-BY-CASE BASIS. WHEN BASIN TRANSFER IS PERMITTED, THE PLAN MUST ACHIEVE HISTORIC FLOW CONDITIONS AT THE CONFLUENCE OF THE BASIN AND MEET THE REQUIREMENTS OF POST DEVELOPMENT CONDITIONS.

I. Floodplain Management

Naturally occurring floodplains and associated floodways are vital for continued

conveyance and storage of runoff. Urban land use can often compete with areas that historically have served this conveyance and storage function. In general, floodplains should be left in historic condition whenever possible.

THE POLICY OF THE CITY SHALL BE TO LEAVE FLOODPLAINS IN A NATURAL STATE WHENEVER POSSIBLE.

J. Stormwater Detention

The value of storm runoff detention has been explored by many individuals, agencies and professional societies. Detention is considered a viable method to reduce urban drainage costs. Temporarily detaining storm runoff associated with the increase in impervious areas caused by urban development can sufficiently reduce downstream hazards as well as infrastructure requirements. Storage also provides for sediment and debris collection, which helps to keep streams and rivers cleaner thus helping to protect the natural resources of the City.

THE POLICY OF THE CITY SHALL BE TO REQUIRE ON-SITE DETENTION FACILITIES FOR ALL DEVELOPMENT, EXPANSIONS AND REDEVELOPMENT, UNLESS A VARIANCE IS GRANTED, AS NOTED IN THE VARIANCE PROCEDURE BELOW. THE REQUIRED MINIMUM VOLUME AND MAXIMUM RELEASE RATES FOR THE 10-YEAR AND 100-YEAR STORM EVENTS WILL BE DETERMINED IN ACCORDANCE WITH THESE CRITERIA.

Variance Procedure:

The City may grant an administrative variance of the Stormwater Detention requirement. The variance will only be granted if it is determined by the Community Development Department that there are no cumulative effects from previous variances in the development proximity and the Applicant demonstrates one of the following:

Impervious area, including structures, streets/roads/driveways/parking areas (paved or unpaved) will not total more than 10,000 square feet. If this limit to the impervious area is used in granting a variance, the development proposal shall restrict the allowable impervious area at the time of building permit issuance so that the maximum impervious area established in the variance request is not exceeded.

In order for the variance report to be approved, the Applicant must display that water quality issues have been addressed.

K. Stormwater Quality

Land development and human activities affect both the quantity and the quality of stormwater discharge to receiving waters. Development increases the volume of stormwater and the pollutants leaving the project property. To remove pollutants, the collection and conveyance infrastructure must be supplemented with

collection and infiltration best management practices. Refer to the Urban Storm Drainage – Criteria Manual (Urban Drainage and Flood Control District, June 2012), for BMPs and design specifications.

THE POLICY OF THE CITY SHALL BE TO REQUIRE USE OF BMP'S TO REDUCE STORMWATER QUALITY POLLUTION CAUSED BY DEVELOPMENT, UNLESS A VARIANCE IS GRANTED AS NOTED IN THE VARIANCE PROCEDURE BELOW.

Variance Procedure:

The City may grant an administrative variance of the Stormwater Quality requirement if the Applicant can demonstrate one of the following:

1. The project disturbs less than one-half acre (1/2) of ground and is not part of a larger common plan or master plan.
2. Regional water quality facilities have been used in satisfying the BMP requirements and it can be demonstrated that the facility provides the required water quality capture volume.

L. Operations and Maintenance

To ensure storm drainage facilities function as they are designed to, continued maintenance is required. Maintenance of drainage facilities may include clearing debris from inlets, culverts, channels, ditches, or detention facilities. Responsibility for maintenance of drainage improvements lies with the property owner, except as modified by specific agreement. Maintenance responsibility will be delineated on all Final Plats.

THE POLICY OF THE CITY SHALL BE TO REQUIRE THAT THE PROPERTY OWNER SHALL BE RESPONSIBLE FOR THE MAINTENANCE OF ALL DRAINAGE FACILITIES, INCLUDING INLETS, PIPES, CULVERTS CHANNELS, DITCHES, HYDRAULIC STRUCTURES, AND DETENTION BASINS LOCATED ON THEIR LAND, EXCEPT AS MODIFIED BY SPECIFIC AGREEMENT; AND THAT THIS RESPONSIBILITY SHALL BE NOTED ON THE FINAL PLAT. SHOULD THE OWNER FAIL TO ADEQUATELY MAINTAIN SAID FACILITIES, THE CITY SHALL HAVE THE RIGHT TO ENTER SAID LAND FOR THE PURPOSE OF OPERATIONS AND MAINTENANCE. ALL SUCH COSTS WILL BE ASSESSED TO THE PROPERTY OWNER.

M. Drainage Easement Requirements

The easement requirements are indicated on the following table:

DRAINAGE FACILITY	EASEMENT WIDTH
Storm Sewer (a.) Less than 36" dia.	(a.) 20'

(b.) Equal to or greater than 36" dia.	(b.) width of pipe plus twice the pipe invert depth with sewer placed in the middle third of the easement.(min. 20')
Swales / Open Channels (a.) Q-100 less than, or equal to 20 cfs (b.) Q-100 greater than 20 cfs	(a.) 15' minimum (b.) 15' minimum (Must accommodate Q100 plus one-foot freeboard)
Detention Pond	Use engineering discretion – as required to contain storage, plus one foot of freeboard, and associated facilities as well as access around the perimeter of the pond.
Along side lot lines for single family residential subdivisions	The easement will be a minimum of 5' centered on the lot line.

Additionally, access easements shall be required for all drainage facilities and they must be adequate for the required maintenance. All required easements must be shown on the Final Plat.

THE POLICY OF THE CITY SHALL BE TO REQUIRE DRAINAGE EASEMENTS FOR ALL ONSITE DRAINAGE FACILITIES. ALL DRAINAGE EASEMENTS SHALL BE DEDICATED TO THE CITY IN A FORM ACCEPTABLE TO THE CITY ATTORNEY AND MUST BE SHOWN ON THE FINAL PLAT. THE CITY HAS THE RIGHT TO ACCESS DRAINAGE EASEMENTS, AND THE RIGHT, BUT NOT THE OBLIGATION, OF CONSTRUCTION AND/OR MAINTENANCE WITHIN DRAINAGE EASEMENTS.

N. Minor and Major Drainage System

Every urban area has two separate and distinct drainage systems, whether or not they are actually planned or designed. One is the Minor Drainage System and the other is the Major Drainage System, which are combined to make the Total Drainage System.

THE POLICY OF THE CITY SHALL BE TO REQUIRE THAT ALL DEVELOPMENT INCLUDE THE PLANNING, DESIGNING, AND IMPLEMENTATION FOR BOTH THE MINOR AND MAJOR DRAINAGE SYSTEMS.

1. Minor Drainage System:

The Minor Drainage System shall be designed to transport the run-off from the 10-year recurrence interval storm with minimal disruption to the urban environment. The Minor Drainage System may consist of any combination of curb and gutter, roadside ditches and culverts, storm sewers and inlets, swales and channels, or other drainage facilities proposed by the design engineer.

THE POLICY OF THE CITY SHALL BE TO REQUIRE THAT ALL MINOR STORM DRAINAGE FACILITIES BE DESIGNED AND SIZED WITHOUT ACCOUNTING FOR PEAK FLOW REDUCTIONS CAUSED BY ON-SITE DETENTION.

2. Major Drainage System:

The design objective of the Major Drainage System is to minimize life and health hazards, damage to structures or improvements, and interruption of emergency vehicular traffic and services. The Major Drainage System may consist of any combination of curb and gutter, roadside ditches and culverts, storm sewers and inlets, swales and channels, or other drainage facilities proposed by the design engineer.

THE POLICY OF THE CITY SHALL BE TO REQUIRE THAT ALL MAJOR STORM DRAINAGE FACILITIES BE DESIGNED AND SIZED TO MINIMIZE LIFE AND HEALTH HAZARDS, DAMAGE TO STRUCTURES OR IMPROVEMENTS AND INTERRUPTION OF EMERGENCY VEHICULAR TRAFFIC AND SERVICES.

O. Floodproofing Existing Structures

Floodproofing can be described as measures that reduce the potential for flood damages to existing property and/or structures within a floodplain. The floodproofing measures can range from the elevating of structures to intentional flooding of noncritical building spaces to minimize structural damages. Floodproofing measures are only a small part of good floodplain management, which encourages wise floodplain development to minimize the adverse effects of floods.

THE POLICY OF THE CITY SHALL BE TO ENCOURAGE THE FLOODPROOFING OF EXISTING STRUCTURES BY UTILIZING THE CRITERIA PRESENTED IN THE HOMEOWNER'S GUIDE TO RETROFITTING, FEMA, 2nd Edition, a copy of which is available through the City Community Development Department.

P. Storm Runoff

THE POLICY OF THE CITY SHALL BE TO REQUIRE STORM RUNOFF TO BE DETERMINED BY THE RATIONAL METHOD, WITHIN THE LIMITATIONS SET FORTH BY THESE CRITERIA, UNLESS A VARIANCE IS GRANTED AS NOTED IN THE VARIANCE PROCEDURE BELOW.

Variance Procedure:

The City may grant an administrative variance of the Storm Runoff requirement if the Applicant can demonstrate and substantiate that a different Methodology is more appropriate than the one required.

6.2.6 RAINFALL

For the purposes of these Standards, the Urban Drainage and Flood Control District Drainage Criteria Manual Figure RA-15 – Rainfall Intensity-Duration Curves (Figure 13) shall be utilized for determining rainfall values. For additional information or to obtain a copy, visit the Urban Drainage and Flood Control District's website, www.udfed.org.

6.2.7 RUNOFF

The information presented in this section shall be used for the determination of stormwater runoff design peaks and volumes. The design engineer is referred to the Urban Storm Drainage – Criteria Manual for specific details pertaining to basic method concepts and technicalities. The purpose of this section is to define acceptable methods to be used within the City.

Standard forms and spreadsheets are available in the Urban Storm Drainage – Criteria Manual. For additional information or to obtain a copy, visit the Urban Drainage and Flood Control District's website, www.udfed.org.

A. On-site Flow Analysis

When analyzing the flood peaks and volumes, the proposed fully developed land use plan shall be used to determine applicable runoff coefficients. In addition, consideration to the changes in developed flow patterns shall be mitigated.

B. Off-site Flow Analysis

When analyzing the flood peaks and volumes from off-site tributary areas, the minor storm shall be calculated assuming fully developed conditions according to anticipated future land use, with no credit for detention. The major storm can be calculated assuming historic conditions for the major event.

6.2.8 STREETS AND ROADS

A. INTRODUCTION

The primary purpose of streets in the urban environment is for vehicular and pedestrian circulation. Streets may be utilized as an integral part of the urban total drainage system, transporting runoff from the Minor and Major recurrence intervals, however use must be restricted.

The purpose of this chapter is to define the limits to which the design engineer may use the streets for conveyance of stormwater runoff generated as a result of

urban development.

Except as modified herein, design of streets for use as drainage conveyance shall be in accordance with the Urban Storm Drainage – Criteria Manual. The design engineer is referred to the Urban Storm Drainage – Criteria Manual or other references cited for basic design concepts or technicalities.

B. DRAINAGE FUNCTION

The curb and gutter of an urban street or the roadside ditch of a rural street can be used as part of the minor drainage system (Figure 4). Stormwater discharge associated with the minor storm may be conveyed up to the design limitations as set forth in these Standards. When the street capacity begins to exceed the allowed parameters some other form of conveyance must be used in conjunction to adequately convey these nuisance flows.

Streets’ function in the major drainage system are to provide an emergency drainageway to convey these larger, less frequent flows with minimum disruption and damage to the urban environment.

C. DRAINAGE CLASSIFICATION

For efficient and convenient use of these Standards, the following drainage classifications are assigned to roadway sections, as designated by average daily traffic values to be used within the City.

Table 6.2.8.3A
STREET CLASSIFICATION

TRAFFIC CLASSIFICATION	DRAINAGE CLASSIFICATION
Urban Local (<2,000 vehicles per day)	A
Rural Local (<2,000 vehicles per day)	A
Urban Collector (2,000-12,000 vehicles per day)	B
Rural Collector (2,000-12,000 vehicles per day)	B

Table 6.2.8.3B
ALLOWABLE ENCROACHMENT

CLASSIFICATION	MINOR STORM	MAJOR
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		STORM
A	Urban – Flow may spread to crown. Rural – Flow must not encroach shoulder.	Urban – Flow must not encroach ROW. Rural – Flow must not encroach structures at ground line.
B	Urban – Flow must leave <u>one</u> 10' drive lane free of inundation w/ no curb overtopping. Rural – Flow must not encroach shoulder.	Urban – Flow must not encroach ROW. Rural – Flow must not encroach structures at ground line.

Table 6.2.8.3C identifies the maximum allowable encroachment of stormwater within the street section.

Table 6.2.8.3C
ALLOWABLE ENCROACHMENT

CLASSIFICATION	MINOR STORM	MAJOR STORM
A	Urban – Flow may spread to crown. Rural – None.	Urban - Flow must not encroach ROW or exceed 6" depth at crown (whichever is more restrictive). Rural - 6" depth at crown.
B	Urban – Flow must leave <u>one</u> 10' drive lane free of inundation w/ no curb overtopping.	Urban - Flow must not encroach ROW or exceed 6" depth at crown (whichever is more restrictive).

	Rural – None	Rural - 6" depth at crown.
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Cross street flow occurs under three conditions, when runoff spreads across the crown to the opposite gutter, when cross pans are used, or when culverts are overtopped. (See Figure 14)

6.2.9 STORM SEWERS

A. INTRODUCTION

Storm sewers serve as part of the Minor Drainage System. The use of storm sewers are necessary when other facilities designed to convey stormwater associated with the Minor storm are approaching, or at capacity.

Except as modified herein, design of storm sewers shall be in accordance with the Urban Storm Drainage – Criteria Manual. The design engineer is referred to the Urban Storm Drainage – Criteria Manual or other references cited in these Standards for basic design concepts or technicalities.

B. CONSTRUCTION MATERIALS

All storm sewer construction shall be either RCP or HDPE. CMP shall not be allowed for use in storm sewers.

C. PIPE SIZE

Minimum pipe size to be used in storm sewers is dictated by hydraulic efficiency, however in no case shall be less than 12 inches in diameter.

D. VERTICAL ALIGNMENT

Storm sewers shall be designed to withstand HS-20 loadings as defined by AASHTO. Minimum cover constraints are dictated by pipe size, type, class and bedding material and thickness, however in no case shall be less than 12" (Figure 15).

Minimum vertical separation from water lines shall be 18". If 18" of separation cannot be maintained, the water line shall be encased 10' either side of crossing.

Minimum vertical separation from sanitary sewer lines shall be 18". If 18" of separation cannot be maintained, the sanitary sewer line shall be encased 10' either side of crossing.

E. HORIZONTAL ALIGNMENT

1. Curvilinear alignment is not allowed for storm sewers less than 48" in diameter.
 2. Minimum horizontal separation from water lines shall be maintained at 10'.
 3. Minimum horizontal separation from sanitary sewer lines shall be maintained at 10'.

F. MANHOLES

Manholes shall be required for maintenance access to the storm sewer whenever there is a change in size, direction, elevation, grade or where there is a junction of two or more pipes (Figure 16). Maximum spacing for manholes shall be 400' for storm sewer runs less than 48" in diameter, and 500' for runs greater than 48" diameter. Minimum drop through a manhole shall be 0.2' and matching crown elevations is encouraged whenever feasible.

Required minimum manhole size shall be as follows:

Table 6.2.9.6
MANHOLES

SEWER DIAMETER	MANHOLE DIAMETER
12" – 18"	4'
21" – 42"	5'
48" – 54"	6'
60" and larger	Special Design

Larger diameter manholes may be required if horizontal alignment is not straight through, or more than one sewer goes through the manhole. Engineering discretion should be used when designing large or complex storm sewer networks.

G. INLETS

Storm sewer inlets can be classified by the operating condition, being continuous grade or sump. The type of inlets permitted for use within the City along with appropriate reduction factors are described as follows:

Table 6.2.9.7
INLETS

CONDITION	INLET TYPE	PERCENT OF THEORETICAL CAPACITY PERMITTED
Sump or Continuous Grade	Type R	
	5' (single)	88
	10' (double)	92
	15' (triple)	95

Sump or Continuous Grade	Grated Type 13 (Figure 17)	50
Continuous Grade	Combination Type 13 (Figure 18)	66
Sump	Combination Type 13	65
Sump	Grated Type C	50

Theoretical inlet capacity shall be designed in accordance with the Urban Storm Drainage – Criteria Manual along with the design limitations as set forth in these Standards.

Adequate provisions shall be designed for inlets located in sumps pertaining to potential clogging or larger than expected storms in the form of emergency overflow conveyance.

6.2.10 CULVERTS

A. INTRODUCTION

A culvert is defined as a conduit under an embankment such as a roadway, railroad, or a canal that allows the passage of surface waters.

Except as modified herein, design of culverts shall be in accordance with the Urban Storm Drainage – Criteria Manual. The design engineer is referred to the Urban Storm Drainage – Criteria Manual or other references cited for basic design concepts or technicalities.

B. CONSTRUCTION MATERIALS

Permitted materials for construction of culverts within the City shall be reinforced concrete pipe (RCP), corrugated metal pipe (CMP), as well as high- density polyethylene pipe (HDPE).

C. PIPE SIZE

Minimum culvert size in the City right-of-way shall be dictated by hydraulic efficiency, however in no case shall be less than 12". The City recommends minimum size be 15", however under certain circumstances 12" will be allowed. For shapes other than round, the minimum cross sectional area shall be equivalent

to that of a minimum round culvert.

Driveway culverts shall be designed to convey stormwater associated with the Minor storm with no overtopping. Minimum diameter for a driveway culvert shall be 12".

D. MINIMUM COVER

All culverts shall be designed for HS-20 loadings. Minimum cover over the pipe shall not be less than 12" measured from the crown of the pipe to the top of the pavement sub-grade.

E. HEADWATER CONSIDERATIONS

The maximum design headwater depth shall be 1.5 times the diameter, or 1.5 times the rise for shapes other than round. When culverts are used for road crossings, the maximum cross-street flow discussed in Chapter 6 of these Standards may dictate allowable headwater depths.

F. VELOCITY CONSIDERATIONS

A minimum velocity of 2 fps should be maintained at the outlet of the culvert, to serve as a cleansing velocity. Maximum velocity through a culvert should be less than 7 fps to limit the effects of erosion. Adequate erosion control measures shall be taken at the inlet and outlet of all culverts. Energy dissipaters may be necessary on steep slopes when velocities exceed acceptable parameters.

6.2.11 OPEN CHANNELS

A. INTRODUCTION

An open channel can be defined as any watercourse, natural or artificial in nature, where runoff is concentrated along a defined path.

Except as modified herein, design of open channels shall be in accordance with the Urban Storm Drainage – Criteria Manual. The design engineer is referred to the Urban Storm Drainage – Criteria Manual or other references cited for basic design concepts or technicalities.

B. NATURAL CHANNELS

Natural channels can be defined as all watercourses that have occurred over time as a result of the erosion process. As development occurs in an urbanizing basin, the altered flow regime due to stormwater runoff peaks and volumes most likely will cause significant erosion or sedimentation along a particular reach. Detailed hydraulic analysis is necessary consisting of cross sections, water surface profiles

for the minor and major events and bed and bank stability calculations to assure that degradation will not occur as a result of development. Some in-stream modifications may be necessary to insure a stabilized condition. If however, calculations by the design engineer conclude that degradation of a natural channel will not occur under developed conditions then, the channel can be left in a natural state.

C. ARTIFICIAL CHANNELS

For the purposes of these Standards, three types of artificial channels will be permitted for conveyance of stormwater associated with urban development. Grass lined channels are most desirable whenever feasible. Rock lined channels will be permitted, however their use should be restricted. Concrete lined channels will only be allowed in instances where other options have been exhausted.

1. Grass Lined Channels

This channel type is the most desirable of the artificial channels. Grasses generally slow runoff facilitating both infiltration and biological uptake. A properly designed vegetated channel will effectively eliminate the potential for erosion by stabilizing the soil.

Velocities shall be limited to 7 fps and Froude numbers restricted to 0.8. Side slopes of 3:1 or greater flatter shall be maintained throughout the reach.

2. Rock Lined Channels

A riprap lined channel will be permitted when design parameters cannot be met for the construction of a grass lined channel. Rock channels can effectively decrease the velocity and energy of a watercourse to within acceptable levels. Rock lined channels can also be used in areas where there is high potential for erosion due to soil properties and gradient, proper sizing and bedding parameters are essential.

Velocities shall be limited to 9 fps and Froude numbers restricted to 0.8. Side slopes of 3:1 or greater shall be maintained throughout the reach.

3. Concrete Channels

A concrete lined channel will only be allowed when no other channel type's design parameters can be met and other options are not feasible.

Detailed structural analysis will be required addressing heaving and undermining in addition to hydraulic design.

D. ROADSIDE DITCHES

Roadside ditches shall be designed to adequately convey stormwater associated

with the Minor storm within allowable parameters as defined in these Standards. Particular attention must be given to prevent the adverse effects of erosion.

E. MAJOR DRAINAGEWAYS

Major drainageways as defined in these Standards shall be planned and designed in accordance with the Urban Storm Drainage – Criteria Manual.

Adequate freeboard shall be provided for all major drainageways, and maintenance access shall be designed into the cross section. A low flow or trickle channel is encouraged with the design of a major drainageway and should have capacity for approximately two percent of the Major storm recurrence interval. A combination of channel linings, or a composite lining is recommended when designing a major drainageway.

A standard backwater analysis shall be required, delineating the 100-year water surface and associated properties of the channel proposed to handle runoff as a result of urban development. Although a floodplain delineation is not required, engineering discretion should be utilized when routing these flows adjacent to structures.

6.2.12 DETENTION

A. INTRODUCTION

Stormwater detention facilities within the City shall be designed in accordance with the procedures and data as set forth in these Standards. Detention facilities will be required for all urban development.

Temporarily detaining excess storm water as a result of urban development can decrease flood potential in downstream conveyances. As landuse changes from agricultural and rural to urban in character, historic imperviousness is generally increased. The construction of roads, sidewalks, driveways parking lots and structures generally prohibit the stormwater infiltration processes and leads to higher rates of runoff as compared to historic conditions.

The purpose of this section is to address these issues and provide solutions and procedures for calculating required stormwater detention volumes as well as allowable release rates to be utilized within the City.

B. DETENTION VOLUME

Detention pond facilities within the City shall be designed to adequately detain excess runoff associated with both the Minor and Major recurrence interval.

C. Rational Procedure

For basins in which the Rational Method is utilized to estimate runoff, typically basins less than 160-Acres, the detention volume shall be calculated by determining the difference in runoff between historic and developed conditions. The equation to be used with the Rational Method does not take into consideration release volumes or timing elements associated with larger basins where significantly more accuracy is essential and justified considering the complexity and cost of the drainage facilities design. For simplified basins, detention volumes can be calculated as follows:

$$V_{\text{required}} = V_d - V_h$$

Where:

V_d = Developed Volume

V_h = Historic Volume

$$V_{10} = (C_{10})(P_{10})(A)$$

Where:

V_{10} = Volume from the Minor Storm (Ac-ft)

C_{10} = 10 -Year Runoff Coefficient

P_{10} = 10 -Year 24-Hour Precipitation (ft)

A = Area of Developed Basin (Ac)

$$V_{100} = (C_{100})(P_{100})(A)$$

Where:

V_{100} = Volume from the Minor Storm (Ac-ft)

C_{100} = 100 -Year Runoff Coefficient

P_{100} = 100 -Year 24-Hour Precipitation (ft)

A = Area of Developed Basin (Ac)

These equations will provide reasonable attenuation of flood peaks. The volume calculated for both the Minor and Major recurrence interval shall be considered the minimum required detention volume. For calculating the water surface elevations for a given area and corresponding volume, the Prismoidal Formula may be used, expressed as follows:

$$V = (H/3) * (A_1 + (A_1 * A_2)^{.5} + A_2)$$

D. RELEASE RATES

Maximum allowable release from a developed basin shall not be greater than the

historic basin discharge for both the Minor and Major recurrence interval. Allowable discharge rates shall be calculated and compared as set forth in the procedures contained in Chapter 6 of these Standards for both design storms. Offsite discharge accepted by a detention basin will be allowed to flow through the pond undetained at historic rates. These discharge values can be considered additional flows to be incorporated into the design and analysis of the outfall structure.

The outfall structure shall be designed to discharge both the Minor and Major recurrence interval at less than historic rates.

E. Orifice Equation

Regulating the discharge from a detention basin through the use of an orifice may be calculated with the following equation:

Orifice:

$$Q = C_d * A * \sqrt{2gh}$$

Where:

C_d = Orifice Coefficient = 0.60

A = Area (ft²)

G = Gravitational Constant = 32 ft/s²

H = Head Measured From Center of Orifice (ft)

F. Weir Equation

Regulating the discharge from a detention basin through the use of a weir may be calculated with the following equation:

Broad Crested Weir:

$$Q = CLH^{3/2}$$

Where:

C = Weir Coefficient = (See Fig. 1000)

L = Length (ft)

H = Head (ft)

G. DETENTION FACILITIES DESIGN

The design and implementation of detention facilities can enhance the urban environment. Detention basins can serve as a buffer to environmentally sensitive areas, the water storage function can provide for consumptive and conjunctive uses, and the upper areas of a large basin can be utilized for passive recreation activities.

H. Permitted Facilities

A grass lined earthen basin is the most desirable method for detaining stormwater runoff within the City and is the focus of this section. Other methods of detaining stormwater runoff as a result of urban development, including but not limited to underground or parking lot facilities will be permitted, however engineering discretion shall be used. Rooftop detention facilities shall be prohibited within the City.

I. Grading Requirements

Storage facilities meeting the specifications in Colorado Revised Statutes 37-87-105 as amended shall require approval by the Office of the State Engineer. Generally, stormwater detention facilities designed for urban stormwater runoff attenuation will not be regulated by the State, and shall be designed in accordance with the provisions and data as set forth in these Standards.

Earthen embankments of less than 10 feet in height shall be designed and constructed with maximum side slopes of 4:1. In certain circumstances, a variance may be requested and granted if slope stability is shown to be maintained.

Grass lined detention basins shall be designed and constructed to promote positive drainage to the bottom stage and outlet areas, generally a 0.5 percent gradient shall be provided throughout.

J. Freeboard Requirements

A minimum of 1.0 feet of freeboard shall be required, measured from the calculated 100-year water surface elevation.

K. Emergency Overflow Requirements

To protect from catastrophic failure of the detention basin as a result of a larger magnitude storm or failed outlet works, an emergency overflow must be provided. Incorporating an overflow weir into the embankment is the most desirable method. This weir shall have an invert above the calculated 100-year water surface elevation and the design head shall be the top of the berm providing the freeboard requirement. The weir shall be designed to discharge at a rate of 1.5 times the calculated 100-year allowable release rate. The entire length down to the toe of the embankment shall be protected from potential erosion. (See Figure 19)

L. Maintenance Access

As provided these Standards, maintenance access shall be provided to detention

facilities. This access shall include vehicular access for maintenance purposes to the outlet structure.

M. Performance Requirements

To assure that the detention facility has been constructed according to the approved plans, an as-built survey shall be required. This pond certification shall be submitted to the City, showing the detention facility has at least 95 percent of the design capacity at the calculated 100-year water surface elevation and the required freeboard.

6.2.13 WATER QUALITY ENHANCEMENT

A. INTRODUCTION

The City recognizes the necessity to address stormwater quality issues that may arise as a result of urban development. Non-point source pollution continues to be one of the major contributors affecting the aesthetic values of receiving waterways, ecological benefits for fish and wildlife populations and environmental public health concerning contamination of drinking waters.

Stormwater runoff across lawns, roofs, and impervious roadways facilitates the transport of sediment laden with fertilizers, nutrients, oil, grease and other contaminants. The most desirable method for treating this sediment laden runoff within the City is to effectively slow and control the release of this stormwater to facilitate deposition prior to discharge into the receiving downstream conveyance.

In recognition that stormwater hydrology is regional in nature, these Standards are written to be in substantial compliance with the Northwest Colorado Council of Governments – Water Quality Protection Standards. The design engineer should be familiar with the intent of those Standards, as well as Local, State and Federal Zoning Regulations concerning the treatment of stormwater runoff.

The purpose of this Section is to identify acceptable design procedures pertaining to permanent water quality control measures incorporated into the design of a detention basin. Except as modified herein, design of Structural BMP's shall be in accordance with the Urban Storm Drainage – Criteria Manual. The design engineer is referred to the Urban Storm Drainage – Criteria Manual or other references cited for basic design concepts or technicalities.

B. WATER QUALITY CAPTURE VOLUME

The City encourages design of water quality control ponds to be calculated as an extended detention basin sedimentation facility (EDB). The EDB is easily incorporated into the design of a stormwater detention basin designed for attenuation of flood peaks.

C. WQCV

The water quality capture volume is determined based on developed watershed imperviousness and is expressed as watershed inches. The design engineer is referred to Figure EDB-2 as provided in the Urban Storm Drainage – Criteria Manual to determine the WQCV required based on the EDB’s 40-hour drain time.

D. Design Volume

The design volume is described as a storage volume equal to 120 percent of the WQCV based on watershed area and can be calculated as follows:

$$V_{\text{design}} = (\text{WQCV}/12) * \text{Area} * 1.2$$

E. Outlet Works

Although many options for control of the release of the WQCV are available to the design engineer, a perforated riser section mounted to the front of the detention pond’s outlet structure is cost effective and generally functions properly with little maintenance requirements. Utilizing the largest diameter perforations with the fewest number of columns reduces potential for clogging of the outlet. A trash rack shall be provided to aid in the prevention of clogging and shall be sufficiently sized so as not to alter the hydraulic properties of the perforations (See Figure 19).

CHAPTER 7: DEMOLITION, SITE PREPARATION, EXCAVATION, AND EMBANKMENT

7.1 INTRODUCTION

The work to be performed shall include the demolition and removal from the site of all designated: buildings, slabs on grade, retaining walls, steps, asphalt, rubbish, stumps, trees, shrubs, fencing, buried tanks, pipe etc.; on site wells shall be sealed; depressed areas are to be filled and graded to drain. These specifications set forth in this Chapter 7 of these Standards shall apply to all new construction within the City.

In public right-of-ways, wherein the City will assume the maintenance of materials installed, the work to be performed shall also include: top soil removal and replacement, unclassified excavation, placing and compacting embankment, shaping and compacting subgrades, etc.; for drainage ways, parks, concrete slabs on grade, etc.

7.1.1 Local Laws, Ordinances and Code

The Contractor shall be licensed with and bonded to the City and shall comply with all current federal, state and local laws, codes and ordinances pertaining to demolition, wrecking, clearing and grubbing operations.

7.1.2 Protection of Public Improvements

The Contractor will be held responsible to insure the protection of all existing public improvements such as fire hydrants, street lights, traffic lights, parking meters, traffic signs, catch basins, manholes, valves, survey monuments, overhead utility lines and poles, and any existing underground sprinkler or utility lines which may be damaged during the execution of the City contract or developer project. It will be the Contractor's responsibility to replace all public improvements so damaged at his own expense. Existing manhole rings and covers, valve boxes and sprinkler heads found defective shall be replaced, as directed by the City Inspector.

The Contractor shall take proper precautions for the protection of and replacement or restoration of driveway culverts, street intersection culverts or aprons, storm drains or inlets, fences, irrigation ditches crossings and diversion boxes, mail boxes, shrubbery, flowers, ornamental trees, driveway approaches and all other public or private installations that may be encountered during the performance of work. He shall provide each property with access at all times during construction. Existing driveways shall be cut, filled and graded as required or as directed by the City Inspector to provide permanent access. Existing driveways shall be resurfaced with the then existing type of surfacing, whenever surfaces are destroyed.

7.1.3 Disconnection of Existing Utilities

Before starting demolition of any structure, the Contractor shall arrange for the disconnection of all utility service connections; such as water, sewer, cable T.V., telephone, gas and electrical power connected thereto. Disconnects shall be made in accordance with the regulations of the utility that controls the supply of service involved.

Underground services are to be cut, capped and marked at point of disconnect to facilitate future location of the line. Caps of underground storm and sanitary sewer shall consist of a plug being placed in the line and the opening then sealed with concrete. Markings of the end of the line shall

consist of a 4 x 4 wooden stake or metal fence post driven into the ground and then tagged to note the type of facility.

The district (BHCCSD) or City Public Works Department will provide a representative to be on site to observe and approve the Contractor's disconnect of the water and sewer services at the main line. It shall also be the responsibility of the Contractor to backfill all holes to finish grade and install concrete or asphalt surfacing when the holes excavated are in streets or paved areas. The Contractor will be given written approval and acceptance for disconnects that are proper. The Contractor shall correct any unsatisfactory disconnects.

7.1.4 Equipment Operated On Streets

The Contractor shall be permitted to operate only pneumatic-tired equipment over any paved surface and shall be responsible for any damage to street surface resulting from his operations.

7.1.5 Protection of Survey Monuments

Prior to start of demolition or construction, any public survey monument or range box that may be disturbed during construction shall be referenced to a minimum of two points outside the limits of construction by a Colorado Professional Land Surveyor. Any public survey monument or range box disturbed as a result of construction shall be replaced by a Colorado Professional Land Surveyor in accordance to the current Colorado Revised Statutes.

7.1.6 Test Results

All subgrade test results including trench compaction, subgrade preparation and stabilization etc. on private developer projects must be submitted to the City Inspector for approval prior to placement of any asphalt or surface concrete. Minimum materials testing frequencies are as outlined in Table 15-1.

7.2 DEMOLITION, CLEARING AND GRUBBING

The Contractor shall remove from the site, or within the limits of construction, all obstructions specified in the Special Conditions of City projects or noted on the construction plans of developer projects.

7.2.1 Fences

Where existing fence or corner markers are to be removed, site corners shall be marked by 1/2" rebar, 18" long, firmly implanted at ground level by the Contractor.

7.2.2 Trees and Shrubs

Trees not impeding demolition of structures or performance of the work will not be removed except as designated. Trees and shrubbery designated for removal will include stumps and roots to a minimum depth of three (3) feet below existing or finished grade, whichever is lower. Downed trees, brush and rubble shall be removed from the site. A tree shall be defined as having a trunk that is greater than twelve (12) inches in diameter when measured four (4) feet above the existing ground surface.

Trees scheduled to remain shall be carefully protected from damage during performance of the

work. Any damage due to the Contractor's operations shall be repaired by suitable tree surgery methods. Damaged trees shall be replaced, as approved by the City at the Contractor's expense.

7.2.3 Cesspools, Privies, Buried Fuel and Septic Tanks

Tanks that may exist on project sites shall be completely removed and contaminated soils remediated. The void created shall be filled by the Contractor to finished grade. Underground motor fuel storage tanks shall be excavated and removed. The Contractor shall notify the Fire Department twenty-four (24) hours in advance of the time he proposes to start excavation in the vicinity of the tanks.

7.2.4 Wells

On site wells and well casings shall be sealed to prevent contamination of ground water aquifers in accordance with Chapter 5; Abandonment Regulations, State Board of Examiners, Rules and Regulations and Water Well and Pump Installation Contractors Law, State of Colorado Division of Water Resources. All abandonment activities shall be approved by the utility that services the location, and the State Engineer. There may be instances where the well will not be plugged, but merely capped with a steel, lockable cover plate.

7.2.5 Buildings

The demolition of buildings shall include the removal from the site of all roofs, walls, chimneys, basement walls, supporting walls, footings, footing post, caissons, basement floors; including all pipes, conduits and similar appurtenances lying therein or beneath for a depth of two (2) feet below grade.

7.2.6 Slabs on Grade

All concrete and asphalt slabs on grade shall be removed from the site. This shall include, but is not limited to, floor slabs, driveway and garage slabs, sidewalks, curbs, crosspans, gutters, etc.

7.2.7 Walls

Retaining walls and their footing shall be removed in their entirety, from the site.

7.2.8 Salvage

Unless otherwise specified in the Special Conditions on City projects; all materials, salvageable or otherwise, to be removed from the site is considered as being the property of the Contractor performing the work.

7.2.9 Filling and Grading

Depressions resulting from the removal of structures, basement walls, footings, buried tanks etc., shall be filled and compacted with clean fill materials so as to eliminate hazards of cave-in, accumulation and ponding of water. Under no circumstances shall organic building material, broken concrete over 1 foot in diameter or asphalt be considered as approved fill material. Immediately following demolition and removal of rubbish from the site, the Contractor shall grade the entire contract area by filling, compacting, and leveling the site to existing adjacent grades. Grading and cleanup of the site must be complete and acceptable before any consideration will be given to making final payment for the work on City projects.

7.2.10 Topsoil

The Contractor shall salvage within the project limits, or acquire when needed, loose friable loam reasonably free of admixtures of subsoil, refuse, stumps, rocks, roots, brush, weeds or other material which would be detrimental to the proper development of vegetative growth for use as topsoil.

Topsoil shall be placed and spread at locations and to the thickness shown on the plans, after the areas to be covered have been properly prepared and grading operations in the area have been completed and accepted. Soil so placed shall be keyed to the underlying subgrade by the use of harrows, rollers or other equipment suitable for the purpose, followed by applying water in a fine spray by nozzles or spray bars in such a manner and extent that wash or eroding will not occur.

7.3 EXCAVATION

Excavation will be unclassified and shall consist of the excavation of all material of whatever character encountered within the limits of the project, including but not limited to surface boulders, muck, rock, concrete foundations, slabs, stripping, excavation for ditches or channels, borrow, etc.

Excavation operations shall be conducted, so that material outside the limits of slopes will not be disturbed, and to provide adequate drainage at all times. Insofar as practicable, all suitable materials shall be used in the formation of embankments and backfilling. Materials that are considered unsuitable or surplus by the Engineer shall be disposed of by the Contractor at his expense.

All excavations shall be made to subgrade elevations and shall be true to grade. Material below subgrade elevation in cuts shall not be loosened by plowing or other methods during the progress of the work except with the approval of the Engineer. No excavation shall be made below subgrade elevation except to remove spongy material, vegetable matter or other undesirable materials. In the event the Contractor over excavates an area, he shall replace the excavated material with satisfactory material and thoroughly compact same at his own expense.

Whenever excavation greater than twelve (12) inches below subgrade elevation is required to remove spongy material, vegetable matter, or other material and is ordered by the 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 and thoroughly compact and moisture treat each layer before the next layer is placed. The volume of material ordered to be removed shall be paid for at the unit price for excavation. When such excavations are backfilled with suitable material from other excavations in the project, no separate payment will be made. In the event the Engineer orders such excavations to be filled with material from borrow, the Contractor will be paid at the unit price for "Select Subgrade Material" when called for in the proposal.

The Contractor shall not deposit surplus or undesirable materials on private property without first securing the written consent of the property Owner and filing a copy of said consent with the

City representative. When approved, disposal of surplus material on City property shall be kept below the grade designated by the Engineer.

7.4 EMBANKMENT

Areas to receive embankment and/or structural backfill material and the top of cut areas shall first be stripped of all vegetation, organic material, asphalt, concrete and materials unsuitable for use in embankments. Topsoil shall be stockpiled for reuse and unsuitable material disposed of. Under no circumstances shall organic building material, broken concrete (greater than 1 ft. diameter) or asphalt be considered as approved embankment material.

Within the limits of the embankment area the subgrade shall be windrowed or deep plowed to a depth of twelve (12) inches and the moisture content increased or reduced as necessary to bring the moisture within +/- 3% of optimum. This windrowed or deep plowed layer shall then be rolled and compacted to the relative compaction specified for the type of soil. The remainder of the embankment volume shall then be constructed in six (6) inch lifts of suitable material, containing +/- 3% of optimum moisture content for sandy soils and compacted to the relative compaction specified for the soil classification. Rollers shall be of a tamping type conforming to CDOT standards. In-place density tests of embankment material shall be taken every 250 lineal feet along the roadway or per every 200 yd³ of embankment, whichever is less. Results shall report densities (maximum dry and relative) to nearest 0.1 lb/cu. ft., moisture content (optimum and in place) to nearest 0.1%, and compaction (relative and required) to nearest 1%. Gradation in accordance with ASTM D 422 and Atterberg Limits in accordance with ASTM D 423 and D 424 shall be taken for each type of embankment soil placed. A moisture density curve determination for each embankment soil type placed in accordance with ASTM D 1557/AASHTO T-180 (A-1, A-3, A-2-4 and A-2-5 soils only) or ASTM D 698/AASHTO T-99 (all other soils) shall also be submitted to the Engineer.

In connection with normal grading operations, the Contractor shall use trucks, tractors, bulldozers and other pieces of equipment in the most effective manner by routing the equipment over the entire embankment or roadway width.

7.4.1 Compaction

Maximum dry densities of all soil types encountered or to be used will be determined in accordance with AASHTO T-99 or T-180. The percent of relative compaction required will be equal to or greater than minimum values as hereinafter shown for the various classes of soil and type of compactions.

Soil Classification (AASHTO M 145)	AASHTO T 99 Minimum Relative Compaction	AASHTO T 180 Minimum Relative Compaction
A-1	100	95
A-3	100	95
A-2-4	100	95
A-2-5	100	95
All Others	95	(not applicable)

Compacted subgrade ready to receive subbase material shall conform to the lines, grades and cross-section called for on the plans. Subgrade is to be established by survey.

7.5 SUBGRADE FOR SLABS ON GRADE AND PAVING

7.5.1 General

Subgrade areas to be occupied by concrete curbs, gutters and sidewalks, base course or asphaltic concrete shall, at a minimum, be stripped of all top soil and excavated to a depth of twelve (12) inches below final subgrade level, be backfilled in two (2) six inch lifts and compacted to establish final subgrade level. This work shall be done with particular care in accordance with all requirements herein.

7.5.2 Preparation

Subgrade soils shall be free of organic material, roots, sod, weeds, wood, ice, snow, or other deleterious matter and all rocks greater than six (6) inches in diameter. Subgrade soil shall be winrowed, tilled in place using a Bomag type rototiller or otherwise completely removed to a minimum depth of twelve (12) inches below final subgrade level, moisture treated to within 2 percent of optimum moisture content (-1% to +3% optimum for A-6 or A-7-6 soils), and replaced and compacted in 6 inch lifts to densities as shown for the soil type in Section 5.4.1. Scarifying in place soils by means of discing or ripping is not acceptable. Minimum removal depth must be verified by City Inspector prior to replacing soil in excavated area. A moisture density curve determination in accordance with ASTM D 1557/AASHTO T-180 (A-1, A-3, A-2-4 and A-2-5 soils only) or ASTM D 698/AASHTO T-99 (all other soils), Atterberg Limits and gradation test of each soil type removed and replaced shall be submitted to the Engineer. In place compaction testing frequency for the subgrade shall be a minimum of each six inch lift on replacement materials with one test for every 250 feet alternating each lane with more tests taken if necessary to establish that compaction requirements are being met. Results shall report densities (maximum dry and relative) to nearest 0.1 lb/cu. ft., moisture content (optimum and in place) to nearest 0.1%, and compaction (relative and required) to nearest 1%. Soft and yielding material and other portions of the subgrade which will not compact when rolled or tamped shall be removed as directed by the Engineer and replaced with suitable material. Additional or alternate subgrade preparation may be required as recommended by the geotechnical and/or pavement design report submitted by the Geotechnical Engineer on developer projects or as called out on the construction plans or in the Special Conditions on City projects. No paving, subbase, or base shall be placed on soft, spongy, frozen or otherwise unstable subgrade that is considered unsuitable by the Engineer.

7.5.3 Proof Rolling

Proof rolling will be required on all prepared subgrade including subgrade under proposed concrete flatwork areas to determine whether the subgrade meets compaction requirements. Proof roll all areas of subgrade with a heavy rubber-tired roller having a minimum GVW of 50,000 pounds, or single axle water truck loaded to provide a single axle weight of 18,000 pounds with a tire pressure of 90 psi or equivalent wheel loading. Areas found to be pumping or deforming shall be re-worked, dried or wetted if necessary, replaced or otherwise modified to provide a smooth, stable, non-yielding base for subsequent base and/or paving courses. The

Engineering Division shall be notified at least 24 hours before final proof-rolling. Approval of proof rolling is valid for 24 hours. Changes in weather such as freezing or precipitation will require reapproval of the subgrade prior to asphalt placement.

Surface of ground between concrete curb or sidewalk line and property line shall be sloped as staked or as directed by the Engineer and rounded into existing lawn or ground surface after concrete is placed.

7.5.4 Wetting and Compacting

Embankments, bases of cuts, natural foundations, base courses and surface courses shall be wetted and rolled to obtain the densities required by the Specifications. The Contractor shall use his equipment to consolidate each layer of embankment in the most effective manner. Each layer shall be compacted by routing the loaded hauling equipment over the entire width, and spreading equipment shall be operated so as to produce a dense, stable fill. Successive layers of material shall not be placed until the layer under construction has been thoroughly compacted. Where methods in use do not consolidate materials to required densities, rollers or mechanical tamping units of the type ordered by the Engineer shall be used.

Concurrently with the rolling or tamping operations, the materials shall be wetted by uniformly sprinkling each layer or course of material being placed, to within 2% of optimum moisture content (-1% to +3% optimum for A-6 or A-7-6 soils). Sprinkling shall be done in such a manner that areas of dry material alternated with areas of saturated material and pools of water will be avoided.

Where mechanical tampers are used as ordered by the Engineer, they shall be operated at all times with an air pressure not less than eighty (80) p.s.i. at the tamper. Successive blows with the tamper shall overlap at least one-fourth the width of the tamper foot.

7.5.5 Stabilized Subgrade Preparation

The subgrade to be stabilized shall be free of roots, sod, weeds, wood, ice, snow, or other deleterious matter and stones greater than six (6) inches in diameter. Material in the stabilized zone shall have a soluble sulfate content less than 0.5 percent. If the subgrade soils have a soluble sulfate content greater than 0.5 percent, the mix design for the stabilized subgrade shall be addressed to prevent adverse sulfate reactions. The subgrade shall not be treated when the ambient air temperature falls below freezing or the subgrade material is below 40 degrees F.

7.6 HOUSEKEEPING, RESTORATION AND CLEANUP

7.6.1 Surplus Excavation

All surplus excavated material shall be removed from the job site by and to locations provided by the Contractor. Written permission shall be obtained by the Contractor, before disposal of excess material on private property, and a copy of said permission shall be furnished to the Engineer. The City relinquishes all right and title to the surplus material unless otherwise specified in the Special Conditions.

Excess material shall not be wasted on any public ROW without written permission from the Engineer.

7.6.2 Concrete Curb, Gutter, Valley Gutter and Sidewalk

The Contractor shall replace in like kind all curb and gutter and valley gutter that are damaged during construction. The replacement shall be of equal or better quality than found at a minimum concrete thickness of 6". Separate payment will be made for replacing curb and gutter and valley gutter removed for the installation of a pipeline on City projects. Minimum removal length shall be five (5) feet from an existing control joint. If, after removal of the minimum five (5) feet, less than five (5) feet of concrete remains to the next control joint, then the entire length to the next control joint shall be removed and replaced.

7.6.3 Repair of Tree Damage

Any trees along the alignment of conduits that are damaged by the Contractor shall be repaired and treated accordingly. All broken limbs shall be sawed off evenly and cut faces painted with an approved compound. All repairs and treatments shall be done in accordance with the forestry regulations of the authority having jurisdiction and at Contractor's expense.

7.6.4 Surface Restoration

The Contractor must secure and pay for all street cut and ROW permits required from the Engineering Division for the prosecution of work. Permits are granted at no charge on City projects. The Contractor shall assume full responsibility for the consequences of such cutting or damaging and shall comply with all requirements contained therein.

The replacement of excavated base course, permanent paving and damaged curb and gutter shall be done in accordance with the "Engineering Code of Standard and Specifications for the Design and Construction of Public Improvements" and requirements contained in the permits.

Damaged driveways shall be replaced in like kind by the Contractor to an equal or better condition than existed prior to construction. All cuts necessary for the replacement of damaged concrete shall be made using a concrete saw. Drainage and ditch facilities shall be maintained in operating condition, at all times during construction.

- A. Unsurfaced Areas: The general grade and condition of all unsurfaced areas shall be restored to nearly as practicable to the grade and condition immediately prior to construction. Topsoil shall be removed, saved and replaced in cultivated and agricultural areas; and any excess earth shall be removed from the ROW at no additional expense to the City. If topsoil is not saved, Contractor must import additional topsoil to match existing prior to resurfacing. All grassed areas shall be reseeded or resodded, and the Contractor shall be responsible for caring for the grass until its growth is established.
- B. Surfaced Areas: Roadway surface cuts shall be made in a vertical plane and in a straight line. All roadway surfacing between the surface cuts on each side of the excavations shall be removed and replaced with base course material and/or hot mix bituminous or concrete surfacing. In the event that the trench must be

paved before hot mix bituminous material can be acquired, the Contractor, at the discretion of the Engineer, shall install and maintain temporary cold mix bituminous paving. When hot mix bituminous material becomes available, the Contractor shall remove the temporary cold mix material, add the compact base course material, if necessary, and install the permanent hot mix bituminous surfacing.

- C. Cleanup: Upon completion of the work, the Contractor shall remove from the job site all rubbish, unused materials, concrete forms and other like material. Also, at all times during construction, the Contractor shall maintain the site, partially finished structures, material stockpiles and other like areas in a reasonable state of order and cleanliness.
- D. In the event of the Contractor's failure to perform the above work in a timely manner, the Work may be performed by the City at the expense of the Contractor.

7.7 EROSION CONTROL BEST MANAGEMENT PRACTICES (BMPs)

This section provides a set of criteria and technical guidance for erosion and sediment control and material management. Erosion control measures limit erosion of soil from disturbed areas including stockpiled material at the construction site. Sediment control measures prevent the transport of sediment off-site to downstream properties and stormwater conveyances. Materials management is the practice of containing and controlling all materials used in order to eliminate potential pollutants from leaving the site, entering the storm sewer system or drainage way. The site's erosion and sediment controls and material management BMPs must be inspected and maintained by the owner/operator daily.

7.7.1 Site Development Permit (SDP)

In accordance with the City's permit criteria all projects with a disturbance area larger than 10,000 square feet must acquire a City Site Development Permit and implement and maintain erosion control, sediment entrapment and material management BMPs.

Initial documentation required:

1. Completed SDP application
2. Application fee
3. Escrow/LOC (unless government exempt)
4. Site map
5. Potential pollutant list
6. BMP specification details

A. SDP – Required Documentation

A site map including construction boundaries, all locations of BMPs, stockpiles, staging areas, portable restrooms, concrete containment, construction material storage and waste material storage must be provided to the Stormwater Division prior to beginning work. This site map must be updated daily to reflect the site's condition.

Potential pollutants must be listed and BMPs prescribed for each individual pollutant. If on-site fueling or maintenance will be conducted, a spill plan must be provided to the Stormwater Division prior to beginning work and a copy must be retained by fueling/maintenance personnel during operations.

A copy of these requirements including BMP specifications and details must remain on site and be referred to by any personnel installing, maintaining, repairing, repositioning or inspecting BMPs.

A daily log of BMP inspections, installation, repair and maintenance must be kept on site. This log must contain the date, name, location of BMP, and nature of work. It must also include that the site map was revised.

B. SDP – Enforcement Policy

If it is determined by the City inspector that BMPs are not inspected, installed and maintained daily, payment to the contractor for that day and up to two business days after will be withheld. If BMPs are not installed or maintained for a period of three consecutive days, a separate company will be contracted to do the work whereas costs incurred will be 100% reimbursed to the City with an inclusion of an additional 50% for administrative fees.

Site Development Permit BMP requirements:

1. All paved surfaces, gutters and sidewalks affected by work must be cleaned at the end of each day.
2. All inlets within and downstream of work areas will be protected.
3. Where consistent with safety and space considerations, excavated material is to be placed on the uphill side of trenches.
4. Trench dewatering discharges must be filtered and not allowed to come in contact with stockpiles or soils remaining on paved surfaces or in gutters. Site dewatering permits must be obtained from the Colorado Department of Public Health and Environment.
5. Water main flushing discharges must be routed around disturbed areas and stockpiles. Water must not come in contact with soil stockpiles or soils remaining on paved surfaces or in gutters.
6. Curb check dams will be installed at all locations downstream of work areas where stormwater flows may potentially come in contact with dirt and exit the work area.
7. An area must be designated for construction material waste. All waste materials must be placed into waste containers and covered immediately.
8. Portable Toilets must be provided on site and an area designated for their placement.
9. A portable concrete washout basin must be provided on site.
10. Staging areas must be designated and employ appropriate BMPs.
11. Stockpiles must, at all times have a perimeter BMP installed at the

- downstream side and all material dragged from a stockpile during operations must be swept back into the pile at the end of each day.
12. If replacing a storm sewer inlet, pipes within the inlet must be plugged during the inlet construction.
 13. All erosion and sediment control practices shall be maintained and repaired by the owner/operator during the construction phase as needed to assure continued performance of their intended function. All BMPs must be inspected, maintained and replaced daily if necessary.
 14. After all work has been completed, including concrete, asphalt and re-vegetation, clean out and remove all temporary construction BMPs.

7.7.2 BMPs

A. BMP - Stockpiles

BMP Application - Straw Wattle or Rock Bag used for stockpile containment. If stockpiles are located within 100 feet of a waterway, including conveyances to them, additional sediment controls must be provided. A weighted down wattle or rock bag must be installed on the downstream side of all stockpiles.

BMP Installation - Install in an arced position on the downhill side of stockpiles. Place two feet from the toe of the stockpile to allow for ponding. Instruct persons accessing the stockpiles with equipment to work around the BMP or temporarily relocate it. Damaged BMPs must be replaced immediately.

BMP Maintenance - Sediment entrapment BMPs (wattles or rock bags) must be cleaned and repositioned daily. Broken or crushed BMPs must be replaced immediately. Any materials spilled from the BMP when damage occurs must be removed from the site and disposed of.

B. BMP – Inlet Protection

BMP Application - An approved design for protecting inlets must be installed at all storm sewer inlets directly downstream of and within work area.

BMP Installation - Install around entire inlet or from curb to curb.

BMP Maintenance - Inlet protection must be repositioned or replaced at the end of every day. Sediment and debris accumulated at inlet protection must be removed and disposed of daily.

C. BMP – Inlet Pipe Protection

BMP Application - An approved design for protecting pipes during storm sewer inlet re construction must be installed within the inlet at all pipe connections.

BMP Installation - Install at piping within inlet.

BMP Maintenance - Inlet protection must be repositioned or replaced at the end of every day. Sediment and debris accumulated within the inlet must be removed and disposed of daily. After inlet construction is completed, all dirt, materials and pipe protection must be removed and disposed of and an approved inlet protection installed.

D. BMP – Curb Socks

BMP Application - Curb Socks used for sediment entrapment downstream of work area.

BMP Installation - Curb Socks must be installed within gutters, contacting the curb and set at a 45 degree angle.

BMP Maintenance - Curb Socks must be repositioned or replaced if broken daily. Accumulated sediment must be removed and disposed of daily.

E. BMP – Street Sweeping (Non-Structural BMP)

BMP Application - Street sweeping either by machine or manually for the removal of excess materials on the roadway, sidewalks or gutters.

BMP Maintenance - Street sweeping must be conducted at the end of each day. This includes the removal of materials in the gutters or accumulated at sediment entrapment BMPs.

F. BMP – Vehicle Tracking Control

BMP Application - Tracking pads used where vehicles enter or exit hard surfaced areas to limit the transport of materials onto impervious areas.

BMP Installation - Tracking pads must be installed anywhere that vehicles or equipment come in contact with unpaved surfaces regardless if the area is public or private. This includes road shoulders. Materials most commonly used are recycled concrete or 1 ½” rock.

BMP Maintenance - Additional rock must be added to tracking pads when original pad material begins to fill with dirt. At the end of the project the areas where tracking pads were installed must be restored to the original condition.

G. BMP – Stabilized Staging Areas

BMP Application - Areas designated for equipment and material storage.

BMP Installation - Staging areas whether on private or public areas must remain organized and clean. The staging area may be used for equipment and construction material storage, sanitary waste receptacles and other waste receptacles. All fluids or hazardous materials stored at the staging area must be stored inside or covered on pallets.

BMP Maintenance - Organize and clean the staging area daily. Do not allow dumpsters to become over full or store waste piles on site. All waste piles must be contained.

H. BMP – Concrete Washout

BMP Application - A washout pit or portable washout bin used to contain concrete waste and

wash water associated with concrete or masonry operations. If small amounts of concrete are to be prepared on site, containment is still required.

BMP Installation - All types of concrete mixing or washing must be contained either by a pit, portable bin or baby pool. Mixing concrete or washing out concrete trucks or equipment on site without approved containment is prohibited.

BMP Maintenance - Accidental spills must be cleaned up immediately. Containers that are full must be removed from the site and properly disposed of.

I. BMP – Waste Management

BMP Application - All waste generated on site must be contained. At no time will construction debris or waste generated at the site be allowed to be stored on site, uncontained.

BMP Installation - Dumpsters and trash bins must be provided on site and placed in a designated area.

BMP Maintenance - Receptacles must be emptied frequently. Liquids may not be placed within the receptacles if there is a possibility they could leak.

J. BMP – Material Management

BMP Application - Construction materials including stockpiles and equipment must be stored in a designated area.

BMP Installation - Perimeter BMPs must be installed at all stockpiles, at pipe storage areas, and where equipment is stored on impervious surfaces that may contribute grease, oil or dirt to the site.

BMP Maintenance - Materials must be kept organized and neatly stored. Perimeter BMPs must be repositioned or replaced if damaged, daily.

K. BMP – Fueling/Maintenance Operations

BMP Application - If equipment undergoes fueling, maintenance or repair on site, BMPs must be used.

BMP Installation - A drip pan or container will be used during on site fueling, maintenance or repair operations. Absorbents will be available should a spill occur.

BMP Maintenance - Spills will be cleaned up immediately. Fluids leaking from any vehicle or equipment will be cleaned immediately and that vehicle or piece of equipment repaired or removed from the site.

L. BMP – Sanitary Waste Management (Portable Toilets)

BMP Application - Portable sanitary waste receptacles required on site for use by all personnel.

BMP Installation - Portable receptacles must be secured in place and not positioned on an impervious surface. Receptacles must be located at least 3' from all impervious areas, flow lines, ditches, creeks or storm sewer inlets.

BMP Maintenance - Receptacles must be checked daily and routinely maintained. In the event materials are spilled from a receptacle, immediate clean up is required. If a contracted company must respond for the clean up and the response time is unknown, absorbents must be applied to the spill by the onsite contractor immediately.

M. BMP - Stabilization

BMP Application - To be installed on all disturbed areas that will not be seeded or paved. All areas disturbed with a final grade slope of 3:1 or greater will require the installation of seeded slope protection matting.

BMP Installation - Matting must be installed with continuous contact with the soil and trenched in at the top of the slope or where matting begins. Pins must be used according to product installation specifications to secure the product.

BMP Maintenance - Matting/Blanketing must be inspected daily and repositioned or replaced if needed.

CHAPTER 8: REVEGETATION, EROSION AND SEDIMENT CONTROL

8.1 INTRODUCTION

Erosion and resulting sedimentation is a naturally occurring process which has the potential to be rapidly accelerated as a result of land disturbing activities associated with development. The purpose of establishing and implementing these Revegetation, Erosion and Sediment Control Criteria is to prevent degradation to downstream properties and receiving waterways as a result of the site disturbance process within the City.

8.2 REGULATORY REQUIREMENTS

The Federal Clean Water Act (CWA), implemented through the Environmental Protection Agency (EPA) requires authorization to discharge stormwater associated with construction activities through the National Pollutant Discharge Elimination System (NPDES). In Colorado, the NPDES is administered through the Colorado Department of Public Health and Environment – Water Quality Control Division (CDPHE-WQCD). As of the effective date of these Standards, any and all construction activities disturbing more than one acre are required to comply with the provisions stipulated in a General Permit for Stormwater Discharges Associated with Construction Activity. The owner or operator of the construction activity shall submit this General Permit Application at least 10 days prior to the anticipated date of land disturbing activities to:

Colorado Department of Public Health and Environment
Water Quality Control Division
WQCD-Permits
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530
(303) 692-3517

The main provision with the Permit is the development and implementation of the Stormwater Management Plan (SWMP).

ACCEPTANCE OF THE SWMP (if required) BY THE CITY IS REQUIRED PRIOR TO FINAL PLAT ACCEPTANCE. SWMP APPLICATION TO THE STATE MUST BE APPROVED PRIOR TO COMMENCING ANY CONSTRUCTION.

THE CITY SHALL HAVE AUTHORIZATION TO ISSUE A STOP WORK ORDER FOR FAILURE TO COMPLY WITH THE PROVISIONS OF THE PERMIT AND/OR THESE CRITERIA. CITY STAFF MAY REQUIRE EMERGENCY MITIGATION MEASURES.

8.3 BEST MANAGEMENT PRACTICES (BMPs)

As the SWMP is the main requirement of the Permit, the BMPs are the main provision of the SWMP. The purpose of this section of these Standards is to provide a guideline for acceptable practices to be utilized within the City. Although many references are available to the design

engineer with respect to selection and design of appropriate BMPs, the Urban Storm Drainage Criteria Manual is the basis for these Standards.

The Erosion and Sediment Control industry has experienced rapid progress over the last decade and is continuing to expand. As such, the design engineer is strongly encouraged to utilize the latest advances in selection methodology and information now available. The greatest benefits to enhancing the water resources of the City are realized if Erosion Control is thought of as preventative in nature whereas Sediment Control is treatment.

The NPDES requirements are strict and the penalties associated with non-compliance are severe. Planning, designing and implementing a thorough SWMP are the most effective way to protect the water resources within the City, thereby complying with the NPDES requirements. These Erosion and Sediment control BMPs are intended to eliminate non-point source pollution to receiving waterways as a result of the land development process during construction activities. Establishing vegetated cover capable of providing equal or greater erosion control benefits as compared to historic conditions is the goal of the Erosion Control BMPs. The maintenance requirements of the Sediment Control BMPs are described in these Standards cannot be overemphasized, that is to say if they are functioning properly, accumulated sediment will need to be removed. As construction progresses, the SWMP and associated BMPs will need to adapt to the changing conditions of the site. In addition to these construction BMPs, Administrative Control BMPs are equally as important. Administrative BMPs include ideas and methodology concerning the manner in which construction occurs. Education, training and coordination of all involved parties is an effective way to limit the erosion on a project, thereby limiting the need for sediment control, and is a prime example of an Administrative Control BMPs.

8.3.1 EROSION CONTROL BMPs

- A. Exposed soil shall be stabilized and protected from erosive forces as soon as possible, but no later than 14 days of achieving finished grade or if the area will remain dormant (disturbed, but not at finished grade). Appropriate soil stabilization techniques include:
 - Mulching
 - Rolled Erosion Control Products or Turf Reinforcement Mats (RECPs or TRMs)
 - Proprietary Geosynthetics
 - Bonded Fiber Matrix (BFM)

- B. In addition to the soil stabilization techniques applied, Temporary Revegetation is required on all disturbed areas having a period of exposure of one year or longer prior to final stabilization. Temporary seeding shall consist of an annual grass cover crop and may be applied:
 - Hydraulically
 - Drilled
 - Broadcast

- C. Permanent Revegetation is required on all disturbed areas that are either at finished grade or expected to remain dormant for a period longer than one year (1yr). Permanent seeding shall consist of an appropriate native perennial cover crop as recommended by the Natural Resource Conservation Service (NRCS) office in Longmont, Colorado, or approved equal.
- D. Other Erosion Control BMP's recommended by the City include:
 - Limiting areas of disturbance
 - Limiting Directly Connected Impervious Areas (DCIA)
 - Establishing buffer strips
 - Planning, scheduling & phasing construction around times of heaviest expected precipitation and snowmelt
 - Transitioning changes in slope
 - Terracing long slopes
 - Surface roughening and contour furrowing

8.3.2 SEDIMENT CONTROL BMPs

- A. Temporary Diversion Dikes or Continuous Berms controls shall be required on all disturbed slopes of 3:1 and greater than 20' in length or as soil condition and tributary area dictates. These dikes or berms must divert stormwater to a properly stabilized channel, slope drain or rundown to limit rill and gully erosion. This BMP can be designed at the top, mid and/or base of a disturbed slope, following the contour, to effectively limit sediment transport from the disturbed area and may be constructed of the following materials:
 - Compacted Soil
 - Straw Wattles
 - Aggregate Bags
 - Proprietary Geosynthetics
- B. Sediment Barriers are perimeter controls designed to pond sediment laden stormwater as a result of overland sheet flow and slowly allows this stormwater to filter through the media as sediment settles out. This BMP shall be required around the perimeter of disturbed areas, at the base of disturbed slopes or as soil condition and tributary area dictates. Proper design of this BMP limits the tributary area to ¼ Acre per 100 lf of barrier, following the contour, to effectively limit the transport of sediment laden stormwater. Sediment barriers may be constructed of the following materials:
 - Silt Fence
 - Straw Wattles
 - Aggregate Bags
 - Geotextile wrapped Brush Barriers
 - Proprietary Geosynthetics
- C. Channel stabilization controls shall be required in all drainage ways where

Froude numbers are expected to exceed 0.8 for the minor storm recurrence interval rainfall or as soil condition and tributary area dictates. Proper design of these BMPs either limits stormwater velocities or armors the channel to limit erosion from occurring therefore eliminating sediment transport. Techniques, materials and methods for channel stabilization within the City include:

- Check Dams
 - Aggregate
 - Straw Wattles
 - Proprietary Geosynthetics
- Channel Linings
 - Aggregate
 - RECP/TRM
 - Proprietary Geosynthetics

D. Energy dissipation controls shall be required at all culvert inlets and outlets. Additionally, energy dissipation controls may be necessary at the terminus of drainage ways, slope drains and/or rundowns to effectively limit erosive forces and sediment transport. Proper design and selection of these BMPs reduce turbulent flow and limit hydraulic jumps within a stabilized area. Techniques, materials and methods for channel stabilization within the City include:

- Riprap
- Aggregate Drop Structures
- Level Spreaders
- Proprietary Geosynthetics

E. Inlet protection controls shall be required at all storm, sewer and/or culvert inlets. The intent of this BMP is to pond sediment laden runoff, allowing sediment to settle out prior to entering the conveyance structure. Proper design and selection of this BMP must allow the conveyance structure to accept the design flow prior to any major inundation as well as have the structural stability to withstand the forces generated by these focused flows. Inlet protection may be constructed of the following materials:

- Block and Aggregate
- Aggregate Bags
- Proprietary Devices

F. Vehicle tracking controls shall be required wherever construction traffic will enter onto an improved road from a construction site. Additionally, as sediment is tracked onto an improved road, the road shall be removed of accumulated sediment at the end of each workday. Proper design and placement of this BMP limits construction access to controlled points of ingress and egress before and after construction of the road base. Vehicle tracking controls shall be constructed of the following materials:

- Geosynthetic Fabric overlain by Course Aggregate (Figure 20)

- G. Sediment entrapment facilities shall be required on all construction sites of one acre or larger. The minimum required volume of the sediment basin shall be calculated based on 1800 cubic feet per tributary acre. The sediment basin shall incorporate a stabilized spillway capable of passing stormwater flows generated by the one hundred year recurrence interval rainfall. The sediment basin can easily be incorporated into the design of a permanent stormwater detention facility and generally provides the most functional and economical solution to implementing this BMP. The sediment basin is designed to effectively slow the velocity of stormwater runoff and allow the suspended sediment to settle; as such the basin shall be dredged of accumulated sediment prior to becoming half full. Proper design and placement of this BMP serves as the final measure in eliminating sediment laden stormwater runoff from leaving the construction site.

8.4 REVEGETATION

All areas disturbed during construction that require revegetation shall receive a minimum of four inches (4") topsoil replacement or an approved design from a landscape architect.

Revegetating disturbed areas of construction is critical to prevent soil erosion. Establishing vegetative cover capable of limiting erosion potential to that of pre-disturbed levels is necessary. Effective revegetation limits raindrop impact erosion, facilitates infiltration, reduces runoff and reduces negative impacts caused by noxious weeds (such as root establishment and out-competing native vegetation). The following seed mix is recommended by the Jefferson Conservation District (includes Gilpin County) and shall be implemented on all sites disturbing soil:

FRONT RANGE MIX

- Western Wheatgrass
- Slender Wheatgrass
- Arizona Fescue
- Canby Bluegrass
- Little Bluestem
- Sandberg Bluegrass
- Blue Grama

NOTES:

1. The applied seed shall not be covered by a soil thickness greater than 0.5" in depth.
2. Seeding shall take place on all disturbed areas and stockpiles expected to remain dormant for a period greater than 30 days.
3. To provide temporary erosion control prior to seed application, utilize surface roughening (on the contour or perpendicular to prevailing winds) and apply mulch.
4. Seed shall be planted with drill seeding equipment, whenever possible.
5. Areas that require broadcast seeding shall be mulched and tackified.

8.5 LANDSCAPING

The objective of a Landscape Plan is to provide a sustainable approach to ensure revegetation of the disturbed site, and to improve aesthetics of the built facilities in a sustainable manner upon completion of a new development. A multi-family development will include landscape features for all open space tracts, and areas disturbed during installation of utilities. A single-family development may include landscape features at the point the development enters a City road, as well as areas disturbed during installation of utilities. Landscaping shall be designed anticipating mature vegetation and shall not interfere with roadway site distances or overhead lines. If necessary, irrigation designs and costs shall be included in the construction plans and cost estimate.

The design shall be completed and signed by a Landscape Architecture, Horticulturist, or revegetation specialist (resource specialist, engineer, etc.) approved by the City. The construction cost shall include all features shown in the landscape plan, maintenance requirements for established plantings, and a two-year warranty.

All landscaping shall not interfere with the intersection sight triangle (See Section 3.7.6). The landscaping plan shall be designed anticipating fully mature plantings.

8.6 REFERENCES AND DESIGN AIDS

Environmental Protection Agency www.epa.gov
Colorado Department of Public Health & Environment www.cdphe.state.co.us
Urban Drainage and Flood Control District www.udfcd.org
Erosion Control Technology Council www.ectc.org
International Erosion Control Association www.ieca.org
International Stormwater BMP Database www.bmbdatabase.org
National Resource Conservation Service (NRCS) www.nrcs.usda.gov
Northwest Colorado Council of Governments (NWCCOG) www.nwc.cog.co.us

CHAPTER 9: HOT MIX ASPHALT

9.1 INTRODUCTION

These specifications include general requirements applicable to all types of plant mixed hot mix asphalt pavements (HMAs) and references sections and subsections of the 2011 edition of the Colorado Department of Transportation (CDOT) Standard Specification for Road and Bridge Construction. This work consists of one or more courses of asphalt mixture constructed on a prepared foundation in accordance with these specifications. These specifications shall apply to all new and resurface construction within the City of Central.

9.2 MATERIALS

The HMA pavement shall be composed of a mixture of aggregate, filler or additives, asphalt cement, and recycled asphalt pavement (RAP) where specified. Up to 20 percent RAP is allowed in mix designs. All mixes shall be designed and produced with 100 percent hydrated lime.

9.2.1 Aggregate

Aggregates for HMA shall be of uniform quality, composed of clean, hard, durable particles of crushed stone, crushed gravel, or crushed slag. Excess of fine material shall be wasted before crushing. The material shall not contain clay balls, vegetable matter, or other deleterious substances and shall meet the following requirements.

Table 9.2.1.1 Aggregate Properties

Aggregate Test Property	Coarse: Retained on #4	Fine: Passing #4
Fine Aggregate Angularity, CP-L 5113 Method A Traffic Level: < 8,000 ADT Traffic Level: > 8,000 ADT		40% Minimum 45% Minimum
Two Fractured Faces, CP-45 Top and Middle Lifts Bottom Lifts	80% Minimum 70% Minimum	
LA Abrasion, AASHTO T 96	45% Maximum	
Flat and Elongated (Ratio 5:1) %, AASHTO M283	10% Maximum	
Adherent Coating (Dry Sieving) ASTM D 5711	0.5% Maximum	
Sand Equivalent, AASHTO L 176		45% Minimum

The HMA aggregate gradation for the proposed design job mix gradation shall be wholly within the control point gradation range set forth in the following table. The allowable job mix gradation for production shall be the design job mix gradation with the tolerances of Section 11.13.3 applied. The proposed design job mix and the final allowable job mix gradation for production shall report all sieve sizes listed in the table.

Table 9.2.1.2 Gradation Range, Percent by Weight Passing Square Mesh Sieves, AASHTO T 11

& T 27

Sieve Size	SX (1/2" nominal)		S (3/4" nominal)		SG (1" nominal)	
	Control Points	Restricted Zone*	Control Points	Restricted Zone*	Control Points	Restricted Zone*
1-1/2"					100	
1"			100		90-100	
3/4"	100		90-100			
1/2"	90-100					
3/8"						
#4						39.5
#8	28-58	39.1	23-49	34.6	19-45	26.8-30.8
#16		25.6-31.6		22.3-28.3		18.1-24.1
#30		19.1-23.1		16.7-20.7		13.6-17.6
#50		15.5		13.7		11.4
#200**	2.0-8.0		2.0-7.0		1.0-7.0	

*The restricted zone is a guideline only. It is recommended that mix design gradations go above the restricted zone boundaries, on the fine side.

**These limits shall include the weight of lime at 1.0%.

9.2.2 Recycled Asphalt Pavement

Recycled Asphalt Pavement (RAP) material shall be of uniform quality and gradation with a maximum size no greater than the nominal aggregate size of the mix.

The contractor shall identify the source of each RAP stockpile proposed to be incorporated in the asphalt mixes. Contractor shall identify the project from which the material was removed, mix data from the original project including mixture type, aggregate classification, location and depth of pavement structure. Extracted gradation information shall also be provided along with a description of the stockpile location and quantity. Additional material shall not be added to an approved RAP stockpile during the course of the work.

The Engineer may reject a RAP stockpile for non-uniformity based on visual inspection. RAP stockpiles containing concrete chunks, grass, dirt, wood, metal, coal tar, or other foreign or environmentally restricted materials shall not be used. Stockpiles are to be worked in such a manner that the materials removed are representative of a cross section of the pile.

Mixes shall not contain more than 20 percent RAP.

9.2.3 Asphalt Cement

The contractor shall provide an acceptable "Certification of Compliance" from the supplier for each applicable asphalt cement grade. Asphalt cement binder shall meet the requirements of the Superpave Performance Graded Binder (PG) as presented below.

Table 9.2.3 Properties of Superpave Performance Graded Binders

Property	PG 58-28	PG 64-22	PG 76-28
Average Daily Traffic (ADT) Volume or Equivalent Single	< 8,000 ADT < 300,000 ESAL	< 40,000 ADT < 1,000,000 ESAL	≥ 40,000 ADT ≥ 1,000,000 ESAL

Axle Load (ESAL) Volume*			
Flash Point Temperature, AASHTO T 48	230°C (minimum)	230°C (minimum)	230°C (minimum)
Viscosity at 135°C, ASTM C 4402	3 Pas (maximum)	3 Pas (maximum)	3 Pas (maximum)
Dynamic Shear, Temperature, where $C^{**}/\sin\delta @ 10$ rad/sec ≤ 1.00 Kpa, AASHTO TP 5	58°C	64°C	76°C
Rolling Thin Film Oven Residue Properties			
Mass Loss, AASHTO T 240	1.00% (maximum)	1.00% (maximum)	1.00% (maximum)
Dynamic Shear, Temperature, where $G^{**}/\sin\delta @ 10$ rad/sec ≤ 2.20 Kpa, AASHTO TP 5	58°C	64°C	76°C
Elastic Recovery @ 25°C	(not applicable)	(not applicable)	50% (minimum)
Pressure Aging Vessel Residue Properties, Aging Temperature 100°C			
Dynamic Shear Temperature, where $G^{**}/\sin\delta @ 10$ rad/sec $\leq 5,000$ Kpa, AASHTO TP 5	19°C	25°C	28°C
Creep Stiffness @ 60 sec, Test Temperature, AASHTO TP 1	-18°C	-12°C	-18°C
S, AASHTO TP 1	300 MPa (minimum)	300 MPa (minimum)	300 MPa (minimum)
m-value, AASHTO TP 1	0.300 (maximum)	0.300 (maximum)	0.300 (maximum)
Direct Tension Temperature @ 1.0 mm/min, where Failure Strain $> 1.0\%$, AASHTO TP 3	-18°C	-12°C	-18°C

* 18,000 pound single axle load over 20 year design life

** Elastic recovery by Task Force 31, Appendix B Method

Note: PG 76-28 is recommended for intersections of high volume arterial streets

9.2.4 Lime

Lime shall be added at the rate of 1% by dry weight of the aggregate and shall be included in the amount of material passing the No. 200 sieve. Hydrated lime for aggregate pretreatment shall conform to the requirements of ASTM C 207, Type N. In addition, the residue retained on a 200 mesh sieve shall not exceed 10% when determined in accordance with ASTM C 110. Drying of the residue in an atmosphere free from carbon dioxide will not be required.

9.2.5 Tack Coat

The emulsified asphalt for tack coats shall be CSS-1h or SS-1h and conform to AASHTO M208 and ASTM D 2397 or AASHTO M 140 and ASTM D 977, respectively.

9.3 MIX DESIGN AND PLANT PRODUCED MIXTURE REQUIREMENTS

9.3.1 General Requirements

The mix design materials shall be in accordance with the requirements of Section 11.2. The design job mix formula (JMF) for each mixture shall establish a single percentage of bituminous material to be added to the aggregate, and a single temperature for the mixture at the plant discharge point. The City may test the contractor's proposed JMF for each hot bituminous pavement grading utilizing materials actually produced and stockpiled for use. The contractor shall provide a sufficient quantity of each aggregate, mineral filler, recycled asphalt, and additive for the required laboratory tests if requested by the City.

After the JMF is approved, a new JMF shall be submitted to the Engineer if there is a change in the sources of materials.

9.3.2 Allowable Mix Production Range

The proposed job mix gradation for each mixture required by the project shall be within the master range of Table 703-4, CDOT Section 703, before the tolerances shown in Table 401-1, CDOT Section 401 are applied. The weight of lime shall be included in the total weight of the material passing the No. 200 sieve.

After the JMF is approved, all mixtures shall conform to the production tolerance ranges of Table 401-1 and the tolerances shall be applied to the JMF to establish the allow mix production ranges for mix production.

If one or more samples of HMA pavement fail to meet the mix production requirements, the contractor shall core the area represented by the failing sample as directed by the Engineer. The Engineer will take possession of the cores and will perform necessary tests for each of the sample locations. Duplicate cores may be taken and retained by the contractor at the contractor's expense. The time during which the core samples are taken and their location shall be established by the Engineer. Taking cores and patching the core holes will be done at the expense of the contractor.

The plant produced mix may be tested by the City for conformance with the allowable mix production range, moisture susceptibility, stability and/or flow, and volumetric criteria shown in the tables below at a testing frequency to be designated by the City. If two consecutive production samples fail to meet any of these criteria and show no correlation to the mix design,

the contractor shall take corrective action and verify compliance with the criteria before continuing production. Measures taken to bring the mix into compliance shall be submitted to the Engineer prior to continuing production.

9.3.3 Marshall Mixture Design Method

The Marshall mixture design method shall not be used unless approved by the Engineer. The mix design for HMA pavement shall conform to the criteria of design and production tables below. The optimum percent asphalt cement shall be chosen in accordance with Asphalt Institute Manual MS-2.

HMA bid items will specify the mixture gradation and the Marshall blows to be used for the mix design.

Lab compactive effort shall be by Marshall compactor for mix designs and testing of plant produced mix. For Grade SG mix, when any particle is retained on the 1-inch screen the sample shall be compacted in 6 inch diameter molds with a Cox Kneader compactor using CDOT procedures. Stability requirements for Grade SG mix will not apply.

Table 9.3.3.1 Required Hot Mix Properties and Production, Asphalt Institute MS-2 and AASHTO T 245 Test Methods

Average Daily Traffic (ADT) Volume or Equivalent Single Axle Load (ESAL) Volume*	< 8,000 ADT < 300,000 ESAL	≥ 8,000 ADT ≥ 300,000 ESAL
Marshall Blows	50	75
Marshall Stability, pounds	1800	2000
Marshall Flow, 0.01 inch	8-18	8-16

* 18,000 pound single axle load over 20 year design life.

Table 9.3.3.2 Volumetric and Stripping Criteria, Design and Production

Air Voids, MS-2 Test Method	3.0% - 5.0%		
Voids Filled with Asphalt (VFA) MS-2 Test Method	65%-78% for 50 blow Marshall Method 65%-75% for 75 blow Marshall Method		
Voids in Mineral Aggregate (VMA) Minimum VMA based on air voids in actual mix			
Nominal Maximum Particle Size*	Mix Air Voids**		
	3.0%	4.0%	5.0%
1"	11.0%	12.0%	13.0%
¾"	12.0%	13.0%	14.0%
½"	13.0%	14.0%	15.0%
Stripping Criteria (Moisture Susceptibility)			
Tensile Strength Ratio (Lottman) % retained, CP-L 5109 Test Method	80% (minimum)		
Dry Split Tensile Strength CP-L 5109 Test Method	30 psi (minimum)		

* The nominal maximum size is defined as one sieve larger than the first sieve to retain more than 10%.

** The specified minimum VMA value shall be interpolated for air voids between those listed.

9.3.4 Superpave Mixture Design Method

The propose design job mix shall be submitted for each mixture required by the contract. The design shall be determined using Colorado Procedure CP-L 511 for the Superpave Method of Mixture Design. Guidance is provided in “Superpave Level 1 Mix Design” SP-2 published by the Asphalt Institute. Mix designs shall meet the following requirements.

Table 9.3.4.1 Superpave Mixture Properties

Average Daily Traffic (ADT) Volume or Equivalent Single Axle Load (ESAL) Volume*	Paths/Trails	≥ 8,000 ADT ≥ 300,000 ESAL	< 8,000 ADT < 300,000 ESAL
Initial Gyration, N _{INITIAL} (Air Void > 11.0%), for information only	6	7	8
N _{INITIAL} Air Voids, for information only	> 8.5	> 9.5	> 11.0
Design Gyration, N _{DESIGN} (Air Void: 3.5% - 4.5%, see Note 1)	50	75	100
Hveem Stability (minimum) CP-L 5106 (Grading S and SX only)	(not applicable)	28	30
Voids Filled with Asphalt (VFA) MS-2	70% - 80%	65%-78%	65%-75%
Lottman, Tensile Strength Ratio, % retained, CP-L 5109, Method Bill D -	80% (minimum)	80% (minimum)	80% (minimum)
Lottman, Dry Tensile Strength, CP-L 5109	30 psi (minimum)	30 psi (minimum)	30 psi (minimum)
VMA, CP-48	Refer to table in Section 11.2.1		

* 18,000 pound single axle load over 20 year design life.

Note 1: Maximum theoretical specific gravity of mix by CP-51.

Note 2: Refer to Section 11.13 for production tolerances.

The Voids in Mineral Aggregate (VMA) shall be based on tests of the Bulk Specific Gravity of the Compacted Mix (CP-L 5103) and Aggregate (T 84 and T 85), and calculated according to CP-48. All mixes shall meet the minimum VMA specified below.

Table 9.3.4.2 Voids in Mineral Aggregate

Nominal Maximum Particle Size*	Mix Air Voids**		
	3.5%	4.0%	4.5%
1" (SG)	12.5%	13.0%	13.5%
3/4" (S)	13.5%	14.0%	14.5%
1/2" (SX)	14.5%	15.0%	15.5%

* Nominal Maximum Particle Size is defined as one sieve size larger than the first sieve to retain more than 10%, but shall not exceed the 100% passing sieve. The Nominal Maximum Particle Size can vary during mix production even when the 100% passing size is constant.

** Minimum VMA criteria apply to both design and plant produced mix. The minimum VMA criteria shall be linearly interpolated based on actual air voids.

9.4 MIXTURE DESIGN SUBMITTALS

9.4.1 General Requirements

Mixture designs, Certificates of Compliance, and laboratory data shall be submitted for approval at least seven (7) calendar days before construction is to begin. The mix design must be approved by the Engineer prior to the start of construction.

9.4.2 Mix Design Submittals

The contractor shall submit all mix designs to the Engineer for approval. Mix designs shall be performed in a materials laboratory under the direct supervision of a professional engineer licensed in the State of Colorado and practicing in this field. In addition, the contractor shall submit as part of the mix design documents to verify the following:

- A. Source of materials
- B. Gradation, specific gravity, source and description of individual aggregates, and the final blend
- C. Aggregate physical properties (CDOT Subsection 703.04)
- D. Design Job Mix Formula (JMF)
- E. Asphalt cement properties (CDOT Section 702)
- F. Mixing and compaction temperatures used
- G. Mix properties determined at a minimum of four asphalt cement contents and graphs showing the mix properties versus asphalt cement content
- H. Properties at the optimum asphalt cement content
- I. Lottman test data at the optimum asphalt cement content

The City reserves the right to verify the proposed mix design for each HMA pavement grading utilizing materials actually produced and stockpiled. If requested by the City, a sufficient quantity of each aggregate, mineral filler, RAP, and additive for the required laboratory tests shall be provided. The City may request a Certificate of Conformance or Certificate of Compliance at any time on any material used.

9.4.3 Change in Source or Grade

Should a change in the source lime occur, or more than one temperature grade change on either the high or low end of asphalt cement (AC) occur, a one point verification test (at optimum

asphalt content) of the mix must be performed to verify that the applicable criteria are still met. If this testing shows noncompliance, a new Design Job Mix shall be established before the new AC or lime source is used.

Any change in aggregate type or source will require a new mix design. The one point verification test may be performed on lab mixed samples or on plant mixed samples.

9.4.4 Mix Verification

Production verification shall occur prior to the start of the project. The production verification shall be performed by LABCAT Level C accredited technicians to verify the volumetric properties of the mix. If the mix has been produced for another project within the last 90 days, data from that project can be submitted for this verification.

9.5 EQUIPMENT

9.5.1 Mixing Plant

The mixing plant shall be capable of producing a uniform material, have adequate capacity, and be maintained in good mechanical condition. Defective parts shall be replaced or repaired immediately if the adversely affect the proper functioning of the plant or plant units, or adversely affect the quality of the hot bituminous plant mix.

Dust, smoke, or other contaminants shall be controlled at the plant site to meet all air quality requirements in the “Colorado Air Quality Control Act”, C.R.S. Title 25, Article 7, and regulations promulgated thereunder.

9.5.2 Hauling Equipment

Trucks used for hauling HMA shall have clean beds thinly coated with a minimum amount of paraffin oil, lime solution, or other approved release agent. Petroleum distillates such as kerosene or fuel oil will not be permitted. Each truck shall have a cover of canvas or other suitable material to protect the mixture from the weather and excessive temperature loss or cooled layers of mix in truck.

9.5.3 Bituminous Pavers

Self-propelled pavers shall be provided for full lane width paving, and shall be equipped with a screed assembly, heated if necessary, capable of spreading and finishing the bituminous plant mix material in full lane widths applicable to the typical section and thickness shown in the contract. Pavers used for shoulders, patching, or similar construction not requiring fine grade control shall be capable of spreading and finishing courses of asphalt plant mix material in widths shown in the contract. The paver shall have an automatic distribution system that will place and spread the mixture uniformly in front of the screed.

The paver shall be capable of operating at forward speeds consistent with uniform and continuous laying of the mixture. Stop and go operations of the paver shall be avoided. The screed or strike-off assembly shall produce the specified finish surface without tearing, shoving, or gouging the mixture. Self-propelled pavers shall be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor shall be constructed to

operate from either or both sides of the paver and shall be capable of working with the following devices when they are required for the situation:

- A. Ski-type device at least 30 feet in length
- B. Short ski or short shoe
- C. At least 5,000 feet of control line and stakes

The controls shall be capable of maintaining the screed at the specified transverse slope within +/- 0.1%. Automatic mode should be used where possible. If the automatic controls fail or malfunction, the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained.

Paving operations shall be suspended until satisfactory corrections, repairs, or equipment replacements are made if the specified surface tolerances are not maintained.

Placement of HMA on a waterproofed bridge deck shall be accomplished with equipment that will not damage the membrane protective covering.

9.6 MANUFACTURE

9.6.1 Preparation of Aggregates

Heating and drying of aggregates shall be accomplished without damaging the aggregate. Lime shall be added to achieve complete and uniform coating of the aggregate. When hydrated lime is used, it shall be added to the aggregate in accordance with one of the following methods:

- A. Lime Slurry: The hydrated lime shall be added to the aggregate in the form of a slurry and then thoroughly mixed in an approved pugmill. The slurry shall contain a minimum of 70% water by weight.
- B. Dry Lime: The dry hydrated lime shall be added to wet aggregate and then thoroughly mixed in an approved pugmill.

The lime-aggregate mixture may be fed directly into the hot plant after mixing it or it may be stockpiled for not more than 90 days before introduction into the plant for mixing with the asphalt cement. The hydrated lime maybe added to different sized aggregates and stockpiled, by adding 75% of the lime to the aggregate passing the No. 4 sieve and 25% of the lime to the aggregate retained on the No. 4 sieve.

9.6.2 Mixing

The dried aggregates and asphalt cement shall be combined in the mixer in the quantities required to meet the design job mix. The materials shall be mixed until the aggregate is completely and uniformly coated, and the asphalt cement is uniformly distributed throughout the aggregate. Baghouse fines shall be fed back to the mixing plant in a uniform and continuous manner so as to maintain uniformity in the mixture. The baghouse, fines feeder, auger, and related equipment shall be in good working condition and operated in accordance with manufacturer's recommendations.

The mixture temperature shall conform to the requirements of the following table.

Table 9.6.2 Mixture Temperatures

Asphalt Grade	Minimum Discharge Temperature	Maximum Discharge Temperature	Minimum Delivered Temperature*
PG 58-28	275°F	305°F	235°F
PG 64-22	290°F	320°F	235°F
PG 76-28	320°F	350°F	280°F

* Delivered mix temperature shall be measured behind the paver screed.

HMA shall be produced at the lowest temperature within the specified temperature range that produces a workable mix and provides for uniform coating of aggregates (95% minimum in accordance with AASHTO T 195), and that allows the required compaction to be achieved.

HMA may be stored provided that any and all characteristics of the mixture are not altered by such storage. If storing or holding the mixture causes separation, excessive heat loss, or adversely affects the quality of the finished product, storage will not be allowed and unsuitable mixture shall be rejected.

When placing hot bituminous mixture over bridge decks covered by waterproofing membrane, the minimum temperature of the mixture when rolling operations begin shall be 250°F. The job mix temperature may be increased up to 30°F to obtain this temperature.

9.6.3 Hauling and Delivery

Each truck shall use covers to protect the mix during transport in cold weather, dust storms, or precipitation. A load of mix that is delivered with improper gradation, thermal segregation, or temperature below the specified minimum delivered temperature shall be rejected. Delivered mix temperature shall be measured behind the paver screed.

9.7 TACK COAT

Prior to placement of HMA, a tack coat shall be applied to all existing concrete and asphalt surfaces. A tack coat shall be used when the surface to be overlaid is old, glazed, dried out, or subjected to dust or traffic film. If the surface of the first course is contaminated by sand, dust, or foreign material deposited by traffic or wind, brooming alone is not acceptable. A very light tack coat should be applied after brooming has been completed.

The material shall be in accordance with Section 11.2.5. The emulsified asphalt shall be diluted 1:1 with water and applied at 0.10 +/- 0.01 gallons per square yard of diluted material. The City may direct other application rates to match the age or condition of the surface.

The surface to receive the tack coat shall be dry and cleaned by sweeping or other approved method until dust, debris, and foreign matter are removed. The surface shall be cleaned such that the tack coat bonds adequately to the entire surface and to the upper asphalt lift. The tack coat shall then be applied uniformly by squeegee, brooms, or distributor. Prior to paving, the tack

must be allowed to break, meaning that all water must have evaporated. Contaminated areas shall be cleaned and tack coat shall be reapplied.

9.8 PLACEMENT

HMA shall be placed only on approved, properly constructed surfaces that are free from loose material, water, frost, snow, or ice. HMA shall be placed in accordance with the air and surface temperature limitations shown in the table below and only when weather conditions permit the pavement to be properly placed and finished as determined by the City.

Contact surfaces of curbs, gutters, manholes, and other structures shall be tack coated prior to placing asphaltic concrete adjacent thereto.

Asphaltic concrete, to provide in place compacted thickness of four (4) inches or less, shall be placed and stuck off by means of bituminous pavers. Use of spreader boxes to place the bituminous mixture shall be limited to asphaltic sidewalks or trails, trench patching, and the bulbs of cul-de-sacs. Black base bituminous mixtures, whose in place compacted thickness is to be greater than four (4) inches and less than seven and one half (7.5) inches, may be uniformly spread using a patrol.

Along the lip lines of gutters and crosspans, sufficient bituminous material shall be deposited so that after compacting, the wearing surface will remain not less than 1/8" nor more than 1/4" above the concrete. For median curb wearing surface will be from 1/4" to 1/2" below concrete.

Placement temperature stated shall be increased by 5°F for each 10 miles per hour wind velocity to a maximum increased minimum placement temperature of 70°F.

Table 9.8 Minimum Air and Surface Temperatures Limitations for Mix Placement

Compacted Layer Thickness	Top Layer of Pavement*		Lower Layers*	
	PG 58-28/PG 64-22	PG 76-28	PG 58-28/PG 64-22	PG 76-28
< 2"***	60°F	75°F	(not applicable)	(not applicable)
2" - < 3"	50°F	65°F	40°F	50°F
≥ 3"	50°F	50°F	40°F	40°F

* Air temperature is taken in the shade. Surface temperature is taken on the subgrade or base.

*** Layer thickness < 2 inches is not allowed for superpave mixes.

Placement temperature should not be less than the specified minimum delivered temperature shown in the table in Section 11.6.2. The mixture shall not be placed at a temperature lower than 245°F for mixes containing PG 58-28 or PG 64-22 asphalt, and 290°F for mixes containing polymer modified asphalt. Mix which is too cold or damaged by weather will be rejected.

The mixture shall be laid upon an approved surface, spread or struck off to obtain the required grade and elevation after compaction. The minimum lift thickness shall be at least three times (preferably four times) the nominal particle size. The mixture should be placed approximately

25% thicker than the existing surrounding mat thickness 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 causes any segregation will not be permitted.

On areas where the use of mechanical spreading and finishing equipment is impracticable, the mixture shall be carefully dumped, spread, raked, screed, and luted by hand tools to the required compacted thickness plus 25%. Carefully move or minimally work the MHA with the use of rakes, lutes, or shovels to avoid segregation. Mixtures made with modified asphalt cement require more rapid completion of handwork areas than for unmodified mixtures. Hauling and placement sequences shall be coordinated so that the paver is in constant motion. Excessive starting and stopping shall not be allowed. A construction joint shall be placed at any tie the paver stops, and the screed drops enough to cause a surface dip in violation of Section 11.13.1, Surface Tolerances, or the mat temperature falls below the breakdown temperature allowed in Section 11.12, Compaction. Bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable. Echelon paving will be permitted.

Variation between any two (2) contacts with the surface shall not exceed 3/16" in 10 feet. All lumps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material as directed.

During placement and compaction of plant mix bituminous pavement, observation and testing shall be on a full-time basis. For each 1,000 tons of material placed or at least one for each day of production, a field sample shall be taken and subjected to Marshall or Rice extraction and gradation analysis. Also, determination of the VMA for the mix is required and bulk specific gravity testing shall be performed on aggregate obtained from stockpiles at the plant.

Mix temperatures will be checked on each truck and where the temperature does not meet standards, the load shall not be placed. Regardless of job mix temperatures, the mixture shall not be delivered for use on the roadway at a temperature less than 235°F, or 260°F for rubberized asphalt (per CDOT). In no case shall asphalt be placed with air or surface temperatures less than 40°F, otherwise reference Table 401-3, CDOT Section 401.

During compaction, the density of the pavement shall be checked randomly, for information only, at the rate of one test for each 500 lineal feet of travel for each lift. Either during or after completion of the paving, the final pavement thickness and density shall be determined for the plant mix bituminous pavement using coring, rings, or other acceptable methods. Thickness determinations shall be made at random locations at intervals of approximately 500 feet in each travel lane as determined and marked by the City. Coring must be completed in the presence of the City representative.

9.9 LONGITUDINAL JOINTS

9.9.1 Joint Placement

The longitudinal joints in both a new pavement and an overlay pavement layer shall offset the

joint in the layer immediately below by a minimum of 6 inches. The joints in any pavement layer shall not fall in a wheel track or path. The joints in the top layer of a new pavement not built on top of an existing pavement shall be located on lane lines, or as shown on plans. Longitudinal joints shall be minimized where feasible with wide paving pulls or echelon paving. Joints shall not cross any centerline, lane line, or edge line unless approved by the Engineer.

Longitudinal joints in wearing surface layer shall be hand luted and provide a uniform transition, after compacting, between passes with the paving machine. Longitudinal joints in the wearing surface shall generally be located as follows:

- A. For two lane roadways: at the centerline of the pavement and at the outside edge of the traveled lanes.
- B. For roadways of more than two lanes: at the lane lines and at the outside edge of the travel lanes.

The contractor shall submit, prior to paving, a joint plan and pavement marking plan showing locations and the methods to field establish a control line. The City must approve such plan prior to paving. The contractor shall use a continuous string line to delineate longitudinal joints during paving as shown on the joint plan. All string line shall be removed at the end of each day's paving.

9.9.2 Joint Construction

When shown by a detail in the standards or on the plans, longitudinal joints shall be constructed using a 1 inch vertical face and a 3:1 taper. The free edge of the paved pass shall be laid as straight as possible, to the satisfaction of the City. This joint, if cold, shall be tack coated prior to placement of adjacent paving.

The new compacted mat shall overlap the previously placed mat no more than 1.5 inches. Excess overlap or thickness shall not be raked or cast onto the new mat, but shall be wasted by pulling back and removing. The hot edge shall be blocked or bumped in a smooth line consistent with the previous longitudinal edge. Minor raking will only be allowed to correct major grade problems or provide mix around manholes and meter covers. The longitudinal joint shall be rolled from the hot side, and overlap the joint by approximately 6 inches on the cold side.

9.10 TRANSVERSE JOINTS

The contractor shall submit, prior to paving, a joint plan showing locations and the methods to be used to construct transverse joints. The City must approve such plan prior to paving. Placing of the HMA shall be continuous with a minimum of transverse joints, and rollers shall not pass over the unprotected end of a freshly laid mixture. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the course. Tack coat material shall be applied to contact surfaces of all joints just before additional mixture is placed against the previous compacted material.

The end of transverse joints shall be located such that they will be constructed with a full head of mix in front of the screed. When butt joints are constructed, runoff boards shall be used to

support the roller on the downstream side of the joint. All tapered sections, rounded edges, and segregated areas shall be removed to achieve a vertical face at the butt joint before paving is restarted.

When a tapered joint is required for traffic access, the ramp shall be removed back to a full depth from segregated section before paving is restarted.

When restarting paving operations, the paver screed shall be placed on starter block on the completed side of the transverse joint. Starter block should be approximately 25% of the thickness of the existing completed mat, so that adequate grade and compaction can be achieved on starting the paving operation. The screed should be nulled (angle removed) when on starting blocks and an up angle of attack set. Proper head of mix should be introduced into the paver prior to starting. The new compacted (downstream) side of the joint may be up to 3/16 inch higher than the old (upstream) side. Raking of this joint shall not be allowed except to correct major grade problems. The surface tolerance at the transverse joint must be verified with a 10-foot straight edge before the paver is more than 100 feet from the joint.

9.11 SEGREGATION

The asphalt mixture shall be transported and placed on the roadway without segregation. All segregated areas shall be removed immediately and replaced with specification material before initial rolling. If more than 50 square feet of segregated pavement is removed and replaced in any continuous 500 linear feet of paver width laydown, operations shall be discontinued until the source of the segregation has been determined and corrected.

The City will visually determine areas that are segregated, and may also use density and gradation measures to help in this determination. The City will visually determine the extent of segregation. The contractor will not be allowed additional compensation for correction of segregated areas.

9.12 COMPACTION

The temperature of the mixture immediately behind the screed is shown in Section 11.6.2. The breakdown compaction shall be completed before the mixture temperature drops 20°F.

The HMA shall be compacted by rolling. The number, weight, and type of rollers furnished shall be that which is sufficient to obtain the required density and surface texture while the mixture is in a workable condition. Compaction shall begin immediately after the mixture is placed and be continued until the required density is obtained. Final compaction shall be obtained using steel wheel rollers.

On all lifts of asphaltic concrete, breakdown rolling shall immediately follow the spreading sequence using a steel wheeled drum roller followed by rubber tired rollers, free of recapped tires, then followed by steel wheel finish rolling. Rolling shall start at the sides and proceed longitudinally parallel with the street centerline, each trip overlapping one-half (1/2) of the roller

width, gradually progressing to the crown of the street. Rolling shall be continued until all roller marks are eliminated and a minimum density of ninety-five percent (95%) of Marshall density (ASTM D 1559) or between 92%-96% of maximum theoretical density of a laboratory specimen made in the proportions of the job mix formula determined according to Colorado Procedure #51 has been obtained. Field density determinations will be made in accordance with Colorado Procedure #44 and #81. Use of vibratory rollers with the vibrator on shall not be allowed during course final rolling.

If the required density is not achieved and the surface temperature falls below 185°F, or there is obvious distress or breakage, no further compaction effort will be permitted unless approved by the City. The criteria for mixtures containing PG 76-28 asphalt cements shall be 235°F. These minimum compaction temperatures may be adjusted according to the asphalt cement supplier recommendations. Adjusted minimum compaction temperatures must be shown on the approved mix design. Pavement operations shall be suspended when density requirements are not met, and the problem shall be resolved prior to continuing paving operations.

All roller marks shall be removed with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted on any bridge decks.

A rolling pattern or procedure shall be established during the beginning of paving operations, which will achieve the required compaction and surface tolerances. This procedure may be re-evaluated throughout the paving operations.

All HMA paving shall be compacted to a density of 92%-95% of maximum theoretical density (Rice; CP-51, Maximum Specific Gravity of Bituminous Paving Mixtures) with the average (mean) of five random and consecutive density tests equaling at least 93% of CP-51. If more than three random density tests fall below 93% of CP-51, corrective measures shall be taken by the contractor. Compaction of less than 90% of CP-51 will be cause for removal and replacement. The average (mean) of the three most recent production CP-51 Rice values shall be used in calculating relative compaction according to CP-44.

The Contractor will core pavement on City projects (unless otherwise noted) and the contractor/developer will be required to core the pavement on private developer projects in order to obtain filed density tests in accordance with Colorado Procedure #44, Method B (AASHTO T 230), or for field calibration of nuclear density equipment in accordance with the Appendix of Colorado Procedure #81 (ASTM D 2950). The contractor shall tack, fill, and compact all core holes. Coring shall be completed for every 500 lane feet. Untested areas during placement will also require cores to be taken to verify compaction.

Along forms, curbs, headers, walls, and all other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers.

9.13 PRODUCTION TOLERANCES

9.13.1 Surface Tolerances

The variation between any two contacts with the surface shall not exceed 3/16 inch in 10 feet. Irregularities exceeding the specified tolerance shall be corrected at the contractor's expense. Transverse measurements for variation shall exclude breaks in the crown section.

9.13.2 Plant Production Criteria

The plant produced mix may be tested by the City for conformance with the allowable mix production range, moisture susceptibility, stability and/or flow, and volumetric criteria at a testing frequency to be designated by the City. If two consecutive production samples fail to meet any of these criteria and show no correlation to the mix design, the contractor shall take corrective action and verify compliance with the criteria before continuing production. Measures taken to bring the mix into compliance shall be submitted to the Engineer prior to continuing production.

9.13.3 Job Mix Formula Tolerances

Production test results that deviate from the design job mix by more than the following tolerances are subject to Section 11.14, Payment Reduction.

Job Mix Formula Tolerances

Passing No. 3/8" and Larger*	+/- 6%
Passing No. 4 and No. 8	+/- 5%
Passing No. 30	+/- 4%
Passing No. 50	+/- 3%
Passing No. 200**	+/- 2%
Air Voids	+/- 1.2%
VMA	+/- 1.2%
Hveem Stability***	(see note)
Asphalt Cement	+/- 0.3%
Asphalt Content, Mixes with > 10% RAP	+/- 0.4%

* There is 1.0% tolerance for the maximum sieve size.

** Mixes with No. 200 sieve material produced over 7.0% are allowed only when air voids are kept within 1.2% of the air voids at mix design optimum and VMA still meets requirements.

***Hveem stability must meet the minimum value specified in Section 11.3.4.

When disagreements concerning determination of specification compliance occur, only valid tests from both the City and contractor will be considered. The City shall determine validity. Generally, valid tests are those in which sampling and test have been performed according to referenced procedures and the results are within the stated precision statements. When disagreements occur with asphalt content and gradation test results, solvent extracted aggregate testing shall take precedence over burnoff oven extracted aggregate, which shall take precedence over cold feed belt testing.

9.14 PAYMENT REDUCTION

All work performed and all materials furnished shall conform to the lines, grades, cross sections,

dimensions, and material requirements, including tolerances, shown in these standards. For those items of work where working tolerances are not specified, the contractor shall perform the work in a manner consistent with reasonable and customary manufacturing and construction practices.

When the City determines that the material furnished, work performed, or the finished product is not in conformity with the contract and has resulted in inferior or unsatisfactory product, the finished product or materials shall be removed and replaced or otherwise corrected by and at the expense of the contractor, unless the Engineer determines that the work can be accepted at a reduced price. Payment reduction, when allowed, shall be accomplished by adjusting pay quantities as indicated herein and applying contract unit prices to the reduced quantities. If allowed, the City shall:

- A. Document the basis for acceptance by “Cure Notice” which shall provide for an appropriate adjustment in the payment quantity for such work or materials not otherwise provided for in this section.
- B. Notify the contractor in writing that the payment shall be adjusted in accordance with this section when P is 25 or less.
- C. In lieu of payment (quantity) adjustment, permit correction or replacement of the finished product provided the correction or replacement does not adversely affect the work or the City.

Materials shall be sampled and tested by a qualified testing laboratory in accordance with the sampling, testing schedules, and procedures contained in Section 11.15, Testing and Inspection. The approximate quantity represented by each sample shall be as set forth in the testing schedule. An additional number of samples, in relation to the quantity of materials represented, may be selected and tested at the City’s discretion. The quantity represented by five consecutive random samples shall constitute a lot, whenever production schedules and material continuity permits. When it is necessary to represent short production runs, significant material changes, or other unusual characteristics of the work, the City may establish a lot consisting of the quantity represented by any number of consecutive random samples from one to seven inclusive. Testing results that are determined to have sampling or testing errors, as determined by the City, shall not be used.

Material or work shall only be evaluated for price adjustment when deviations from standards occur on any of the individual tests for the lot. The several individual test values shall be averaged and the percentage of payment (quantity) reduction for the lot shall be determined by applicable formula. This shall apply only when a payment reduction factor for the element is listed in the payment reduction factor table of this section. The formulas below shall be used only when the lot is represented by three to seven tests inclusive.

- A. $P = (X_n + aR - T_U) * F$ Shall be used if a maximum limit only is specified or when the average of the several test values is above the midpoint of the specification band or above the job mix formula value.
- B. $P = (T_L + aR - X_n) * F$ Shall be used if the minimum limit only is specified or when the average of the several test values is below the midpoint of the specification band or below the job mix formula value.

C. When the lot is represented by fewer than three tests, the materials shall be evaluated for cost (quantity) reduction by the following procedure. Lots represented by two tests shall be divided into two separate lots represented by one test each, as determined by the City. Each lot that deviates from the standards shall be cost adjusted by one of the following formulas.

$P = 0.76 * (T_O - T_U) * F$ When a maximum limit only is specified or the test value is above the maximum specified limit.

$P = 0.76 * (T_L - T_O) * F$ When a minimum limit only is specified or the test value is below the minimum specified limit.

P	Percentage of reduction in payment quantity	
X _n	Average of the several test values from samples taken from the lot with “n” indicating the number of values	
a	Variable factor to be used in “n” changes according to the following:	
	n	a
	3	0.45
	4	0.38
	5	0.33
	6	0.30
	≥ 7	0.28
R	Difference between the highest and lowest values in the group of several test results from the lot	
T _U	Upper or maximum tolerance limit permitted by the standards	
T _L	Lower or minimum tolerance limit permitted by the standards	
T _O	Test value of the test that deviates from the standards	
F	Cost reduction factor to be applied for each element as shown in the following table	
	Element	F
	100% size sieve	1
	½” sieve and larger	1
	No. 100 sieve to 3/8” sieve inclusive (except 100% size sieve)	3
	No. 200 sieve	6
	No. 200 sieve (cover coat material)	25
	Density of Bituminous Mixture	8
	Asphaltic Cement Content (all asphalt-aggregate mixtures)	20
	Total Air Voids	30
	Voids in Mineral Aggregate	20
	Stability	5

If “P” is less than ten, or a negative quantity, the material shall be accepted as being in conformity. In cases where one or more elements show a positive “P” value, such positive values

shall be added and the resulting sum shall be used to determine whether the material is in conformity. If the total “P” value is between 10 and 25, the City may require correction or may accept the material at a reduced cost. If “P” is greater than 25, the City may:

- A. Require complete removal and replacement with specification material at no additional cost to the City.
- B. Require corrective action to bring the material into conformity at no additional cost to the City.
- C. Where finished product is found to be capable of performing the intended purpose and the value of the finished product is not affected, permit the contractor to leave the material in place with an appropriate cost adjustment to be based on the City’s evaluation but not to be less than that which would have occurred had an adjustment been made where $P = 25$.

When aggregate sieve analysis for aggregate base course deviates from the specification requirements and the total “P” is ≥ 3 , the reduction shall apply to the contract cost (quantity) multiplied by 0.60.

If asphaltic cement content, aggregate sieve analysis, or compaction deviates from the specification requirements and the total “P” is ≥ 3 , the reduction shall apply to the contract cost (quantity) multiplied by 0.60 for aggregate base course and HMA.

Payment adjustment for those elements that are not included in the table of payment reduction factors shall be determined by the City.

The contractor shall not have the option of accepting a payment reduction in lieu of producing the specification material. Continued production of non-specification material shall not be permitted. Material that is obviously defective shall be isolated and rejected without regard to sampling sequence or location within a lot.

For thickness deficiencies, payment reductions shall be per lot, based upon a lot encompassing 250 lineal feet or the quantity between tests, and shall be at the cost of the entire pavement system. The entire pavement system shall include only those items placed as part of this contract and those items impacted: mobilization, traffic control, subgrade preparation, pavement materials and installation, striping, and traffic signal loops need be considered.

Table 9.14 Payment Reduction – Thickness

Price Reduction	0%	25%	45%	Remove and Replace
Thickness Deficiency	0-0.5 inch	0.5-1.0 inch	1.0-1.5 inches	> 1.5 inches

9.15 TESTING AND INSPECTION

The Contractor shall be responsible for checking temperatures of mix in truck and on pavement,

segregation, rolling patterns, and other construction means and methods which affect performance of the pavement system. The contractor shall provide assistance in sampling and testing at all facilities and at the job site.

Testing of HMA shall be performed in accordance with the following table. Testing shall be performed by a qualified geotechnical engineer working under the direction of a geotechnical engineer licensed in the State of Colorado and shall be paid for by the contractor/developer on private projects. Testing will be performed and/or paid for by the City on City projects unless otherwise noted in the special conditions for the City project.

Table 9.15 Schedule for Minimum Materials Sampling and Testing

Test	Standard	Minimum Frequency
In Place Density	ASTM D 1188, D 2950	One test for each 500 lineal feet per layer of HMA per lane alternating lanes
Thickness and Density (Core)	AASHTO T 166 ASTM D 3549	One test for each 500 lineal feet per lane alternating lanes
Air Voids and VMA	AASHTO T 269 ASTM D 3203	One test for each mix design
Gradation	AASHTO T 27 ASTM C 136	One test for each day or 1,000 tons placed
Hveem/Marshall Stability	AASHTO T 245, T 247, T 166 ASTM D 1559, D 1561	One test for each mix design
Asphaltic Content	AASHTO T 164, T 269, TP53 ASTM D 2172, D 3203, PS90	One test for each day or 1,000 tons placed
Maximum Theoretical Specific Gravity (Rice)	AASHTO T 209 ASTM D 2041	One test for each day or 1,000 tons placed

9.16 MEASUREMENT

HMA shall be measured based by the delivered tons of accepted material, complete in place on City projects.

9.17 PAYMENT

Haul, aggregate, asphalt cement, asphalt recycling agent, additives, lime, tack coating, and all work necessary to complete each hot bituminous pavement item shall be included in the unit bid price and will not be paid separately on City projects.

Pay items for patching on City projects shall be complete in place to include sawcutting, removal of existing asphalt, excavation to subgrade of the specified patch section, tack coating, placement of new hot bituminous pavement material, and compaction.

The pay items for overlaying on City projects shall be complete in place to include sweeping and tack coating of existing bituminous pavement.

CHAPTER 10: SURFACE TREATMENTS

10.1 INTRODUCTION

The work to which these specifications apply shall consist of applying slurry seal, micro-surface, chip seal, hot chip seal or crack sealant material to residential and collector pavements. The pay item for seal coats and crack seal shall include surface preparation, notification, traffic and parking control, mobilization and all other work not specified as separate pay items. These Specifications shall apply to all new construction within the City.

10.2 MATERIALS

10.2.1 Slurry Seal Asphalt Emulsion

The emulsified asphalt shall be a quick setting, cationic type conforming to the requirements of ASTM specification for CQS-1hL (latex polymer modified) emulsion. Polymer modified asphalt emulsion shall contain 1.0%, by weight, of styrene-butadiene rubber (SBR) polymer solids by weight of residual asphalt. Residual asphalt shall range between 7.5 and 13.5 percent by weight to dry aggregate.

10.2.2 Tack Coat for Slurry Seal and Micro-surfacing

Tack coat shall be CSS-1h emulsified asphalt thinned to a mixture of one part emulsified asphalt and three parts potable water.

10.2.3 Micro-surfacing Asphalt Emulsion

The emulsified asphalt shall be a quick setting, cationic type conforming to the requirements of ASTM specification for CQS-1hP (latex polymer modified) emulsion. Polymer modified asphalt emulsion shall contain 3.0% to 3.5%, by weight, of styrene-butadiene rubber (SBR) polymer solids by weight of residual asphalt. Residual asphalt shall range between 7.5 and 13.5 percent by weight to dry aggregate.

10.2.4 Chip Seal Asphalt Emulsion

The emulsified asphalt shall be a rapid setting, cationic type conforming to the requirements of ASTM specification for CRS-2P (latex polymer modified) emulsion. Polymer modified asphalt emulsion shall contain 3.0% to 3.5%, by weight, of styrene-butadiene rubber (SBR) polymer solids by weight of residual asphalt. Residual asphalt shall range between 7.5 and 13.5 percent by weight to dry aggregate.

10.2.5 Hot Cover Coat Asphalt

Asphalt material shall be AC 20 and asphalt content shall be 5.0% to 5.5%.

10.2.6 Fog Seal

The emulsified asphalt shall be a rapid setting, cationic type conforming to the requirements of ASTM specification for CRS-2P (latex polymer modified) emulsion. Polymer modified asphalt emulsion shall contain 3.0% to 3.5%, by weight, of styrene-butadiene rubber (SBR) polymer solids by weight of residual asphalt. Residual asphalt shall range between 7.5 and 13.5 percent by weight to dry aggregate. Emulsion shall be diluted to one part CRS-2P to one part potable water.

10.2.7 Crack Sealant

Crack sealant shall be Elastoflex 500 as manufactured by Maxwell Products, Inc. or Engineer approved equal. Elastoflex 500 is a polymer modified, hot applied, non-tracking asphalt conforming to the requirements of ASTM D3405 or ASTM D1190. Sealant shall not contain vulcanized or reclaimed rubber.

10.2.8 Slurry Seal and Micro-surfacing Aggregate

Screening of aggregate shall be required at the stockpile prior to delivery to the paving machine. Presence of oversized granular material shall be grounds to stop work on the project until compliance with these Specifications is demonstrated to the Engineer.

Aggregate shall be free of clay lumps and other deleterious material. Presence of clay lumps in the aggregate shall be grounds to suspend operations until compliance with these Specifications is demonstrated to the Engineer.

Mineral fillers such as Portland cement, limestone dust, lime fly ash and others shall be considered as part of the blended aggregate and shall be used in the minimum amount required by the mix design. Mineral filler limits shall be 0.50% to 3% of dry weight of the aggregate. Mineral fillers shall be manufactured in the same year as the project.

Mineral fillers shall be used for the following purposes:

1. To improve the gradation of the aggregate.
2. To control the time of break and the set time of the emulsion.
3. To provide improved stability and workability.
4. To increase the durability.

10.2.9 Aggregate

Aggregate shall have the following gradation and application rate:

Table 10.2.9 Aggregate Gradation and Application Rate

	Slurry Seal	Micro-surfacing	Chip Seal	Hot Cover Coat
	Type II	Type III		
SIEVE SIZE	Percent Passing	Percent Passing	Percent Passing	Percent Passing
1/2"	--	--	90-100	90-100
3/8"	100	100	0-50	60-90
No. 4	90-100	70-90	0-10	25-35
No. 8	65-90	45-70	0-3	15-25
No. 16	45-70	28-50	--	--
No. 30	30-50	15-35	--	--
No. 50	18-30	10-25	--	--
No. 100	10-21	7-18	--	--
No. 200	5-15	5-10	0-2	3-8
APPLICATION RATE	17-19 pounds per square yard	20-25 pounds per square yard	20-25 pounds per square yard	60-80 pounds per square yard

The mineral aggregate shall consist of 100 percent crushed gray granite as supplied by the Asphalt Paving Company quarry at 6959 Highway 93, Golden, Colorado or an approved equal. The aggregate shall have a maximum 15% loss when tested for soundness in accordance with ASTM C88 and a maximum 35% loss when tested for hardness in accordance with ASTM C131.

10.2.10 Water

Water used for the slurry seal and micro-surfacing shall be potable and the amount used shall take into account the moisture content of the aggregate when calibrating the slurry machine to deliver asphalt in the correct proportion.

10.2.11 Mix Design for Slurry Seal and Micro-surfacing

The mix design shall be submitted two weeks prior to start of work. A qualified independent testing laboratory shall prepare the mix design at the Contractor's expense. The mix design shall include sources of all materials and testing data by a qualified laboratory, verifying conformance with these Specifications. Only minor field changes to the mix design will be permitted without retesting and approval by the laboratory preparing the mix design.

The Contractor shall provide a mixture with curing properties that will allow the roadways to be opened within 3 hours of material placement. The amount of asphalt emulsion to be blended with the aggregate shall be that as determined by laboratory mix design subject to final adjustment in the field and the Engineer's approval. A minimal amount of water may be added as necessary to obtain a fluid and homogeneous mixture. The mixture shall be sufficiently stable during the entire mixing-spreading period that the emulsion does not break in the spreader box, that there is no segregation of fines from the coarser aggregate and that the liquid portion of the mix does not float to the surface. The mixture shall be homogeneous during mixing and spreading and free of excess water. The residual asphalt content by dry weight of the aggregate should not vary plus or minus 1.5 percent from the rate determined by laboratory design and final field adjustment.

10.2.12 Mix Design for Hot Cover Coat

The mix design shall be submitted two weeks prior to start of work. A qualified independent testing laboratory shall prepare the mix design at the Contractor's expense. The mix design shall include sources of all materials and testing data by a qualified laboratory, verifying conformance with these Specifications. Only minor field changes to the mix design will be permitted without retesting and approval by the laboratory preparing the mix design.

10.2.13 Crack Sealant Submittals

Sealant material shall be approved by the Project Engineer prior to the start of work. Submittals shall include, but may not be limited to, manufacturer's technical data and testing data by ASTM standards, descriptive information and application instructions. Certified test results by a commercial or State Highway testing laboratory verifying conformance of the material by batch, lot or other identification number to the requirements of the project Specifications may be required.

10.3 CONSTRUCTION PRACTICES

10.3.1 Slurry Seal and Micro-surfacing

- A. Equipment - All equipment, tools, and machines used in the performance of this work shall be maintain in satisfactory working order at all times. Descriptive information on the mixing and applying equipment to be used shall be submitted for approval not less than 7 days before the work starts.

1. Mixing Equipment:

The mixing machine shall be a continuous flow mixing unit, capable of delivering accurate predetermined proportions of aggregate, mineral fillers, water and asphalt emulsion to a revolving multi blade mixer tank, and of discharging the thoroughly mixed product on a continuous basis. The machine shall be capable of mixing materials in preset proportions regardless of the speed of the machine engine, and without changing machine settings. The spreader box shall be furnished with a full width burlap drag.

The aggregate shall be pre-wetted immediately prior to mixing with the emulsion. The mixing unit shall be capable of thoroughly blending all ingredients together without violent action. The mixing machine shall be equipped with suitable means of accurately metering each individual material being fed into the mixer, so the machine can be accurately calibrated and that the quantities of material used during any one period can be accurately totaled.

The mixing machine shall be equipped with a water pressure system, and fog type spray bar adequate for completely fogging the pavement surface with up to 0.55 gallons per square yard, immediately ahead of the spreading equipment.

2. Spreading Equipment:

The spreader box shall be equipped to prevent loss of mixture from all sides and shall have a flexible rear strike-off screed. It shall be capable of producing a uniform surface over its full width. The ability to regulate width of placement of new material is a desirable feature. It shall have suitable means for side tracking to compensate for deviations in pavement geometry. Drags shall be kept in a completely flexible condition at all times. The box shall be kept clean and build-up of asphalt and aggregate shall not be permitted.

3. Cleaning Equipment:

Power brooms, power blowers, air compressors, water flushing equipment and hand brooms shall be suitable for cleaning the base pavement surface and cracks therein.

- B. Preparation of Surface - The City will be responsible for any pavement repairs, crack filling or necessary tree trimming prior to Contractor's operations. The Contractor shall be responsible for removing vegetation, cleaning cracks larger than 1/4 inch, hand cleaning work and removing loose debris by power sweeping the streets immediately prior to placement of the material.

Immediately prior to applying the material, the Contractor shall notify the Engineer for an

inspection and approval that the surface has been prepared properly. The Contractor will be responsible for a properly cleaned condition of the street whether the Engineer approves the surface or not.

- C. Tack Coat - A tack coat shall be applied to concrete pavement, chip sealed surfaces, surfaces that are polished and slick or when directed by the Engineer in accordance with CDOT Section 407. Tack coat shall be applied immediately prior to application of the material. Tack shall be applied by an asphalt distributor truck at the rate of 0.10 gallons per square yard. Payment for tack coat shall be made separately at the contract unit price.
- D. Water Fogging - The surface shall be fogged with potable water directly preceding the spreader except where a tack coat was applied.
- E. Application - The slurry mixture shall be of the desired consistency as it leaves the mixer and no additional elements shall be added in the spreader box. A sufficient amount of slurry shall be carried in all parts of the spreader box at all times so that complete coverage is obtained over the application area.

Work hours shall be established at the pre-construction meeting. Each day's application of slurry surfacing shall end with sufficient time to allow for complete curing by the end of the established work hours.

No lumping, balling or unmixed aggregates shall be allowed in the mixer or spreader box. If the coarse aggregate settles to the bottom on the mix, the affected slurry will be removed from the pavement and the problem corrected. No breaking of the emulsion will be allowed in the spreader box. No longitudinal streaks will be allowed in the finished pavement. Any area of longitudinal streaking will be replaced or repaired.

Operators and equipment shall be capable of producing straight lines along curbs and shoulders. No runoff into these areas will be permitted. Overlap onto gutter pans shall not exceed two (2) inches. The Contractor shall remove excessive overlap or runoff. Lines at intersections will be kept straight to provide a neat looking appearance.

1. Joints: Longitudinal joints shall be overlapped no more than 6 inches over previously placed slurry. Building paper shall be used at transverse joints to minimize or eliminate overlap and bumps. No excessive build-up or unsightly appearance shall be permitted on longitudinal or transverse joints. Drags are required and shall be burlap type. Drags must be kept relatively clean and free of excessive build-up. Drags shall be replaced daily or more often at the discretion of the Engineer.
2. Hand Work: Approved squeegees shall be used to spread slurry in areas not accessible to the slurry mixer. Squeegee areas shall be hand finished with a burlap drag prior to breaking of the emulsion. Care shall be taken to leave a pleasing appearance similar to that of

- the machine spreader surface.
3. Curing: The slurry seal mixture shall be cured and the roadway opened to traffic within 3 hours of placement. Each day's application of slurry surfacing shall end with sufficient time to allow for complete curing by the end of normal work hours as set at the pre-construction meeting.
 4. Manholes and Valves: Manholes, water valves and other street appurtenances on streets to be slurry sealed shall be clean during and after the work is completed. They shall be covered in a suitable manner prior to sealing and the covering shall be removed immediately after the street is sealed.
 5. Finish: No streaks, such as those caused by oversized aggregate, will be left in the finished surface. No ripples or chatter marks will be allowed. If these conditions develop, the job will be stopped until the Contractor proves to the Engineer that the situation has been corrected. After lay-down work is completed and before final acceptance by the Engineer, spot application of slurry seal material may be required to correct any deficiencies such as streaking, chattering, scuff marks, tire tracks, gaps, etc., to improve the ride quality and overall appearance. Slurry seal repairs will be made at the Contractor's expense.

10.3.2 Chip Seal

- A. Surface Preparation - Surface preparation shall be in accordance with paragraph 10.3.1 B.
- B. Equipment – Equipment shall be in accordance with Section 409 of CDOT Standard Specifications for Road and Bridge Construction.
- C. Application – CRS-2P shall be applied at a rate of 0.35 to 0.38 gallons per square yard. Application of bituminous material and application of cover coat material shall be in accordance with Section 409 of CDOT Standard Specifications for Road and Bridge Construction. Work hours shall be established at the pre-construction meeting. Each day's application of slurry surfacing shall end with sufficient time to allow for complete curing by the end of the established work hours. The Contractor shall be responsible for cleaning all utility covers following application of chip seal.
- D. Sweeping and Fog Seal – Chip sealed surface shall be swept of loose chips one day following application. After sweeping, surface shall be immediately coated with a fog seal at the rate of 0.10 gallons per square yard. Sweeping and fog seal operations are to be accomplished in such a manner as to provide overnight set on fog seal prior to opening for traffic. Work should be conducted after 7:00 PM with opening of traffic prior to 6:00 AM the next day. If fog seal cannot be applied immediately after sweeping, the street shall be swept again before fog seal.

10.3.3 Hot Chip Seal

A. Equipment - All equipment, tools, and machines used in the performance of this work shall be maintain in satisfactory working order at all times.

1. Chip Seal Equipment

Chip seal equipment shall be in accordance with Section 409 of CDOT Standard Specifications for Road and Bridge Construction.

2. Mixing Plant for Hot Cover Coat

The mixing plant shall be capable of producing a uniform material, have adequate capacity, and be maintained in good mechanical condition. Dust, smoke, or other contaminants shall be controlled at the plant site to meet all air quality requirements in the "Colorado Air Quality Control Act," Title 25, Article 7, CRS and regulations promulgated thereunder.

3. Hauling Equipment for Hot Cover Coat

Trucks used for hauling shall have clean beds thinly coated with a minimum amount of paraffin oil, lime solution, or other approved release agent. Petroleum distillates such as kerosene or fuel oil will not be permitted. Each truck shall have a cover of canvas or other suitable material to protect the mixture from the weather and excessive temperature loss or cooled layers of mix in truck.

4. Bituminous Pavers for Hot Cover Coat

Self-propelled pavers shall be provided for full lane width paving, and shall be equipped with a screed assembly, heated if necessary, capable of spreading and finishing the bituminous plant mix material in full lane widths applicable to the typical section and thickness shown in the Contract.

The paver shall have an automatic distribution system that will place and spread the mixture uniformly in front of the screed.

The paver shall be capable of operating at forward speeds consistent with uniform and continuous laying of the mixture. Stop and go operations of the paver shall be avoided. The screed or strike-off assembly shall produce the specified finished surface without tearing, shoving, or gouging the mixture. Self-propelled pavers shall be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor shall be constructed to operate from either or both sides of the paver.

The controls shall be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent. Automatic mode should be used where possible. If the automatic controls fail or malfunction the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained.

5. Rollers for Hot Cover Coat

Steel wheel rollers shall be used to seat the hot cover coat material.

B. Application - Chip seal application, to include sweeping and fog seal, shall be in accordance with paragraph 12.3.2 of these Specifications.

Hot cover coat shall be applied within 5 days of the chip seal application. The material shall have a minimum temperature of 275 degrees F at placement and be applied in a ½” thick layer. A minimum of two steel wheel rollers making two or more passes shall follow immediately to seat and cool the material. The Contractor shall be responsible for cleaning all utility covers following application of hot cover coat.

10.3.4 Crack Seal

A. Surface Preparation

Two weeks prior to filling of cracks, a weed killer shall be applied to all cracks containing weeds. Such weed killer shall be approved by the City prior to application. No separate payment will be made, but shall be included in the other items of work. Cracks to be filled shall be dry and cleaned of loose and foreign matter to a depth of approximately twice the crack width immediately prior to sealant application. Cleaning and drying shall be accomplished using a hot compressed air lance. The air lance shall be equipped with a bonnet or shield to minimize the amount of flying debris and shall be directed toward the street, away from private properties. The Contractor shall sweep and clean blown material off sidewalks on the same day that cracks are cleaned and dried. The City shall coordinate and perform street sweeping after crack sealant operations are complete.

B. Sealant

Sealant material shall be supplied pre-blended, pre-reacted, and pre-packaged. If supplied in solid form, the sealant material shall be cast in a plastic or other dissolvable liner having the capability of becoming part of the crack sealant. Sealant shall be delivered in the manufacturer's original sealed container. Each container shall be legibly marked with the manufacturer's name, the trade name of the sealer, the manufacturer's batch or lot number, the application temperature range, the recommended application temperature and the safe heating temperature. Only pre-tested material with identification number corresponding to certified test results will be accepted for the job. Using material that is a mixture of different manufacturer's brands or different types of sealant is prohibited.

Crack seal material to be used on the project shall be stored and adequately covered at the storage site specified in the contract Special Conditions. Delivery tickets shall be given to the Project Engineer and shall be used to account for material at the beginning and end of the project and as a basis for monthly pay estimates. Material usage will be monitored daily as a means of indicating yield.

C. Application

All cracks with widths larger than 1/8 inch and less than one (1) inch, including joints at concrete gutter lip where practical, shall be filled with hot poured crack sealant flush with the pavement surface. Immediately following the filling, any excess sealant shall be leveled off at the surface by squeegee, a shoe attached to the applicator wand or other suitable means approved by the engineer. The squeegeed material shall be centered on the cracks and shall not exceed three (3) inches in width and 1/16 inch in depth. Material applications exceeding these limits will be subject to quantity deduction.

Sealant shall be applied only when pavement and air temperature are at least 40 degrees F and rising and crack faces shall be surface dry.

Contractor shall not crack sealing areas of alligator or block type cracking. A deduction will be made, as determined by the Project Engineer, for crack sealant in those types of cracked areas. Sealant material shall be heated according to the manufacturer's recommendations and shall be applied at the manufacturer's recommended temperature. Equipment used for heating the material shall be constructed as an indirect heating type double boiler using oil or other heat transfer medium and shall be capable of constant agitation. Additionally, the heating equipment shall be capable of controlling the sealant material temperature within the manufacturer's recommended temperature range and shall be equipped with a calibrated thermometer capable of +5 degrees F accuracy in the range of 200 degrees F to 600 degrees F. The thermometer shall be located in such position to allow the engineer to safely check the sealant temperature at his discretion. Overheating the material instantaneously or holding it at elevated application temperatures for periods of time in excess of that recommended by the manufacturer will be cause for rejection at the Contractor's expense. Heating equipment shall be emptied at the end of each day's operations.

Sealant material picked up or pulled out after being placed shall be replaced at the Contractor's sole expense. Tracking and or pulling out of material shall be cause for its rejection for use on the project. The Contractor shall have blotter material available on the project at all times in the event it is required to prevent tracking or pulling. Blotter material shall be subject to prior City approval and no separate payment will be made for furnishing and/or placing it. Any property damage resulting from surface preparation, application, tracking or pullout shall be corrected at the Contractor's expense.

10.3.5 Storage Site

If required, the Contractor is responsible for finding a storage site for equipment and stockpiled materials unless a location is specified in the contract Special Conditions.

10.3.6 Weather Limitations

No emulsion seal coats shall be applied:

- A. When there is any danger the finished product will freeze before it cures completely.
- B. When the pavement or air temperature is 70 degrees or below and falling.
- C. In the period following a rain while puddles of water remain on the surface to be coated.
- D. During periods of abnormally high humidity or when rain may fall within four hours of placement.

10.3.7 Traffic and Parking Control

Traffic control and "NO PARKING" signs shall be required in accordance with the contract Special Conditions. Residential streets may be closed to traffic during resurfacing operations. Closures shall be coordinated so that parking for residents is available within one street of a

closed street. Collector streets, as designated in the contract documents, must remain open in one direction during resurfacing operations.

10.3.8 Storm Damage

Areas damaged by storm related events will be re-surfaced as directed by the Engineer. Costs associated with repairing storm damaged areas and removal of asphalt emulsion from curbs, ditches and lawns will be the responsibility of the Contractor. The Contractor will be allowed to suspend work to minimize the potential for storm damage to the surfacing and surrounding facilities with an appropriate adjustment to contract time.

10.3.9 Citizen Notification

The Contractor shall notify all properties adjacent to construction with a door hanger a minimum of 24 hours prior to commencement of work. The City will provide door hangers. In the event there is a delay due to weather, equipment or other causes, the Contractor shall give a minimum of 24 hour notice with another door hanger. Contractor shall provide a 24-hour phone number that will be printed on the door hanger for calls from citizens.

WORK WILL NOT BE ALLOWED IN AREAS WHERE REQUIRED NOTICES HAVE NOT BEEN GIVEN UNLESS THE CITY DETERMINES IT IS IN THE BEST INTEREST OF THE PUBLIC HEALTH AND SAFETY TO COMMENCE WORK IMMEDIATELY.

10.3.10 Warranty

The Contractor shall warrant the work for two (2) years following the completion date of the project.

10.3.11 Measurement and Payment

Seal coats and tack coats shall be measured by the square yard of surfaced pavement, complete-in-place, applied in accordance with the contract documents. Payment shall be made in accordance with the square yard unit price for the specified seal coat and tack coat.

Hot poured joint and crack sealant will be measured by the ton of material used. The engineer may require weighing of equipment, weighing of material, kettle depth measurement or take necessary steps to ensure adequate and correct measurements of materials applied. Payment for tons of hot poured joint and crack sealant shall constitute full compensation for furnishing all labor, equipment, materials and incidentals required to clean and dry.

CHAPTER 11: ROAD ACCEPTANCE AND MAINTENANCE

11.1 VARIANCES

11.1.1 VARIANCE REQUEST

If an Applicant responsible to the City for public improvements desires to design and construct such improvements in variance to criteria in these Standards, such variance(s) should be identified in the initial submittal of construction plans at preliminary plat stage. The variance request(s) shall consist of:

- A. Name.
- B. Project.
- C. Identification of the criteria provision to be waived or varied.
- D. Identification of the alternative design or construction criteria to be adhered to.
- E. A thorough justification of the variance request.

All variance requests shall be signed and stamped by a Colorado Licensed Professional Engineer and signed by the Applicant.

11.1.2 VARIANCE REVIEW AND ACCEPTANCE CRITERIA

Variations from the design criteria and construction specifications contained in these Standards shall be reviewed by the City and may be granted by City Staff administratively under the following circumstances:

- A. Where, by reason of exceptional situations or conditions, the strict application of these Standards would result in peculiar practical difficulties, or undue hardship upon an individual to meet the conditions in these Standards.
- B. Where an individual is proposing to construct a low volume or local access road and the strict application of these Standards would result in excessive cut and fill slopes, visual scarring, or other environmental damage, variances in road design standards may be granted if granting the variance will result in lessened environmental damage.
- C. Variations from the difficulties or hardships described may be granted provided relief will not result in substantial detriment to public health, safety and welfare, substantial impairment of the road design and construction standards, or the granting of any special privilege or use.

11.2 CONTINUATION OF ROADWAYS AND TRAILS

Streets, bike pathways, walkways and easements shall be aligned to join with the planned or existing public ways adjacent to the subdivision. The Planning and Zoning Commission may require public ways to provide direct, continuous routes to all adjacent lands, whether such adjacent lands have been subdivided or not. The location of public ways providing access to

adjacent lands shall be selected by the Applicant provided such location shall be reasonably calculated to provide usable access to the adjacent lands. The cost of such public ways leading to and within a subdivision shall be borne by the Applicant.

Streets shall be extended to boundaries of the property, except where such extension is prevented by topography or other physical conditions, or where the connection of streets with existing or probably future streets is deemed unnecessary for the advantageous development of adjacent properties.

Where future extensions of a street are anticipated, a temporary turn-around, meeting City cul-de-sac standards may be required.

11.3 INSPECTIONS

Prior to the commencement of construction within the City Right-of-Way, the Applicant must notify the City of their intent, obtain a Right-of-Way Use Permit and submit a proposed schedule of construction activities. The City, or their representative, shall inspect the work throughout the construction period to verify that Standards and all applicable regulations are being complied with. In cases where Right-of-Way is not publicly dedicated, the City shall, by the Subdivision Improvement Agreement, be allowed to inspect the construction of streets and drainage appurtenances to insure that it complies with the approved plat. The City shall be notified as to any changes in scheduling or in the approved design.

11.4 PAYMENT OF COSTS FOR ROAD CONSTRUCTION

Any and all costs of new road construction in new developments are the responsibility of the Applicant. The Applicant is responsible for constructing the new roads according to these Standards.

Existing City Roads serving a new development or an area proposed for either platting or replatting shall be upgraded to the Standards when existing roads do not meet the Standards & Specifications for the road classification or for the projected traffic volume.

The participation of the Applicant in the design and construction of new roads, and improvements to existing roads, shall be determined by the relative impacts identified in the Traffic Impact Study and at the discretion of the City Council.

11.5 UPGRADING EXISTING ROADS

In many instances, older roads in the City are substandard because they were built prior to the City having an adequate system for enforcing design and construction standards. Cases where existing roads are sought to be upgraded may include correcting a grade, road width or drainage problem. It might include upgrading the roadway to pavement surface, asphaltic or concrete. Chip and Seal roads will not be considered for acceptance for maintenance by the City. Grade, drainage and road width issues will be addressed under current Standards and Specifications and

an engineer stamped drawing addressing the specific issues will be required.

A Subdivision Improvement Agreement (SIA) and City Council approval must be in place prior to any roadway pavement upgrading, either asphaltic or concrete. It is the HOA or homeowners responsibility to provide an engineer stamped soil test, drainage, design pavement, striping and any other requirements where they are seeking to upgrade existing roads. Roadway design in accordance with the Standards and Specifications such as drainage, road width, and revegetation will apply. A warranty period and posting of security shall be in place for a two year period once preliminary acceptance has been granted in accordance with the provisions contained within the SIA and these Standards. Upgrading existing roads to correct these problems shall be at the expense of the property owners served by such road. Completion of the improvements does not in itself constitute acceptance for maintenance by the City.

11.6 ROAD MAINTENANCE

An application for City maintenance requires a letter of interest for City maintenance, signed by all property owners or the HOA having ownership interest in the road along with a copy of the HOA meeting minutes, requesting consideration by the City Council. The City will not consider acceptance of roads for maintenance until Final Acceptance has been granted, after the two (2) year warranty period has been satisfied. The City Council shall base their decision upon recommendation from the Operations Director, City Planner and the City Engineer that the roadway(s) have met the following minimum requirements:

1. Roads have been constructed according to City regulations and Standards.
2. All drainage criteria as outlined in the City regulations and Standards have been satisfied.
3. Proper easement for drainage requirements and pedestrian movements, both offsite and onsite have been identified and are shown on the plans.
4. The included roads are properly connected to the existing City road system.
5. All necessary road Right-of-Ways have been dedicated to the City.
6. All combustible or objectionable material is cleared from the roadside and all required signing is properly installed. All areas requiring seeding and/or foliage producing the proper stand as outlined in Section 7.4.

NOTE: Acceptance of platted developments by the City does not constitute acceptance of the roads and Right-of-Ways for maintenance. Until each road is specifically accepted for maintenance by the City Council as set forth in Section 11.10, maintenance, construction repair and snow removal are the responsibility of the owners of the land within the development or other entity as may be designated on the City-approved subdivision plat.

11.6.1 CITY OWNED AND MAINTAINED ROADS

Under this category, the City holds either a deed or an easement for the road Right-of-Way and has assumed responsibility for the road maintenance. These roads are listed in the annual inventory filed with the State of Colorado and the City receives an annual allotment of highway users' fees to defray maintenance costs, based on the mileage of roads listed.

11.6.2 CITY OWNED ROADS, BUT MAINTAINED BY OTHERS

In certain cases, private property owners using City owned roads for access desire a higher level of service than the City can provide (e.g. snow plowing). In such cases, the City and the property owners must execute a written agreement assigning maintenance responsibilities to the property owners or HOA, as applicable.

In other cases, City owned roads might be maintained by an adjacent jurisdiction. Such arrangements have been made when it makes more sense for the city to plow a portion of a City road because of its location and its connection to city streets in exchange for the City plowing sections of outlying city roads.

11.6.3 MAINTENANCE CLASSIFICATIONS

- A. FULL - This category includes roads where the Right-of-Way, or recreational pathway easement has been dedicated to the City, the road meets City design and construction standards, the City Council has accepted the Right-of-Way, or recreational pathway easement dedication, and the road has passed any required probationary period. It also includes roads which may or may not meet current City design and construction standards, but which were dedicated to and accepted by the City for full maintenance before road standards were adopted or enforced. Full maintenance status assigns complete responsibility to the City for snowplowing, grading, resurfacing, ditch maintenance and repair as necessary. For snowplowing, priorities are assigned which reflect the use of the road and its relative importance to traffic flow.
- B. PROBATIONARY - When roads are dedicated to the City as public roads, the City Council may consider probationary maintenance for a two year probationary period provided the roads meet the requirements outlined in Section 11.10. During this period, any repairs are the responsibility of the property owners or Applicant seeking final acceptance from the City. The procedures for converting a road from probationary to final acceptance follow the same guidelines outlined in Section 11.10.
- C. LIMITED - This category includes roads which do not meet current City standards with respect to widths, curves, or grades, but which were dedicated to and accepted by the City prior to road standards being adopted or enforced. Such roads may receive seasonal maintenance. This maintenance level is low priority and is dependent on the availability of funds, manpower and equipment.
- D. NO MAINTENANCE - This category includes any and all public or private roads that are not maintained by the City under any circumstances.

11.7 QUALITY CONTROL

Tests ordered by the City to ascertain compliance with specifications shall be the most recent standard methods of AASHTO or ASTM and shall be made by an independent testing firm at the expense of the Applicant. Where the Applicant or owner maintains his own testing equipment and qualified personnel, the requirement for an independent testing firm may be waived by the City. Copies of test data are to be furnished to the City.

The roadway and roadside areas wherein construction work has been performed shall be thoroughly cleared of all debris and extraneous material and shall be restored to a condition at least as good as the original condition. Example: clean-up of pavement and all roadway appurtenances, pavement failures, broken concrete, damaged signs and fencing, debris on adjacent private property, etc. All deficiencies must be resolved to the satisfaction of the City. The City may bring a civil action to collect for damages from any person causing damage to any public road or highway (C.R.S. §42-4-512).

11.8 SIGHT TRIANGLE MAINTENANCE

When the City receives a complaint of a sight obstruction on public land the appropriate jurisdiction will be responsible for removing the obstruction. If the obstruction is on private land the property owner will be given 30 days to remove the obstruction unless the structure was built prior to these Standards, the owner was previously granted a waiver, or the obstruction is due to the natural topography and not by earthwork undertaken by the current property owner. In cases deemed to be an immediate threat to public safety, the City may authorize the removal of an obstruction in the sight triangle with less than 30 days prior notice. Where a building permit application is filed for property which was platted or replatted after the effective date of these Standards, no building permit shall be issued for any structure which would interfere with the maintenance of a sight triangle for such property. If the property was platted or replatted prior to the effective date of these Standards a sight triangle must be maintained unless application of the requirements would result in peculiar and exceptional practical difficulties to the individual proposing development of the property.

11.9 RIGHT-OF-WAY

11.9.1 OBSTRUCTIONS

No person or corporation shall erect any fence, house, or other structure, or dig pits or holes in or upon any highway, or place thereon or cause or allow to be placed thereon any stones, timber, or trees or any obstruction whatsoever. No person or corporation shall tear down, burn, or otherwise damage any bridge of any highway, or cause waste water or the water from any ditch, road, drain, flume, agricultural crop sprinkler system, or other source to flow or fall upon any road or highway so as to damage the same or to cause a hazard to vehicular traffic.

11.10 ADMINISTRATIVE ROAD ACCEPTANCE PROCEDURES

The City of Central Administrative Road Acceptance Process is set forth below.

Applicant may submit a request to the City for acceptance or maintenance of City roads in the following circumstances:

1. Requests for maintenance on existing dedicated City roads
2. Requests to increase or decrease the level of existing road maintenance on a dedicated City road; or
3. Requests for acceptance of a dedicated City road after the two year warranty period

An application for City road maintenance requires a letter of interest signed by all individuals having ownership interest in the road. The City will not consider acceptance of publicly dedicated roads for maintenance until Final Acceptance has been granted by the Council in accordance with a SIA. The Council shall base its decision upon recommendation from the City Engineer and City Planner that the roadways have met the following minimum requirements:

1. Roads have been constructed according to City Land Use Regulations and Standards.
2. All drainage criteria as outlined in the City Land Use Regulations and Standards have been satisfied.
3. Proper easement for drainage requirements and pedestrian movements, both offsite and onsite have been identified and are shown on the plans.
4. The included roads are properly connected to the existing City road system.
5. All necessary road Right-of-Ways have been dedicated to the City.
6. All combustible or objectionable material is cleared from the roadside and all required signing is properly installed. All areas requiring seeding and/or foliage producing the proper stand prescribed by the plan.

NOTE: Acceptance of platted developments by the City does not constitute acceptance of the roads and Right-of-Ways for maintenance. Until each road is specifically accepted for maintenance by the City Council, maintenance and construction repair are the responsibility of the owners of the land within the development.

11.11 ROAD VACATION

Road vacations are a separate procedure following Municipal Code State Statute, and City Council action and are not a part of these Standards. Please refer to Article VI of Chapter 4 of the Municipal Code and C.R.S. §43-2-301 for procedural information.

CHAPTER 12: ROAD CUT STANDARDS, REGULATIONS AND RIGHT-OF-WAY PERMIT

12.1 STATEMENT AND PURPOSE

The purpose of this Chapter is to prescribe the standards and procedures to be followed by the contractor and/or his representative in making proper excavations and backfilling of installations within the City Road Right-of-Way (RIGHT-OF-WAY or ROW), and to define the position of the City in administering this regulation. No permit shall be required for work including, but not limited to, maintaining ditches, conducted in the Right-of-Way exclusively for purposes of Husbandry.

12.2 PERMIT AND REGULATIONS

The Right-of-Way use permit must be obtained at least five (5) days prior to any commencement of construction. Applications may be downloaded from the City website at www.centralcitycolorado.us The Applicant shall submit construction plans, specifications, and a written schedule covering the general sequence and staging of the work to be performed on large scale projects. The Right-of-Way Use Permit may contain stipulations and must be adhered to or the permit shall be revoked.

Work authorized by this permit shall be performed between the hours of seven o'clock (7:00) am and seven o'clock (7:00) pm, Monday through Friday, unless the Applicant obtains written permission from the Operations Director to do the work earlier or later than the stated hours or on a weekend.

Once the Permit is approved, no change shall be allowed to the schedule or plans, without the consent of the City. Permits must be available at the work site, on demand to City personnel at all times. Construction Permits expire at the approved scheduled ending date and must be renewed in advance if the bond is not to default.

Any person conducting work within the Right-of-Way without an approved Right-of-Way use Permit shall be subject to the fines and penalties set forth in Section 1-72 of the Municipal Code.

12.2.1 BORING/JACKING

Where the installation crosses an asphalt surfaced roadway five (5) years old or newer, the installation shall be made by boring or jacking beneath the roadway surface; however open cutting shall be allowed to the edge of the shoulder portion of the road. No water shall be used in boring and no tunneling shall be permitted. Any variance to this will require City approval.

12.2.2 ASPHALT CUTS

Pavement cuts are permitted only when unsuccessful attempt(s) has been made to bore or jack the installation or site constraints exists. (i.e. attachment to manholes).

All road cut backfill should use flowable fill material during construction. Any road cuts within

paved Right-of-Ways older than five (5) years shall require proof of density test meeting the requirements of CDOT's Materials Test Procedure Module by compaction or flowable fill.

All cuts made in asphalt or concrete surfacing shall be made by mechanically cutting to a true horizontal and vertical line, and shall be cut one foot wider than the top of the trench excavation.

All excavations made in paved streets must be completely restored within 48 hours after acceptance of the backfill by the City. In hot mix asphaltic concrete, temporary repairs shall be made by tamping and rolling into place a cold mix asphaltic concrete. Such cold mix patches shall be removed and replaced by a permanent hot mix asphaltic concrete as soon as weather and availability of materials permit. Permanent hot mix asphaltic concrete patches shall be one and a half (1 ½) times the depth of the existing asphalt, but no less than 2", and shall be installed in accordance with good construction practice.

Damaged pavement shall be repaired by appropriate methods as approved by the City. In general, cracks are to be filled with the proper asphaltum product and the surface properly seal coated. An asphalt concrete overlay 1 1/4" thick for the full width of the paved surface shall be required in those instances, which in the opinion of the City, the ride quality, or the appearance of the finished roadbed has been impaired. Subgrade failures caused by the Applicant's operation of heavy equipment shall be rectified by reconstructing the subgrade layers and replacing the subbase, base and asphalt pavement.

In the event that asphaltic concrete base, soil cement or other base course materials are encountered during excavation, restoration shall be made in kind or as otherwise specified by the City.

All excavation work will expressly warrant and guarantee that the compaction and rebuild work on the road/Right-of-Way for a period of two (2) years will not fail. If the compaction/rebuild work fails at any time during that two (2) year period, the Applicant will be responsible for beginning repairs within forty-eight (48) hours of being notified that such repairs are needed and if those repairs are not made, the City may make repairs at the Applicant's expense.

12.3 PROCEDURES FOR OBTAINING A PERMIT

12.3.1 DRIVEWAY PERMIT

Refer to Chapter 4

12.3.2 RIGHT-OF-WAY PERMIT APPLICATION

- A. One (1) application must be completed for **each** installation.
- B. Each application must be completed and signed by the applicant contractor, incomplete applications will be denied.
- C. The application must be submitted to the City **at least 5 working days prior** to the anticipated start of the installation. Applications may also be downloaded

from the City website at www.centralcitycolorado.us

- D. Except in cases of emergency, no work shall begin until a valid permit has been issued by the City.
- E. The application is not a valid permit and is not a guarantee that a permit will be issued.
- F. Any construction started prior to permit issuance shall be subject to the fines and penalties set forth in Section 14.1 of these Standards.
- G. A permit fee is required with the submittal of this application.
- H. A job cost estimate must accompany this application.
- I. A detailed sketch of the work site must accompany this application and must show the placement of the utility or City road access.
- J. A detailed traffic control plan, including signage and distances, must accompany the RIGHT-OF-WAY application.
- K. Applicant must mark the work site prior to submitting application.
- L. Utilities must be buried to the minimum depth. See Chapter 5.
- M. Applicants are required to call for all utility locates.
- N. Roadway must be capable of re-opening for emergency vehicles at all times.
- O. Applicants shall contact Gilpin County's Sheriff Dispatch office and the City prior to closing any road and in case of emergencies.
- P. A copy of the permit application shall be available for inspection at the work site at all times.
- Q. If the work site fails inspection upon completion of installation, Applicant has ten (10) calendar days after notification to repair the work site to City of Central Standards and Specifications for Design and Construction and a re-inspection fee shall be assessed.
- R. Failure to perform under any one (1) permit issued to Applicant, may result in the suspension or revocation of any and all other open permits and permit applications pending for Applicant.
- S. Compaction tests are required and must be certified by a professional Geo-Tech engineer. Any failure in the first two years will go against the Bond and after that, the utility owner will be responsible.
- T. Photo documentation may be required.
- U. All flaggers must be CDOT Certified (including appropriate apparel).

12.3.3 APPLICANT'S STATEMENT OF RESPONSIBILITY

- A. The Applicant for a Right-of-Way use permit understands that they have certain responsibilities.
- B. The Applicant shall return the road/Right-of-Way to its original condition including placement of vegetation, or they may incur additional fees and construction requirements.
- C. The Applicant shall be responsible for any and all damage occurring to the roadway during the installation.
- D. The Applicant shall call the City upon completion of the construction project to schedule an inspection. If the work site fails inspection, the Applicant shall be

responsible for repairing the work site to City of Central Standards and Specifications for Design and Construction within ten (10) calendar days of being notified that repairs are needed and the Applicant shall be responsible for payment of a re-inspection fee.

- E. The Applicant shall comply with all standards listed in this document.
- F. The Applicant shall take any and all measures to ensure the safety of all travelers over, around, and through the construction site, including, but not limited to, certified flaggers, barricades and signage.
- G. The Applicant shall not close any road to traffic without the authority/permission from the City.
- H. The Applicant shall not store any excavated materials at the work site that will obstruct traffic in any manner.
- I. The Applicant shall remove contaminated materials and replace with new Class 6 Minus gravel at a depth of 6" on the road surface.
- J. The Applicant shall expressly warrant and guarantee the compaction and rebuild work on the road/Right-of-Way for a period of two (2) years. If the compaction and/or rebuild work fails at any time during that two (2) year period the Applicant will be responsible for beginning repairs within forty-eight (48) hours of being notified that repairs are needed and if the Applicant does not perform repairs, the Applicant shall authorize the City to file a claim against the surety bond submitted with the Right-of-Way application.
- K. The City is hereby released from liability for any damages to utilities not buried at the proper minimum depth or not installed in compliance with these Standards. If during normal maintenance/grading, the City damages a utility that is not at the proper minimum depth, the Applicant shall be responsible for the damages during the bond period. The Applicant agrees to indemnify and hold harmless the City, its employees and affiliates, from all liability for any and all damage to property or person resulting from improper installation of utilities under the Right-of-Way permit.
- L. The Applicant shall be required to sign the Right-of-Way permit application.

12.3.4 GUARANTEE - TERMS AND CONDITIONS

- A. If a ROW permit application is approved, a performance, payment, and completion guarantee ("Guarantee") in the form of a surety bond, letter of credit, cash escrow account or certificate of deposit acceptable to the City shall be submitted prior to commencement of work under the permit.
- B. All Guarantees will be in the amount of 125% of the projected project costs that are supplied with the application (a surety bond is required for each permit application).
- C. An annual general contractor liability bond in the amount of \$1 million dollars (\$1M) may be acceptable in the City's discretion for meeting the bond requirements.
- D. The Guarantees shall be ongoing and have a termination date of two (2) years after notification to the City by the Applicant that he has completed all Right-

of-Way work in the City. When all work is completed, the amount of the Guarantee may be reduced.

- E. Annual renewal notification of the Guarantee shall be to the City. Failure to follow this requirement will result in suspension or revocation of any and all other open permits and future applications of the permittee will not be approved.
- F. The Guarantee may be called at the option of the Operations Director to defray the cost of repairing defective work.
- G. The Guarantor shall promptly notify the Operations Director of any circumstances which affect the status of the Guarantee. Failure to follow this requirement will result in suspension or revocation of any and all other open permits and future applications of the permittee will not be approved.

12.3.5 WARRANTS

The Applicant shall be responsible for the repair of all failed road cuts for a period of two (2) years following completion of the work. A failed road cut which will require repair shall be defined as a settlement or breakdown of the cut area whereby the travel surface is visibly impaired and/or the structural integrity of the installation and its backfill is impaired.

12.4 GENERAL POLICIES

Construction work is to be planned so as not to create safety hazards, maintenance problems, render portions of Right-of-Way infeasible for future road improvement or to obstruct drainage ways. Where feasible, parallel installations are to be placed outside the roadbed within the Right-of-Way and transverse installations shall be “jacked” or bored under the road in lieu of trenching. No cuts will be permitted on City roads that have been overlaid (pavement) without the consent of the City. The City shall be advised 48 hours prior to the start of construction as to when construction will begin and shall be advised when construction is completed.

No cleated or track equipment shall work on or move over asphalt surfaces without mats. Any damage to asphalt due to equipment operation shall be repaired immediately (to the satisfaction of the City) at the expense of the permittee.

12.5 ROAD CLOSURE

In general, road closures are not permitted unless justified on the basis of safety or the overall benefit to the general public as determined by the City. When road closures are deemed necessary, the Applicant must:

- A. Verify the road closures specified on the permit with the City and with their approval, notify one week in advance the appropriate fire protection district, school district, E.M.S. and Sheriff’s office of the exact location, date and time, and duration traffic will be impeded.
- B. Erect and maintain, at Applicant’s own expense, necessary barricades,

flashers, construction signs and CDOT approved flaggers (per Manual on Traffic Control Devices - Work Zone Traffic Control), and take all necessary precautions for public safety and convenience. Road closures will be permitted only:

- C. If explicitly specified on the approved Permit.
- D. Between the hours of 8:30 A.M. and 3:30 P.M. When closures of more than one day are approved, a suitable detour must be provided and be adequately marked and signed to accommodate night traffic.
- E. May notify appropriate public notifications (i.e. newspapers), if time allows.

12.6 SAFETY AND PUBLIC CONVEYANCE

CDOT approved flaggers shall be required when restricting travel to one-lane or otherwise unsafe operations. Adequate warning signs, barricades, lighting and other devices as specified in the Manual on Uniform Traffic Control Devices (MUTCD) and as approved by the City shall be provided, maintained and paid for by the Applicant. The Applicant's operations are to conform to the applicable requirements established by the Industrial Commission of Colorado and the Occupational Safety and Health Act (OSHA), as well as any other applicable State or Federal laws.

12.6.1 TRAFFIC CONTROL PLAN

A traffic control plan following MUTCD guidelines shall be submitted as part of the Right-of-Way use application for all road cuts. A Colorado Registered Professional Engineer or other applicable State of Colorado certification shall be responsible for the Traffic Control Plan. All traffic control plans shall include the following:

- 1. Name of preparer
- 2. Date prepared
- 3. North arrow
- 4. Number of devices and type
- 5. Number of flaggers if needed
- 6. Distance between devices
- 7. Statement "NOT TO SCALE" if applicable
- 8. Drawing of the work zone & roadway
- 9. Work hours
- 10. Posted speed limit
- 11. Reference to MUTCD typical applications

12.7 ROAD CHANGES

In the event any changes are made in a City road Right-of-Way that would necessitate the removal or relocation of an installation made by a permit Applicant, the relocation or removal shall be at the utility owner's expense upon written request by the City. The relocation or removal shall be completed within 30 (thirty) days after notification or for projects that do

require extensive design, securing of contracts or material orders, the relocation or removal shall be within 90 days. To avoid the necessity for such changes, the Applicant is encouraged to locate his facility consistent with future plans for the roadway where they exist.

12.8 INSPECTIONS

The City Manager and/or his authorized representative are empowered to:

1. Review the methods specified for road repair and restoration on all permits.
2. Review the alignment of all utilities within the City Right-of-Way.
3. Direct that unsatisfactory material be removed and replaced.
4. Direct that special conditions warrant higher standards than contained herein, or that special precautions be taken to promote the safety and welfare of the public and to protect all property.
5. Inspect all completed road cuts before two (2) year warranty completion and acceptance.

If it is determined that the design or construction is unsatisfactory and the Applicant or his representative does not respond to the direction in a timely manner, the City is authorized to stop work immediately. Notification shall be given to the responsible contractor by the most expedient means when an emergency repair is apparent. If the contact cannot be made, City will make the repair and charge the contractor. If the failure is not an immediate hazard to safety and property, a period of 72 hours will be allowed the contractor for repair after notification.

Re-inspections for work within the Right-of-Way shall be charged a re-inspection fee.

12.9 EMERGENCY

For emergency situations where time is not available to follow the procedures outlined herein, work may be approved by submitting an emergency request to the Operations Director in writing or verbally, with justification for such emergency. If the emergency request is granted by the Operations Director, the Applicant must submit a permit application following the procedures set forth in these Standards within five (5) business days of approval of the emergency work.

An emergency will be defined as “the immediate threat to the loss of life, property or the overall health to the public” as determined in the sole discretion of the Operations Director.

CHAPTER 13: MISCELLANEOUS

13.1 FENCES

13.1.1 RESIDENTIAL AND COMMERCIAL FENCES

Residential and commercial fences shall utilize either natural stone walls, wrought iron, or a combination of both materials. Proposed design for fencing will be reviewed by the City Engineer and Historical Preservation Commission for consistency with standard engineering practice and historical suitability. Reference Section 16-182, Fences, hedges and walls of the Central City Municipal Code and Chapter 3, General Design Guidelines of the Central City Design Guidelines for additional requirements.

A. Natural Stone Walls

Natural stone walls shall meet the following specifications:

1. Location: Natural stone walls shall be used along the sidewalk and where terracing is necessary.
2. Footings: Concrete footing shall be used to support the natural stone wall, and design shall be performed by a registered engineer in the State of Colorado.
 3. Construction: Dry stack natural stone walls are preferred. The use of grout will be reviewed on a case-by-case basis.
 4. Width: Natural stone walls should be a minimum of 12 inches wide, and no more than 24 inches wide.
 5. Gates: Gate openings shall be a minimum of 42 inches wide and gates shall be equipped with hinges and latches to allow 180 degree opening.
 6. Height: Overall height shall be consistent and between 4-6 feet.
 7. Elevation: Elevation for fencing may be either stepped, level, or raked as needed for the location.

B. Wrought Iron Fences

Wrought iron fences shall meet the following specifications:

1. Posts: 2-inch square posts with welded decorative finial, spaced at consistent intervals between 6-8 feet.
 2. Footings: Concrete footing shall be a minimum of 8-inch diameter and 36 inches deep with a post embedment of 24 inches. Top of footing shall be 3 inches below grade. Alternatively, posts may be embedded in a stone wall a minimum of 8 inches and grouted with hydraulic cement. Concrete shall have a minimum 28 day compressive strength of 3,000 pounds per square inch.
 3. Rails: Top and bottom rails are required and must be securely fastened to each post. Additional rails will be required such that all pickets are secured by at least two rails. Bottom rail shall be within 3-6 inches from grade and top rail shall be within 6-12 inches of the picket finial top.
 4. Pickets: 5/8-inch minimum square pickets with plain or decorative

finials. Design may utilize a combination of full and partial pickets.

5. Gates: Gates shall be a minimum of 42 inches wide and equipped with hinges and latches to allow 180 degree opening.
6. Coating: All fence components shall be coated utilizing an epoxy and polyurethane coating system suitable for exterior applications and ultraviolet light exposure. Coating system shall include surface preparation, primer, and top coat in accordance with manufacturer's recommendations. Color shall be black.
7. Height: Overall fence height shall be consistent and between 4-6 feet.
8. Elevation: Elevation for fencing may be either stepped, level, or raked as needed for the location.

13.1.2 MUNICIPAL AND INDUSTRIAL FENCES

Municipal and industrial fences shall utilize chain link fence.

A. Chain Link Fence

Chain link fence shall meet the following specifications:

1. Material: All chain link fence components shall be hot dip galvanized steel.
2. Footings: Concrete footing shall be a minimum of 12-inch diameter and 36 inches deep with a post embedment of 24 inches. Top of footing shall be 3 inches below grade. Concrete shall have a minimum 28 day compressive strength of 3,000 pounds per square inch.
3. Posts:
 - a. Line Posts: 2-inch schedule 40 pipe, 3.65 pounds per foot.
 - b. End and Corner Posts: 2 ½ inch schedule 40 pipe, 5.70 pounds per foot.
 - c. Gate Posts: 3 ½ inch schedule 40 pipe, 9.1 pounds per foot.
4. Rails and Bracing: Top rail and braces shall be 1 ¼ inch schedule 40 pipe, 2.27 pounds per foot. Horizontal bracing shall be provided at all end, corner, and gate posts, in conjunction with diagonal tension members.
5. Fence Fabric: Fence fabric shall be No. 9 galvanized steel wire with a 2-inch mesh, with a knuckled finish on the top edge and a twisted barbed finish on the bottom edge.
6. Fabric Ties: Fabric ties shall be No. 9 galvanized steel wire, spaced 14 inches apart on posts and 24 inches apart on rails. A continuous No. 7 galvanized steel wire shall be interlaced with the fence fabric along the bottom edge.
7. Barbed Wire: Barbed wire shall be 2-strand No. 12-1/2 gauge zinc-coated steel or iron wire with 4-point, 14 gauge barbs spaced not more than 5 inches apart. Three lines of barbed wire shall be used at the top of the fence.
8. Fasteners:

- a. Stretcher Bars: ¼ inch by ¾ inch steel bars
 - b. Steel Bands: 1/8 inch by ¾ inch steel straps
 - c. Nuts, Bolts, and Screws: Minimum size is 3/8 inch diameter
 9. Gates: Gates frames shall be use a minimum 1 ¼ inch schedule 40 pipe and include one diagonal brace. Gates shall be equipped with hinges and latches to permit opening in either direction and allow for securely locking the gate. Gate fabric shall match fence fabric.
 10. Height: Overall height shall be consistent and between 6-8 feet, including barbed wire lines.
 11. Elevation: Elevation for fencing may be either stepped, level, or raked as needed for the location.
- B. Other Fence Types
1. Other fencing may be proposed for municipal and industrial applications in lieu of chain link fence.
 2. The alternative fence will be reviewed and assessed in reference to the overall project and historical factors.
 3. The Operations Director shall have authority to approve such alternative fencing.

13.2 TRASH

The City does not allow any trash dumpsters within the public Right-of-Way and is in violation of C.R.S. §43-5-301.

CHAPTER 14: PENALTIES, FINES AND FEES

14.1 PENALTIES AND FINES

It is unlawful for any person, firm, or corporation to violate any provisions of these Standards, or any amendment thereof. Any person failing to comply with these Standards shall be subject to the fines and penalties as set forth in Section 1-72 of the Municipal Code. The City may seek restitution for expenses of enforcement or damage to public property. In addition, for any violation of these Standards or any condition which may constitute a threat to the public health, safety and welfare or damage to property, the City may:

- A. Issue cease and desist orders to halt a violation of these Standards;
- B. Place a hold on current or new permits related to platting, construction, expansion, or operation of a use until the violations are corrected, or until the municipal court or other court of appropriate jurisdiction orders that the hold be lifted;
- C. Revoke permits; or
- D. Issue stop work orders to stop any or all construction activities.

14.2 FEES

All applicable fees referenced herein shall be adopted by resolution of Council, or as set forth in the Municipal Code. Fees are required for permits, inspections, engineer's review, and other items related to application and enforcement of these Standards.

CHAPTER 15: ACCEPTED PUBLICATIONS

The most up to date publications listed below are acceptable sources for design information not found in these Standards or the Municipal Code. These publications may be useful for variance request submittals. A publication not listed below may be used at the discretion of the City.

1. Central City Design Guidelines (1993)
2. City of Central, Colorado Comprehensive Development Plan Update (2003)
3. Home Rule Charter and Code of the City of Central, Colorado (1994)
4. Gilpin County Driveway and Access Policies
5. Gilpin County Road Regulations, Policies, Standards, and Specifications
6. A Policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials (AASHTO)
7. Colorado State Forest Service Wildfire Safety
8. Colorado Supplement to the MUTCD
9. Design Manual, Division of Highway State of Colorado
10. Design of Pavement Structures, (AASHTO)
11. Erosion and Sediment Control For Construction Activities Guidance Handbook, East Grand Water Quality Control Board (EGWQCB)
12. City of Central Subdivision Regulations, Community Development Department
13. Guide for the Planning, Design and Operation of Pedestrian Facilities, AASHTO
14. Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT<400), AASHTO
15. Homeowner's Guide to Retrofitting, 2nd Edition (FEMA)
16. M&S Standard Plans, Colorado Department of Transportation (CDOT)
17. Manual on Uniform Traffic Control Devices (MUTCD), Federal Highway Administration
18. Roadside Design Guide, AASHTO
19. Rules and Regulations of the Colorado Department of Transportation, Pertaining to Transport Permits for the movement of extra-legal vehicles or loads.
20. Standard Specifications for Highway Bridges, AASHTO
21. Standard Specifications for Road and Bridge Construction, CDOT
22. Transportation Engineering Handbook, Institute of Transportation Engineers (ITE)
23. Trip Generation, ITE

CHAPTER 16: REFERENCES

These publications listed below have been referenced for the preparation/revision of these Standards and are incorporated herein by reference.

1. Central City Design Guidelines (1993)
2. City of Central, Colorado Comprehensive Development Plan Update (2003)
3. Home Rule Charter and Code of the City of Central, Colorado (1994)
4. Gilpin County Driveway and Access Policies
5. Gilpin County Road Regulations, Policies, Standards, and Specifications
6. A Policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials (AASHTO) (2004)
7. Article 4: Site Development Standards, Eagle County (January 4, 2005)
8. Colorado Revised Statutes
9. Erosion And Sediment Control For Construction Activities Guidance Handbook, East Grand Water Quality Control Board (EGWQCB) (Spring 2005)
10. Guide for the Planning, Design and Operation of Pedestrian Facilities, AASHTO (July 2004)
11. Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT<400), AASHTO (2001)
12. Land Use and Development Code Chapter 5: Road and Bridge Standards, Summit County (October 1, 1998)
13. Larimer County Road Manual, Larimer County (January 1, 2000)
14. M&S Standards Plans, Colorado Department of Transportation (CDOT) (October 2000)
15. Manual on Uniform Traffic Control Devices, Federal Highway Administration (2003 Ed.)
16. Road and Bridge Standards, Department of Planning and Zoning (Adopted September 11, 1985)
17. Road and Bridge Specifications, Mesa County Public Works (February 1, 2006)
18. Roadside Design Guide, AASHTO (January 1996)
19. Rules and Regulations of the Colorado Department of Transportation, Pertaining to Transport Permits for the movement of extra-legal vehicles or loads.
20. Transportation Engineering Handbook, Institute of Transportation Engineers (ITE) 5th Ed.
21. Grand County Road and Bridge Standards (August 2010)

CHAPTER 17: DEFINITIONS

The following definitions shall be observed and applied when interpreting these Standards, except when the context clearly requires otherwise:

1. Unless the context clearly indicates otherwise, words used or defined in one tense or form shall include other tenses or forms.
2. Unless the context clearly indicates otherwise, words in the singular number shall include the plural number, and words in the plural number shall include the singular number.
3. The masculine gender shall include the feminine and the feminine gender shall include the masculine.
4. The words “shall” and “will” are mandatory.
5. The words “may” and “should” are permissive.
6. The word person includes individuals, partnerships, firms, corporations, associations, trusts, and any other similar entities or combination of individuals.

Applicant – person responsible for the development and/or improvements being proposed.

Average Daily Traffic (ADT) – the average 24-hour volume, being the total number during a stated period, divided by the number of days in the period. Unless otherwise stated, the period is a year.

Backfill – material used to replace or the act of replacing material removed during construction; also may denote material placed or the act of placing material adjacent to structures.

Base Course – the layers of specified or selected material of selected thickness placed on a subbase or a subgrade to support a surface course.

Bridge – a structure including walls or abutments erected over a depression or an obstruction, as water, highway or railway, and having a track or passageway for carrying traffic or other moving loads.

Clear Zone – is used to designate the unobstructed, relatively flat area beyond the edge of the roadway for the recovery of errant vehicles. Recoverable slope are defined as 4:1 or flatter, and a non-recoverable slope between 4:1 and 3:1.

Contour – a line, as shown on the plans that connects points of equal elevation on a land surface

Corner Sight Distance – the necessary distance needed to accelerate enough so as to not slow the travel speed of other cars by more than 10 MPH. The corner sight distance is measured from a point on the minor road at 15' (ten (10') feet for Local-Local intersection) back from the edge of the major road pavement (flowline) and measured from a height of eye at three and a half feet (3 ½') on the minor road to a height of object at three and one half feet (3 ½') on the major road.

Critical Flow – a condition which exists at the critical depth; under this condition, the sum of the velocity head and static head is a minimum.

Crown/Cross Slope – on roads, each lane of the pavement may be sloped separately or have a unidirectional slope across the entire width of pavement, almost always downward to the outer edge

Cul-de-sac – a local street open at one end only, and with special provisions for turning around (bulb, hammerhead, “T”, etc.)

Culvert – a closed conduit, other than a bridge, which conveys water carried by a natural channel or waterway transversely under the roadway

Decision Sight Distance – the distance needed for a driver to detect an unexpected or otherwise difficult-to-perceive information, source or condition in a roadway environment that may be visually cluttered, recognize the condition or potential threat, select an appropriate speed and path, and initiate and complete the maneuver safely and efficiently

7.

Design Speed – a speed determined for design and correlation of the physical features of a highway that influence vehicle operation. It is the maximum safe speed that can be maintained over a specific section of highway when conditions are so favorable that the design features of the highway govern.

Driveways – an access point onto the City road system from a home, garage or other structure.

Drainage Appurtenances – inlets, storm sewer, curb and gutter, drain pipes, culverts, valley pans, etc.

Easements – a right to use or control the property of another for designated purposes.

Engineer – a Colorado Licensed Professional Engineer.

Erosion – the wearing away of land surface by detachment and transporting of soil and rock particles by the action of water, wind, or other agents.

Flowable Fill – liquid soil which is placed as a flowable liquid, yet hardens and rapidly develops excellent load-bearing properties with no compaction.

Grade – the rate expressed in terms of percent of ascent or descent divided by the length

Grading Plan – a drawing showing an arrangement of contours intended to integrate construction and topography, improve appearance, retard erosion and improve drainage

Gross Floor Area – Refer to the definition in Chapter 16, Zoning, in the City of Central Municipal Code.

Guardrail – a protective device intended to make roadways safer by reducing accident severity.

Husbandry – The act or practice of cultivating crops or breeding or raising livestock; agriculture.

Horizontal Alignment – horizontal geometries for safe and continuous operation at a uniform design speed for substantial lengths of roadway and shall afford at least the minimum stopping distance for the design speed at all points on the roadway.

Implement of Husbandry – An “Implement of Husbandry” is a vehicle which is used exclusively in the conduct of agricultural operations.

Intersection – the area embraced within the prolongation or connection of the lateral curb lines or if none then the lateral boundary lines of the roadways of two (2) roadways which join on another at, or approximately at right angles, or the area within which vehicles traveling on different roadways joining at any other angle may come in conflict.

Mailbox – any receptacle used to receive mail, newspapers, packages, etc. from any type of delivery service.

Minimum Turning Radius – the radius of a minimum turning path of the outside of the outer front tire or overhang.

Manual – The Urban Storm Drainage Criteria Manuals – Volumes 1-3.
http://www.udfd.org/downloads/down_critmanual.htm

Municipal Code – The Central City Municipal Code, as may be amended.

MUTCD – Manual on Uniform Traffic Control Devices.

Plowing – utility installation by the use of ripping or cutting the surface for utility placement, does not involve major excavation

Point of Curvature (PC) – beginning of horizontal curvature, tangent to previous segment

Point of Tangency (PT) – end of horizontal curvature, tangent to next segment

Point of Vertical Curvature (PVC) – beginning of vertical curvature, tangent to previous segment

Point of Vertical Inflection (PVI) – a point of two intersecting grades

Point of Vertical Tangency (PVT) – end of vertical curvature, tangent to next segment

Regulations – Refer to Section 1.4 of the Standards and Specifications for Design and Construction

Right-of-Way (ROW) – a general term denoted land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

Roadway – a portion of a roadway including shoulders for vehicular use. A divided highway has two or more roadways.

Shoulder – the portion of a roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use and for lateral support of base and surface courses.

Standards – The City of Central Standards and Specifications for Design and Construction.

Stopping Sight Distance (SSD) – the sum of the brake reaction distance and the braking distance. SSD is measured from the driver's eyes, three and a half feet (3 ½') above the road surface, to an object two feet (2') high on the road.

Subbase – the layer or layers of specified or selected material of designed thickness placed on a subgrade to support a base course.

Subgrade – the top surface of a roadbed upon which the pavement structure and shoulders, including curbs, are constructed.

Superelevation – the vertical distance between the heights of inner and outer edges of roadway pavement used to prevent vehicle from sliding outward, or to counteract all the centrifugal force of a vehicle traveling at an assumed speed, or roadway banking.

City – Employees and/or representatives of the City of Central. Includes but not limited to the Community Development Department, Public Works, City Council, City Attorney, City Engineer, City Surveyor, etc.

Traffic Control Device – any sign, signal marking, or installation placed or erected under public authority, for the purpose of regulating, warning, or guiding.

Vertical Alignment – element of road design intended to provide adequate sight distance, safety, comfortable driving, good drainage, and pleasing appearance. Stopping sight distance requirements controls minimum lengths of crest vertical curves.