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DIVISION 1

INTRODUCTION
Division 1 Introduction

1.1 INTRODUCTION

This Public Works Manual for the Town of Granby has been initially authorized by Ordinance No.943. This document shall be known as the “Town of Granby Public Works Manual.” The design of drainage and utility systems under these guidelines is intended to be consistent with the Colorado Department of Public Health and Environment for potable water systems, sewage works and water quality design. The roadway design criteria are intended to be consistent with the American Association of State Highway and Transportation Officials (AASHTO) Standards for Geometric Design and the Colorado Department of Transportation design and construction criteria. Design of electrical service and transmission facilities is intended to be consistent with the National Electric Code and the National Electrical Safety Code.

Failure to comply with these standards and guidelines may delay project approvals or be the cause of the withholding or withdraw of project permits or approvals.

1.2 PURPOSE

The purpose of this Public Works Manual is to act as a guide for the uniform design and construction of infrastructure including roads, water and sewer facilities, drainage conveyance structures, and other municipal infrastructure and appurtenances within the Town of Granby. This Manual identifies the minimum standards, specifications, and processes necessary to achieve public safety, functional effectiveness, ease of maintenance, uniform materials and consistent lines of communication. More comprehensive or strict standards may be applied to a specific development if necessary, to provide for the public health and welfare. These standards will be applied by the Town when reviewing developments and public projects for compliance with the Town of Granby Municipal Code.

1.3 SCOPE AND APPLICATION

These standards and guidelines shall apply to all new construction, reconstruction and rehabilitation of Town operated sewer, water, stormwater, utilities as well as to any publicly maintained roads within the Town. In addition, these standards and guidelines shall apply to all private developments within the Town.

These regulations apply to lands within the town limits of the Town of Granby. Granby includes lands on both the north and south sides of the Fraser River. For water and sewer purposes, the Town has established the North Service Area (NSA) and South Service Area (SSA) delineated by the Fraser River, each with separate Rules & Regulations. With the development of the new River Run Resort and adjoining parcels, the Town will create a new “West Service Area” (WSA). The Granby Sanitation District treats wastewater from all service areas and owns the wastewater infrastructure in the NSA and WSA, while the Town owns the wastewater infrastructure in the SSA. The annexation process has also led to the formation of various entities having responsibility over infrastructure. Of major significance are the Grand Elk General Improvement District and the Headwaters Metropolitan District on Granby Ranch (fka Sol Vista). Adopted standards for those entities will also apply.

1.4 WAIVER

No exception or waiver of these regulations, standards and specifications shall be valid unless approved by the Town or representatives of the Town in writing. A waiver shall be project
specific and shall not establish a precedent for any other proposed waiver. A request for a waiver must be made in writing and identify a detailed explanation of why the proposed waiver is warranted by site-specific conditions. Exceptions from these standards may be granted upon evidence that the exceptions are in the public interest, that they are based upon sound engineering judgment, and that the requirements for safety, function, appearance and maintainability are fully met. Exceptions shall be approved on a case by case basis in writing prior to construction. No public hearing is required for determination of a waiver by the Town Manager or Town Engineer.

1.5 DESIGN REVIEW PROCESS KEY CONCEPTS

A. The Town will review all civil infrastructure within its jurisdiction through the Town Engineer for compliance with the Public Works Manual and the minimum standards adopted by the Town.

B. The Granby Sanitation District will review wastewater infrastructure for compliance with their standards.
DIVISION 2

DRAINAGE AND EROSION CONTROL
## Division 2 Drainage and Erosion Control

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SECTION 2.1

DRAINAGE

2.1.1 DRAINAGE

Drainage easements and improvements shall be designed by a registered engineer to accommodate expected run-off as determined by the drainage plan. All drainage improvements described herein shall be the financial responsibility of the developer or subdivider, subject to provisions of Town Code and this Public Works Manual.

2.1.2 DRAINAGE CRITERIA

A. The drainage design should be in general conformance with the “Grand County Storm Drainage Design and Technical Criteria Manual”, adopted August 1, 2006. The Urban Drainage and Flood Control District “Urban Storm Drainage Criteria Manual”, Volumes 1 through 3, also contain applicable procedures that may be utilized in completing the drainage plan.

B. Project specific requirements should be discussed with the Town Engineer as early as possible in the application process. The rate of runoff from any developed area shall not exceed the historic rate of runoff based on a ten (10) year, twenty five (25) and one hundred (100) year rainfall event.

C. The following methods of runoff estimation may be utilized for determining the rate of runoff from a particular site as applicable:
   1. Rational Method. Used for Drainage Basins less than 200 acres in size and for minor system design.
   2. SCS TR 55 Methods. Used for drainage basins up to 20 square miles in size for flood flow determination and design in minor and major systems. Also used to compute flood storage volumes.
   3. Unit Hydrograph. HEC-HMS or other Town approved programs. Advance approval of method and application required. Used for drainage basins up to 1,000 square miles in size. Also used for flood flow determination and design in minor and major systems. Also used to compute flood storage volumes.
SECTION 2.2
CONTROL OF EROSION AND SEDIMENTATION

2.2.1. PURPOSE AND APPLICABILITY

A. Purpose: The goal of these requirements is to minimize the water quality impacts resulting from construction, clearing, grading, excavation and other land disturbing activities. Siltation is often a cause of water quality impairment in waterbodies in Colorado.

B. Applicability: These regulations apply to any land development and disturbing activities. Land disturbing activities include grading, excavation, clearing timber or vegetation, and construction.

C. Exemption: Single Family Construction
Construction of single-family residential units shall be exempt from these regulations if:
1. Less than ½ acre.
2. The Planning Department determines that exempting construction will not have a significant impact on water quality.

D. Other: Occasions may arise where these minimum standards are either inappropriate or cannot be practically implemented. In these cases, a variance to these criteria shall be considered. Written requests for each variance should be directed to the Town of Granby Manager or designated representative.

2.2.2 EROSION AND SEDIMENT CONTROL REQUIREMENTS

A. Minimize Erosion on the Site:
1. Phase construction: Stage and schedule the timing of earth disturbing construction activities, such as clearing, grading, road construction, and utilities installation to minimize soil exposure.

2. Install erosion and sediment control measures before site grading or other construction, to the greatest extent practicable. Erosion and sediment control measures are required for all construction sites in close proximity to existing storm drain infrastructure.

3. Soil stabilization: Disturbed areas and soil stockpiles shall be stabilized or protected to effectively control erosion. These areas should be surface roughened, mulched, or seeded and mulched, or otherwise protected from erosive forces if they will remain exposed and inactive for periods longer than 14 days. This requirement also applies if soil is expected to be exposed over winter to minimize erosion from occurring during spring snowmelt. Disturbed areas should be mulched or seeded and mulched within 7 days after final grade is reached, weather permitting.

4. On slopes steeper than ten percent (10%), or within one hundred feet (100') of any waterbody, exposed soils shall be stabilized using appropriate techniques.

5. Temporary and permanent revegetation: Disturbed areas that will not be built upon for one (1) year shall incorporate a temporary cover crop to promote soil
stability. Areas exposed for two (2) or more years must be revegetated with a perennial, native grass mix (or other grass mixtures as recommended by the local Natural Resources Conservation Service office). Within two (2) full growing season of project completion, vegetative site coverage shall have a perennial ‘herbaceous component equal to or greater than seventy percent (70%) of the adjacent undisturbed areas.

6. Cut and fill slopes: Where cut and fill cannot be avoided, slopes shall be designed for long-term stability. Permanent vegetation should be used as the priority approach to stabilization of cut and fill areas where slopes are less than or equal to 3:1. On steeper cut and fill slopes, stabilization may be attained by utilizing a combination of retaining walls, rock walls, up slope runoff diversions, terracing, slope drains, soil nailing, mulch binders, erosion control blankets, vegetation or other measures appropriate for the specific situation. Retaining walls over four feet (4’) in height or step retaining walls shall be designed by a Colorado registered engineer. The soil surface of cut and fill slope shall not remain exposed without an approved method of soil stabilization.

7. Construction in or directly adjacent to any waterbody, such as culvert or bridge installation, shall require measures to protect water quality and channel stability. This requirement may include stream isolation through the use of cofferdams, complete containment of the stream in the area of the disturbance, stream crossing structures, or limitations on the dates when in-stream work can be performed. In all cases construction shall conform to applicable USACE Section 404 permitting requirements and Colorado, DOW.

8. Protect new or re-routed irrigation ditches, swales, receiving channels and streams from accelerated erosion until conveyance section has established vegetation and is stable under flows for which the feature was designed. The minimum recurrence frequency storm during active construction for channel stability design is the 2-year event for the entire drainage area served by that flow conveyance feature. Diverting off-site flows around construction sites can effectively reduce the design flow. Must have approval from Ditch Company.

9. Protect culvert outlets from erosive flows by installing velocity reducers such as gravel dikes, riprap or similar measures.

B. Minimize Sediment Leaving the Site:

1. Manage stormwater runoff flows to minimize erosion and sediment transport off-site. Divert concentrated flows away from disturbed slopes and minimize length and steepness of disturbed slopes or use slope drains.

2. Minimize sediment and mud from leaving the construction site by protecting access routes by either immediate placement of street base or construction of vehicle tracking pads. Vehicle tracking pads shall be at least fifty feet (50’) in length, if available, and comprised of angular rock and/or a wheel washing facility.

3. Protect adjacent properties from sediment-laden runoff by using sediment fences, and sediment or silt traps or other appropriate control options.

4. Storm sewer inlets shall be protected from entry of sediment-laden water. Straw bales, supported silt fence structures, dumped rock or other barriers may accomplish this.

5. Divert off-site runoff around construction site when practical.
C. Detention and Treatment:
   1. When the contributing drainage area, including off-site area (unless bypassed), is greater than five (5) acres, one or more sedimentation basin(s) shall be constructed to provide a total of 1800 cubic feet of basin volume for every acre contributing runoff into the basin. The outlet of the sediment basin should be designed to empty the storage volume in no less than 12 hours. The basin's length should be no less than twice the basin's width; otherwise a baffle may be installed to minimize short-circuiting. If the discharge from the basin is passed through a filtration device (i.e. a vegetated field, forested area, or a constructed wetland) the basin volume requirements may be reduced.
   2. Where the contributing drainage area is less than five (5) acres, a specific engineered design for sediment trapping facilities is not necessary. Silt traps may be used to detain and treat runoff if the contributing drainage area is less than 5 acres.
   3. Sedimentation basins will be removed after successful revegetation of the site. Embankments to be left as permanent facilities shall have a capacity to safely pass the 100-year flood and meet any relevant dam and diversion requirements of the Colorado State Engineer's Office.

D. Construction De-watering:
   1. Construction dewatering activities will conform to the State's NPDES construction dewatering permit requirements.
   2. Discharges from construction dewatering operations shall be done in a manner which minimizes erosion and utilizes best management practices such as velocity reducers, sediment basins, straw bales or other measures.

E. Inspection and Maintenance of Erosion and Sediment Control Devices:
   1. Inspection: The applicant or the applicants designated representative shall inspect all erosion and sediment control devices and make repairs at a minimum, of every 14 days, or after precipitation or snowmelt event that causes surface erosion. An inspection log shall be kept on site for review by the Town until the project is complete and submitted to the Town upon request.
   2. Maintenance: Erosion and sediment control devices shall be maintained in a manner to support their effectiveness. Accumulated sediment should be periodically removed from sediment basins and traps; straw bale and silt fence barriers should be checked for undermining and bypass and repaired or expanded as needed; and mulched soils shall be re-mulched where mulch has been lost or damaged.
SECTION 2.3

CONTROL OF STORMWATER AND URBAN RUNOFF

2.3.1 PURPOSE AND APPLICABILITY

A. Purpose:
The intent of these regulations is to minimize water quality and flooding impacts resulting from increased imperviousness and land use changes which have been shown to degrade water quality and alter natural hydrology.

B. Applicability:
These regulations should apply to any commercial or industrial development, new subdivisions, new development within 150 feet of a waterbody (an ESA), and to any other development creating 10,000 square feet or more of impervious surface area.

C. Exemptions:
Occasions may arise where these minimum standards are either inappropriate or cannot be practically implemented. In these cases a variance to these criteria shall be considered. Written requests for each variance should be directed to the Granby Town Engineer or designated representative.

2.3.2 REQUIREMENTS FOR STORMWATER AND URBAN RUNOFF

A. Avoid Direct Discharge to Streams or Other Waterbodies:
Stormwater runoff from project areas likely to contain pollutants shall be managed in a manner that provides for at least one of the following:
1. Direct runoff to stable, vegetated areas capable of maintaining sheetflow for infiltration. Vegetated receiving areas should be resistant to erosion from a design storm of 0.5 inches in 24 hours.
2. On-site treatment of stormwater by use of best management practices designed to detain (see #3. Detain and Treat Run-off below) or infiltrate the runoff and approved as part of the Stormwater Quality Control Plan prior to discharge to any natural waterbody, or
3. Discharge to a stormwater conveyance structure, designed to accommodate the projected additional flows from the proposed project, with treatment by a regional or other stormwater treatment facility prior to discharge into any natural waterbody.

B. Minimize Directly Connected Impervious Areas:
The site design should minimize the extent of directly connected impervious area (DCIA) by including the following requirements:
1. Runoff from all developed impervious surfaces (rooftops, parking lots, sidewalks, etc.) shall drain over stable, vegetated pervious areas before reaching stormwater conveyance systems.
2. When impervious surfaces drain onto well-maintained grass buffer strips (or the equivalent) the maximum slope the grass buffer strips is 10 percent (10%) and the gradient should be uniform to insure evenly distributed sheet flows. Check dams may be necessary to maintain 10% slopes.
3. Practices other than grass buffer strips can be used to minimize DCIA. For example, play areas, parks, ball fields, and landscape features.

4. The requirement that all of the impervious area drain to vegetated pervious buffer strips may be reduced if the outflow from the vegetated pervious buffer strip is directed to other stormwater treatment methods. Examples of other potential techniques to be used in conjunction with vegetated pervious buffer strip are grass depressions, constructed wetlands, sand filters, vegetated swales, and dry ponds. Due to groundwater susceptibility to pollution, dry wells may not be used without specific approval by the Granby Town Engineer.

C. Detain and Treat Runoff:
Permanent stormwater detention facilities are required to be multipurpose facilities; that is facilities that not only detain flows to historic peak discharge rates, but which also provide water quality benefits. Such detention can be either "on-site" or "regional" in nature; however, detention must be provided concurrent with land development. Specific design criteria for detention facilities include:

1. Detention facilities must ensure the post-development peak discharge rate does not exceed the pre-development peak discharge rate for the 10-year and 100-year return frequency, 24-hour duration storm. In determining runoff rates, the entire area contributing runoff must be considered, including any off-site contribution. Off-site contributions shall be determined using the fully developed potential, based upon existing zoning subject to these requirements, of the area draining into the detention facility.

2. To minimize the threat of major property damage or loss of life all permanent stormwater detention facilities must demonstrate that there is a safe passage of the 100-year storm event without causing property damage.

3. Channels downstream from the stormwater detention pond discharge shall be protected from increased channel scour, bank instability, and erosion and sedimentation from the 25-year return frequency, 24-hour design storm.

4. Removal of pollutants shall be accomplished by sizing dry detention basins to incorporate a 40-hour emptying time for a design precipitation event of 0.5 inches in 24 hours, with no more than 50% of the stored water being released in 12 hours. If retention ponds ("wet ponds") are used, then a 24-hour emptying time is required. For drainage from parking lots, vehicle maintenance facilities, or other areas with extensive vehicular use this practice may require the additional use of a sand and oil grease trap or similar practice (e.g., constructed wetland, extended detention with no initial release, etc.). To promote pollutant removal, detention basins length-to-width ratio should be not less than 2, with a ratio of 4 recommended where site constraints allow. A sedimentation "forebay" is recommended to promote long-term functioning of the structure. Access to both the forebay and pond by maintenance equipment is essential.

5. On-site stormwater detention facilities require a written arrangement, which ensures that the facility is regularly inspected to ensure it is functioning properly and to provide any necessary maintenance.

6. All permanent stormwater detention basins shall be designed by a Colorado registered engineer.
D. Permanent Revegetation:
The requirements for permanent vegetation identified in Article V.B.(d) shall be applied following permanent revegetation standards are required:

1. Revegetate landscape within 7 days after final grade is reached. Grass or straw mulch should be crimped, tracked or tacked in place to promote surface anchoring.

2. On slopes steeper than ten percent (10%), or within one hundred feet (100') of any waterbody, exposed soils shall be stabilized using appropriate mulching techniques such as hydro-mulching, erosion control blankets, bonded fiber matrices or other equally protective measures.

3. Temporary measures for soil stability like mulch or silt fences shall be left in place until the vegetative cover has reached 70% of the disturbed area.
SECTION 2.4

HAZARDOUS MATERIALS MANAGEMENT

2.4.1 PURPOSE AND APPLICABILITY

A. Purpose:
Hazardous materials stored or used in close proximity to waterbodies create a potential threat to fish and other aquatic life. The purpose of these requirements is to minimize the likelihood of detrimental impacts to the waters and aquatic life from the storage and use of hazardous materials.

B. Applicability:
The following regulations should apply to all non-residential facilities and during any construction activity.

2.4.2 REQUIREMENTS FOR HAZARDOUS MATERIALS STORAGE AND USE

A. Compliance with Regulations:
At a minimum, all hazardous materials shall be stored and used in compliance with applicable state and federal hazardous materials regulations.

B. Storage Near Waterbodies Restricted:
The storage of hazardous materials within 100 horizontal feet of any waterbody is restricted. When no practical alternative exists, site specific BMP’s must be utilized to minimize potential adverse water quality impacts. Sand and salt for road traction, while not hazardous materials, shall not be stored within 100 horizontal feet of any waterbody unless there is no practicable alternative, in which case suitable site-specific BMP’s must be utilized.

C. Spill Prevention:
Measures shall be designed and implemented to prevent spilled fuels, lubricants or other hazardous materials from entering a waterbody, including groundwater, during construction or operation of equipment and/or facility. If a spill occurs, it should be cleaned up immediately and disposed of properly.

D. Machine Maintenance:
Routine field maintenance of vehicles or mobile machinery shall not be performed within 100 feet of any waterbody. Emergency maintenance can be conducted until the vehicle or machinery can be moved. Routine equipment maintenance should be performed in a designated area and measures such as drip pans used to contain petroleum products.

E. Fuel Storage Areas:
Containment measures shall be provided for all fuel storage areas to prevent release to any waterbody. Inventory management or leak detection systems may be required.

F. Waste Storage:
Areas used for the collection and temporary storage of solid or liquid waste should be designed to prevent discharge of these materials in runoff from the site. Collection
sites should be located away from the storm drainage system. Other BMP's such as covering the waste storage area, fencing the site, and constructing a perimeter dike to exclude runoff may also be necessary.
SECTION 2.5

SNOW STORAGE

2.5.1 PURPOSE AND APPLICABILITY

A. Purpose:
Snow removal often results in the accumulation of sand, oil and grease, metals, trash, pet wastes, and other pollutants found in urban stormwater. The purpose of these requirements is to promote responsible snow storage and management techniques to minimize the likelihood of these pollutants entering waterbodies.

B. Applicability:
The following regulations should apply to all development. Single-family residential units are exempt from these requirements if they are part of a subdivision that provides snow storage and removal.

2.5.2 SNOW STORAGE REQUIREMENTS

A. An area equal in size to fifteen percent (15%) of the area to be plowed shall be set aside for snow storage. Site-specific analysis may also be used to determine snow storage requirements.

B. Designated snow storage area shall not be less than six feet wide. These areas shall be adjacent to the area from which the snow is to be removed when practical, shall not be included in any parking area required by the minimum parking requirements of the town/county and shall be contained in such a manner that runoff is directed through a detention or infiltration facility or other BMP that removes pollutants, including vegetated areas.

C. In lieu of on-site snow storage, off-site snow storage may be approved if: (1) an appropriate off-site snow storage site is available; (2) arrangements for the off-site removal have been made in a manner assuring the continuation of such practice; (3) assurances of continued availability of such a storage site are made; and, (4) the alternative snow storage site provides adequate water quality protection through the use of appropriate snow storage treatment practices.

D. Design of snow storage treatment facilities for off-site snow storage facilities shall be in accordance with the following:
1. Maintain existing peak flow rates for storms up to and including the 25-year, 24-hour rainfall event, in combination with a melt rate from the snow stockpile of 2 inches in 24 hours.
2. Sites with favorable infiltration rates are encouraged.
3. Minimize run-on by diverting runoff around stockpiles if possible.
4. Vegetate the storage areas with species appropriate to the site conditions.
5. Discharges shall be non-erosive and/or measures shall be taken to protect receiving channels.
6. Good site access for trash removal and periodic maintenance.

E. Dumping snow plowed from roadways and parking areas into any waterbody is prohibited.
 SECTION 2.6

SUBMITTAL REQUIREMENTS

2.6.1 EROSION AND SEDIMENT CONTROL PLAN

A. Erosion and Sediment Control Plan must be submitted for review and approval. The Erosion and Sediment Control Plan shall be prepared by a Colorado registered engineer, or if not needed for building plans a Colorado registered architect. This information may be included as part of a Stormwater Quality Control Plan, if required.

B. A concise erosion and sediment control plan shall be submitted that addresses site-specific issues and contains the following information:

1. A site map showing construction site boundaries, locations of any existing structures, waterbodies or hydrologic features on the site, including intermittent water features, springs, landscape irrigation return flows, wetlands and the 100-year floodplain boundaries.

2. Locations of existing and proposed drainage structures or natural drainage features on the land adjacent to the site and within a minimum of 100 feet of the site boundary line, including as examples: Street gutters, storm sewers, drainage channels, other water conveyance structures, wetlands or other waterbodies receiving storm runoff from the site.

3. Existing topography at reasonable contour intervals, 2-foot or less if possible, to provide necessary detail of the site. The map should extend a minimum of 100 feet beyond the property line and show the location of the property line.

4. Proposed development plan and grading plan. The proposed topography at reasonable contour intervals that provide necessary detail of the site shall be submitted. The map should show elevations, dimensions, location, extent and slope of all proposed clearing and grading including building site, areas of cut and fill, and driveway grades.

5. Probable locations of soil stockpiles and snow storage areas.

6. Proposed drainage plan

7. Location of storage areas designated for equipment, fuel, lubricants, fertilizers, chemical and waste storage with an explanation of spill containment structures.

8. Location of temporary roads designed for use during construction period.

9. Areas of steep slope locations must be shown for the following conditions:

   Existing Site:        areas greater than or equal to 10%
   areas greater than or equal to 30%

   Developed Area:     areas greater than or equal to 10%
   areas greater than or equal to 30%

10. Construction schedule indicating the anticipated starting and completion time periods of the site grading and/or construction sequence including the installation and removal of erosion and sediment control measures, and the estimated duration of exposure of each area prior to the completion of temporary erosion and sediment control measures.

11. Permanent stabilization - A brief description of existing vegetation at the site including an estimate of the percent vegetative ground cover and a description of how the site will be stabilized after construction is completed.
12. Plan view drawings of all erosion and sediment control measures (such as sediment traps, silt fence, inlet protection, etc.) showing approximate locations and site drainage patterns. Text may be necessary to accompany and explain the drawings.

13. Detail drawings - For those measures that are not typical erosion control practices or require specific engineering design, such as sediment basin outlet works.

14. Estimated total cost (installation and maintenance) of the required temporary soil erosion and sediment control measures to assist the Town to determine performance guarantees, if any, for the proposed plan.

15. Calculations - Any calculations made for determining rainfall, runoff, sizing any sediment basins, diversions, conveyance or detention/retention facilities.

16. Other information or data as may be reasonably required by the local jurisdiction.

17. Signature block for owner or legal agent acknowledging the review and acceptance of responsibility, and a signature and stamped statement by the qualified individual acknowledging responsibility for the preparation of the Erosion and Sediment Control Plan.

18. A copy of the required NPDES Construction Permit, if required. State and federal law mandates a Stormwater Permit for construction sites disturbing one acre or more even where the disturbance is phased. In most cases the information required herein will meet state submittal requirements.

2.6.2 STORMWATER QUALITY CONTROL PLAN (SQCP)

A. A Site-specific Stormwater Quality Control Plan (SQCP) must be submitted for review and approval. The SQCP should consist of a narrative report supported by exhibits, where necessary, and should be developed and submitted as an integral part of the site's drainage plan. The following information must be included within the SQCP, or identified in the Erosion and Sediment Control Plan or the drainage report:

1. Name, address and telephone number of the applicant and the qualified individual preparing the report, if applicable;

2. Project description briefly describing the nature and purpose of the development or redevelopment, the total area of the site, the area of disturbance involved, and project location including legal description;

3. Existing site conditions should be described including existing topography, vegetation, and drainage. If wetlands are present on the site, they must be described according to the applicable Army Corps of Engineers delineation manual;

4. A vicinity map indicating the general area and property lines;

5. An exhibit or map of drainage features and basin boundaries on the site. If the location of the SQCP BMP’s are not indicated on the site drainage map than these BMP’s should be shown here;

6. Percentage of steep slope areas must be calculated for the following conditions:

   Existing Site: 
   - areas greater than or equal to 10%
   - areas greater than or equal to 30%

   Developed Area: 
   - areas greater than or equal to 10%
   - areas greater than or equal to 30%
7. Neighboring areas must be described as to land use and existing pertinent features such as lakes, streams, structures, roads, etc.;
8. A description of the stormwater quality management-planning concept for the site, including both structural and non-structural best management practices;
9. Hydrologic, hydraulic and all other calculations used to size and design drainage facilities and/or structural BMP’s; and,
10. Maintenance requirements for all proposed BMP’s should be discussed including access, schedules, costs, and designation of a responsible party.
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# Division 3 Utilities

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SECTION 3.1

GENERAL UTILITIES

3.1.1 GENERAL

A. This section includes general information and material specifications for utilities within the Town of Granby.

B. All development will be required to construct all infrastructure necessary to support the proposed uses, as determined by the Town. In the event oversized utilities are required or warranted for proper planning, arrangements for reimbursements may be made, whereby the developer could be allowed to recover the cost of the utilities that have been provided beyond the needs of his development and standard Town requirements. The method and time of payment under the reimbursements shall be established in accordance with the current policies of the Town relating to the placement of such oversized utilities.

3.1.2 EASEMENTS

A. All utilities shall be located in the right-of-way or an approved easement.

B. Minimum easement width shall be thirty (30) feet for water, sewer and drainage facilities. Over-depth installations shall require wider easements.

C. Electric, telephone, TV cable and gas shall be located completely within the right-of-way or easements approved by the respective utility provider.

3.1.3 WATER DISTRIBUTION

A. Water distribution lines and service connections shall adhere to requirements detailed in this Public Works Manual.

B. Design of the system shall be the responsibility of the Applicant with all plans subject to approval of the Town Board through their designated representatives.

C. Installations of the system shall be to Town specifications and at the direction of the Town Board through their designated representatives.

D. Financial responsibility for the water distribution system shall be subject to existing Town regulations and agreement relating thereto between the Town Board and the Applicant, subject to provision of the Town of Granby Public Works Manual.

3.1.4 SANITARY SEWAGE COLLECTION

A. The sewage collection system shall be designed to connect with the Town Authority/Granby Sanitation District system and provide service to each lot in the proposed subdivision.
B. Design of the system shall be the responsibility of the Applicant with all plans subject to the approval of the Town and Granby Sanitation District through their designated representatives.

C. Financial responsibility for the sanitary sewage collection system shall be subject to existing Town regulations and agreements relating thereto between the Town and the Applicant, subject to the provisions of the Town of Granby Public Works Manual, and requirements of the Authority and Granby Sanitation District.

3.1.5 OTHER UTILITIES

A. All utilities, except major power transmission lines, shall be underground, unless specifically exempted by the Town Board, who shall grant such exemption only in cases of extreme difficulty.

B. Facilities necessary and appurtenant to underground facilities or other installation of peripheral overhead electrical transmission and distribution feeder lines, or other installation of either temporary or peripheral overhead communications, distance, trunk, or feeder lines may be above ground.

3.1.6 CROSS-CONNECTION CONTROL

A. Refer to Chapter 13.15 of the Town of Granby Municipal Code.

3.1.7 SUBMITTALS

A. Prior to Town approval of any development, a Master Utility Plan shall be submitted with all development applications. The Master Plan shall be at a scale (1” = 200’ or larger) sufficient to show all connections to existing infrastructure, proposed utility corridors and easement widths. Detailed plans shall be submitted that indicate proposed utility elevations and demonstrate that conflicts at crossing do not exist.
SECTION 3.2
WATER TRANSMISSION AND DISTRIBUTION LINES

3.2.1 GENERAL

A. This section shall include all materials, labor, equipment and miscellaneous items necessary to install all raw water, potable water transmission and distribution pipelines and appurtenances as specified herein for the Town of Granby.

B. The water main distribution system shall be designed to connect with the Town water system and make water available to each lot in the proposed subdivision.

C. Design of the system shall be the responsibility of the Applicant with all plans subject to approval of the Town Board through their designated representatives. Installations of the system shall be to Town specifications and at the direction of the Town Board through their designated representatives. Financial responsibility for the water distribution system shall be subject to existing Town regulations and agreement relating thereto between the Town Board and the Applicant, subject to provision of the Town of Granby Public Works Manual.

3.2.2 PROTECTION OF WORK

A. All pipe, fittings, valves and equipment shall be carefully handled, stored and protected to prevent damage to materials, protective coatings and linings. At no time shall such materials be dropped or dumped into the trench.

B. Precautions shall be taken to prevent foreign matter from entering the pipe, fittings and valves prior to and during installation. No debris, tools, clothing or any other material shall be placed in the pipe during installation. Whenever pipe installation is suspended, either temporarily or overnight, the open end of the pipe shall be sealed with a watertight plug to prevent the entrance of trench water, debris or foreign matter into the pipeline system.

C. Under no circumstances shall trench water be allowed to enter the pipeline. When water is present in the trench, the plug shall remain in place until the trench is pumped dry. Whenever trench water becomes evident, measures shall be taken to prevent pipe flotation.

D. If, in the opinion of the Engineer, the Contractor is incapable of keeping the pipe free of foreign matter during installation, the Engineer shall require the Contractor to protect the pipe ends with water tight plugs until the start of the joining operation.

3.2.3 DUCTILE IRON (DIP) PIPE AND FITTINGS

A. DIP Pipe:
   2. Thickness Class 52.
   3. Reference Standard – ANSI A21.44. Specialties - Tracing wire, 12-gauge stranded copper insulated wire with bolt type splices on all water mains,
services and fire hydrants. All splices shall be water tight and underground. Tape wire to pipe every 4 feet.

4. **Size** - Shall conform to outside diameter of DIP.

5. **Restrained Joint Pipe** – Shall be ductile iron manufactured in accordance with requirements of ANSI A21.5 / AWWA C151. Push-on joints for such pipe shall be in accordance with ANSI A21.11/AAWA C111. Pipe shall be U.S. Pipe Field Lok 350 or equal. Unless otherwise specified on engineered drawings.

6. **Cement mortar lining and bituminous outside coatings for the pipe and fittings** shall be as specified above for ductile iron pipe.

7. **Restrained push-on pipe shall be capable of being deflected after assembly.** Any special assembly tools recommended by the manufacturer will be supplied by the Contractor.

8. **Contractor is required to perform conductivity test prior to paving.**

**B. Fittings:**

1. **Reference Standard** - ANSI A21.10 or 21.53 / AWWAC153. Fittings for pipes of 12” and smaller shall be C250 and for pipes larger than 12” C150

2. **Pressure Rating** – 350 psi for C153 and 300 for C150.


4. The interior of the fittings shall be cement-mortar lined or epoxy coated, as is required for the pipe with a 1 mil bituminous exterior coating. Gaskets for the joints shall be suitable for potable water service.

5. Retainer glands (Mega Lugs or equal) are required on all fittings.

6. Core Blue bolts to be used on all fittings.

7. **Restrained push-on pipe shall be capable of being deflected after assembly.** Any special assembly tools recommended by the manufacturer will be supplied by the Contractor.

**C. Joints:**

1. **Push-on rubber gasket.**


3. **Restrained joint fittings shall be ductile iron in accordance with applicable requirements of ANSI 21.10/AAWA C110 with the exception of the manufacturer's proprietary design dimensions.** Push-on joints for such fittings shall be as specified above for the pipe. Fittings Shall be provided by the pipe manufacturer.

**D. Polyethylene Encasement:**


2. **Polyethylene –** The polyethylene film shall be manufactured of virgin polyethylene material conforming to the requirements of ASTM D-1248. The raw materials shall be Type 1, Class A (Natural) or C (Black, Grade E-1 with flow rate of 0.4 max. and dielectric strength of 10 ohm-cm min.

3. **Polyethylene Film –** The finished polyethylene film shall have a minimum nominal thickness of .008-inch (8mil), and the minus tolerance on thickness shall not exceed 10 percent of the nominal thickness. The film shall have a minimum tensile strength of 1200 psi with an elongation of 300 percent minimum. The dielectric strength shall be 800 volts/mil thickness minimum.

4. **Tube Size or Sheet Width:** The tube size of sheet width for each pipe diameter shall be as listed in the following table: Nominal Minimum Width (inch)
Nominal Pipe Diameter (inch) | Nominal Width (inch) | Flat Tube | Sheet
---|---|---|---
4 | 16 | | 32
6 | 20 | | 40
8 | 24 | | 48
10 | 27 | | 54
12 | 30 | | 60
14 | 34 | | 68
16 | 37 | | 74

E. Thrust Restraint:
1. Thrust Restraint- Thrust blocks and retainer glands to be used on all fittings and valves. Where specified on engineered drawings or where existing conditions do not permit the use of concrete thrust blocks, fitting restraints shall be made with approved mechanical restraints, tie rods and clamps or special fitting bolts. Tie rod restraint system shall have a minimum of 2 bolts or rods per joint or clamp. Minimum tie bolt sizes are as follows:

<table>
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<tr>
<th>Pipe Size</th>
<th>Bolt Diameter</th>
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<tr>
<td>4” – 8”</td>
<td>5/8”</td>
</tr>
<tr>
<td>10” – 14”</td>
<td>3/4”</td>
</tr>
<tr>
<td>16”</td>
<td>1”</td>
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</table>

The tie bolts shall be fabricated from “Cor-Ten” steel or equal according the requirements of ASTM A242 with a minimum yield stress of 46,000 psi.

3.2.4 INSTALLATION – GENERAL

A. All transmission and distribution lines to be dedicated to the Town of Granby, shall be located a minimum of ten feet inside the right-of-way or a public easement. The location of water lines within side lot line easements or rear lot easements is discouraged.

B. At all times, water lines shall be located so that Town maintenance personnel can easily maintain and operate those lines. Trees, shrubs and heaving landscaping are not permitted over waterlines.

C. Easements or rights-of-way used during installation of water mains shall be a minimum width of 30 feet. In dredge areas and other special conditions, a wider easement may be required.

D. Utility crossing shall be perpendicular to the waterline alignment.

E. Maintain a minimum separation of ten feet from parallel utility installations. Larger separations may be required for deeper utilities.
F. All waterlines shall be installed in a trench condition. In cases where fills are to be placed required along a waterline alignment, those fills shall be placed and compacted in accordance with project requirements to a minimum elevation equal to at least 12" above the top of pipe. Subsequently, the pipe trench shall then be cut excavated followed by bedding, pipe and pipe zone backfill installation.

3.2.5 PIPELINE DEPTH

A. The minimum depth of bury of water mains shall be as follows: (Depth of bury equals depth to top of pipe) Mains shall be buried a minimum depth of 8 feet (below existing or proposed grade) in all locations.

B. When water mains are to be located underneath storm drains, culverts or any other submerged air space, the required depth of bury shall be deepened as necessary to ensure that the water line is beyond the frost depth associated.

C. Design profiles shall minimize high and low points with the storm drain culvert, etc. In some cases, the Town engineer may allow insulation in place of increased depth.

3.2.6 CLEANING AND INSPECTION

A. Clean all pipe, fittings, valves and related materials thoroughly of all foreign material; inspect for cracks, flaws, or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayons or paint and remove from job site. Of particular concern should be the gasket groove in the pipe bell. All spurs, excess paint, and any other defects within the gasket groove shall be either removed or repaired, or the pipe shall be deemed unacceptable.

B. The Contractor shall take all necessary precautions to prevent any construction debris from entering the water lines during construction of water lines and appurtenances. If debris shall enter the distribution system, the Contractor shall furnish all labor and materials necessary to clean the system. Under no circumstances will the Contractor flush the debris into an existing distribution system.

3.2.7 INSTALLATION

A. Pipe shall be laid in straight sections with bell ends facing the direction of laying unless otherwise directed by the Town. Where pipe is laid on grade of 10% or greater, the installation shall proceed uphill with the bell ends facing upgrade. The pipeline shall be installed so that a continuous positive or negative grade is maintained between high and low points to avoid air pockets. At no time will a high point in the line be acceptable unless a fire hydrant is installed to relieve air pockets. Jointing of the pipe shall be made in accordance with the directions of the manufacturer of the pipe and the manufacturer of the couplings. The allowable pipe deflection per joint shall not exceed the maximum deflection tolerances specified by the manufacturer.

B. Pipe shall be lowered into the trench with ropes, slings or machinery. Under no circumstances should the pipe be pushed off the bank and allowed to fall into the trench. In joining the pipe, the exterior four inches of the pipe end (at the spigot), and the inside of the adjoining bell shall be thoroughly cleaned to remove oil, grit, tar and
other foreign material. The gasket shall be placed in the bell so it will spring into its proper position inside the pipe bell. A thick film of the non-toxic NSF approved joint lubricant shall be applied over the entire surface of the gasket. The spigot end of the pipe shall then be wiped clean and inserted into the bell to contact the gasket. The pipe shall be pushed all the way into the bell by crowbar or by jack and choker slings. Extreme care shall be exercised when joining the pipe to avoid damaging the bell or rolling the gasket. The bell end of the pipe shall be protected by a piece of wood when pushing the pipe. Generally, every pipe has a depth of insertion stripe on the spigot end. The pipe shall be inserted to the full depth of the stripe. Check bells for rolled gasket with feeler gauge.

C. The cutting of pipe for fittings or closure pieces shall be done in a neat and workmanlike manner to prevent damage to the pipe or lining. All cuts should leave a smooth end at right angles to the axis of the pipe. Once a pipe is cut, the cut end shall be beveled free of spurs, which may damage rubber gaskets. Only pipe certified round for the full length shall be cut and used for closure pieces.

3.2.8 ALLOWABLE PIPE DEFLECTION

A. If permitted by the Town, gasket-joined pipe may be deflected with the following limitations as defined in the most current version of Ductile Iron Pipe Research Association (DIPRA).
   1. Contractor shall block or brace pipe joints to ensure bending of pipe does not result in joint offset that exceeds the manufacturer’s published limits as damage may occur.
   2. Design deflections shall not exceed ½ of manufacturer’s recommendations.

3.2.9 CONNECTION TO EXISTING WATER FACILITIES

All main line connections between existing and proposed piping shall be made during non-business hours or at a time, which is acceptable to the Town. All shut-offs shall be planned 72 hours in advance and all persons affected by the shut-off shall be given a 24-hour notice. Special circumstances may exist calling for evening or weekend shutoffs. Shutoffs will not be allowed on Fridays or weekends or holidays unless pre-approved. Take all precautions to prevent contamination when making connections to existing potable water lines. No trench water, mud, or other contaminating substances shall be permitted to enter the pipeline.

3.2.10 FUTURE CONNECTIONS

At intersections, dead-end runs, or other locations where the possibility may exist for a future connection, a tee or cross and a valve should be provided. In addition, the stub out must extend to the property line. This procedure allows a future connection to be made while keeping the existing main line in service at all times. In each case, the valve shall be properly restrained to the tee or cross, using restraining rods with eyebolts. In addition, a concrete reaction block will be placed on the plugged end of the valve. Contractor shall install a tee-post at end of line.

3.2.11 PROTECTION OF WATER SUPPLIES

A. Water lines shall be located a minimum of 10 feet horizontally from existing or proposed sewer mains. Wherever the sewer line crosses above or within 18 inches
beneath the water lines, the sewer line shall be made impervious by the following method listed below.

1. Twenty feet of AWWA DR18 C-900 PVC, centered over water line, shall be used for sewer pipe and centered over the water main. The joints between the sewer pipe and the placement pipe (PVC) shall be sealed with solid sleeves with transition gaskets. All work should be in strict conformance with the current Colorado Department of Health and Environment's "Design Criteria for Potable Water Systems".

2. Concrete encasement or flow fill around the sewer line extended 10’ to either side of the water line.

3.2.12 REACTION ANCHOR AND BLOCKING

A. Concrete thrust blocks shall be provided for all tees, elbows, plugs, reducers, valves, fire hydrants, and crosses if one or more sides of the cross are plugged. The bearing area of the block shall be at least equal to that stated on the attachment. The bearing surface shall be against undisturbed earth. The block shall be placed normal to the thrust as shown on the drawings. Concrete for thrust blocks shall have a 28 day 4,000 psi compressive strength. (NOTE: No other materials other than concrete may be used in thrust blocks and ready mix or bagged concrete is not allowed).

B. Contractor shall allow concrete to cure for 3 days prior to backfilling, or 1 day if high early additive is used. If the concrete has not had sufficient time to cure (e.g., restoring water service), the Contractor shall be required to use temporary bracing for added strength. Use of additional wood bracing will help prevent fitting and valves from leaking or "blowing off" when water pressure is restored to the main line.

C. Whenever a concrete thrust block is placed, wood or plastic sheets shall be used to prevent concrete from adhering to nuts and bolts. Any concrete splattering onto a nut or bolt will be removed before the line is backfilled.

D. Materials: Sakrete or approved equal can be used for 11.25° bend fittings to virgin soil, otherwise use Redi-Mix concrete.

3.2.13 TRACER WIRE

Electrical tracing wire shall be required on all water mains. The wire shall be taped to the top of the pipe at 4 foot intervals to prevent dislocation of the wire during backfilling. The tracer wire shall be extended to the surface at all valves and fire hydrants. The wire shall be extended towards the ground on the outside of the valve box until the wire is within 4 inches of the top of the lid, at which point it shall be brought back inside the box and securely fastened. Sufficient slack in the outside of the wire shall be provided to compensate for any future adjustment to the valve box. Tracer wire shall be installed on all water and sewer services and shall be continuity tested prior to acceptance of the pipeline.

3.2.14 DETECTABLE UNDERGROUND MARKING TAPE

Underground marking tape shall be a 3 inch width detectable marking tape, with a minimum 5.0 mil overall thickness. Tape shall be manufactured using a 0.8 mil clear virgin polypropylene film, reverse printed and laminated to a 0.35 mil solid aluminum foil core, and
then laminated to a 3.85 mil clear virgin polyethylene film. Tape shall be printed using a diagonally striped design for maximum visibility, and meet the APWA Color-Code standard for identification of buried utilities. Tape shall be buried 2 feet above pipe.

3.2.15 SIZING OF MAINS

All main water lines shall be sized for peak hour flow plus fire flows required by the Town of Granby and Fire Department at a 20 psi residual flow. Minimum size shall be 8 inches in diameter.
SECTION 3.3
WATER SERVICE LINES AND APPURtenances

3.3.1 GENERAL

This section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to install all water service lines and appurtenances as specified herein for the Town. Note: The customer will own and maintain the service line from the main line up to the residence/building including the curb valve. The curb valve shall be placed on the property line; however, at all times, it will fall on the Town side of the property line. All work and materials from the curb valve to the building shall be in conformance to the most recently adopted Plumbing Code. The property owner owns water service lines and appurtenances from main to meter including the corporation and curb stops. Refer to Details W3 and W3A.

3.3.2 COPPER SERVICE PIPE

A. Reference Standard - ASTM B88, latest revision, Type K soft copper unless otherwise approved by Town. If HDPE is used, tracer wire must be used with service line.

B. Size - 0.75 – 1.5 inches.

C. Any water services 4 inches or greater shall be ductile iron pipe.

D. Do not use any pipe lubricants for service line fittings.

3.3.3 CORPORATION STOPS

A. Material - Brass or bronze.

B. Size - Same as copper service line.

C. Reference Standard - AWWA C800, latest revision.

D. Inlet - Threaded CC type.

E. Outlet - Compression fittings.

F. Manufacturer Reference - Mueller 300-B25029

G. Non-leaded.

3.3.4 SERVICE SADDLES

A. Materials – ductile iron service clamp, 'O' ring gasket, stainless steel double straps, CC thread.

B. The Town will require saddles to be installed on all service connections.

C. Manufacturers reference – Mueller or Ford.
3.3.5 CURB STOP

A. Materials - Cast bronze body, resilient 'O' ring seals, standard tee head operator, Teflon ball valve type. No waste stops unless approved by Town.

B. Riser rods – Stainless steel

C. Inlet - Compression fitting.

D. Outlet - Compression fitting.

E. Standard reference AWWA C800, latest revision.

F. Manufacturer’s reference - Mueller or McDonald.

G. Non-leaded.

3.3.6 CURB BOX

A. 0.75 inch to 1.25 inch, Manufacturer’s reference - Mueller H-10314 or equal.

B. 1.5 inch to 2.0 inch, Manufacturer’s reference - Mueller H-10336 or equal.

C. Curb box must be traffic rated when located within traffic areas.

D. Material type – Cast Iron

E. All curb boxes shall be traffic rated.

3.3.7 COUPLINGS

Couplings are not allowed for services less than 100 feet long from the curb stop to the main and curb stop to house. In the case of a service line exceeding the available length of copper piping, couplings may be used, compression fittings only. If a coupling is used the service line must be tested to 1.5 times normal working pressure or 150 psi minimum with the coupling exposed so a Town representative can verify.

3.3.8 SERVICE LINE INSTALLATION

All trenching, backfilling and compaction shall conform to these regulations. All service lines shall be disinfected and pressure tested as per these regulations.

3.3.9 SERVICE LINE DEPTH.

A depth of bury for all service lines shall be a minimum of 8 feet.

3.3.10 TAPPING PRESSURIZED MAINS

All residential taps shall be a standard ¾". Taps on pressurized mains shall be made by the Contractor. Larger services are allowed with approval of the Town.
3.3.11 PERMITS

A road cut permit for excavation in Granby streets, alleys and easements must be completed prior to tap. 72 business hour notice is required by the Town prior to making taps and locating lines. Taps and locations will not be done without a water application filled out by Customer. Permits can be obtained from 8:00 am to 1:00 pm, Monday through Thursday.

3.3.12 SERVICE LINE SIZING

Service lines are to be 0.75". Larger services are allowed with approval of the Town. Maximum copper service line allowed will be 1.5 inches. Services 1.5” to 2” shall be C-901 HDPE and C-151 4” DIP (Class 52) shall be used for services larger than 2”. The customer shall have an engineer size the service line. The Town will not provide this service.

3.3.13 SERVICE CONNECTIONS OVER 100 FEET LONG

Service connections 1.5 inches in size and smaller shall be continuous type k type soft copper without pipe unions between the main and curb stop and the curb stop and the house.

3.3.14 FINAL INSPECTION

The final inspections shall be scheduled with the Town 72 business hours in advance. The first inspection will include the service line. The second inspection will include other appurtenances such as the water meter, backflow device, PRV, curb valve and sewer cleanout.

3.3.15 FLOW METERS

A. General:
   1. Magnetic drive
   2. Sealed register
   3. Automatic meter read device
   4. Turbo meters for 3 inch and larger
   5. The Town will provide the meter and equipment at the Owner’s cost.

B. Installation:
   1. Install all meters in a horizontal position with a suitable holding device to support piping, meter and provide electrical bond when meter is taken out for testing. Pre-manufactured holding devices or yolks are available which cut down labor time to install meter. Install in building where meter and pressure reducing valve will not freeze. Upon final inspection, if the meter is not able to be read by radio from the street, the MXU may need to be relocated on an outside wall at least 36-48” above grade where it is freely accessible and where falling or melting snow will not cover it (stucco construction can prevent the meters from being read by radio). MXU shall be easily accessible and located near the other utilities.
   2. Turbine meters should be installed with five pipe diameters upstream or downstream of bends, valves, PRV’s, check valves or any other fitting that causes turbulence.
C. The water meter must be inspected by the Town at final inspection after it is installed and before the Certificate of Occupancy is issued.

D. Meter pits are not allowed

3.3.16 PRESSURE REDUCING VALVE (PRV)

A. Manufacturer’s Reference: Watts U-5-B or approved equal.

B. Installation:
   1. Install upstream of all meters.
   2. Allow for easy access to strainer and cleanout plug.

C. Pressure Testing: Downstream pressure to be set at 70 psi for single family and 90 psi for multi-story.

D. Inspection: PRV will be inspected during final inspection.

3.3.17 BACKFLOW PREVENTION DEVICES

A. Refer to Town Code 13.15.

B. A backflow device is required on all new construction. Residential construction will require at a minimum a non-testable double check device. Non-testable devices must be replaced every five years and notice of replacement sent to the Town. Commercial complexes (low risk) and residential complexes that have a common water line are required to install a testable double check device. Testable devices must be tested every year and the results sent to the Town. Commercial and industrial complexes that use hazardous materials are required to install a reduced pressure assembly (RP). The RP device must be tested by a certified backflow technician every year with the results sent to the Town.

C. A single backflow device may be insufficient to protect the water supply. Irrigation systems that use potable water must have a separate vacuum breaker. Most of the secondary installations are addressed in the plumbing code.

D. Because backflow devices prevent pressure from bleeding back to the water main, an expansion tank will need to be installed to prevent damage to the buildings water system.

E. Type:
   Reduced pressure principle backflow assembly (RP) or as required by state law

F. Manufacturer’s Reference:
   Febco/Watts

G. Installation:
   Backflow prevention device must be installed after the meter and the pressure reducing reducing valve.
H. Inspection:
Backflow preventer will be inspected during final inspection.

3.3.18 ABANDONMENT OF SERVICES

A. Water Services:
Shall be abandoned at the main. Abandonment will consist of removing the service from the corporation valve and closing the corporation valve and/or tapping valve.

B. Water Wells:
All wells located on the subject property must be properly plugged and sealed as required by Rule 15 of the Colorado State Engineer’s Regulations, or any amendment or revision of that rule. There shall be no direct connection between a private well and the Town’s water system. It is the ultimate responsibility of the well owner to have a well properly plugged and sealed. Water rights associated with such wells must be assigned to the Town of Granby before water service will be extended to such property. Evidence of well abandonment must be provided to the Town of Granby prior to issuance of Certificate of Occupancy. Additionally, a recorded copy of the Colorado State Well Abandonment filing must be provided to the Town of Granby within 90 days of abandonment.

3.3.19 BLOW OFFS

A. Temporary blow-offs will be considered and require approval by the Town. Any permanent blow-off shall be installed as a fire hydrant.
SECTION 3.4

FIRE PROTECTION FACILITIES

3.4.1 GENERAL

This section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to install fire hydrants as specified herein for the Town of Granby.

3.4.2 FIRE HYDRANTS

A. Materials:
   1. Type - Dry barrel, traffic model with breakaway flange bolts and coupling.
   2. Reference Standard - AWWA C502, latest revision
   3. Outlet Size - One 4.5 inch NST, two 2.5 inch NST
   4. Hydrant Size – 6 feet or greater, from bury line to top of pipe
   5. Inlet Size - 6 inch
   6. Operation – 1.5 inch pentagonal national standard operating nut, open counterclockwise, lubricating reservoir.
   7. Depth of Bury – 8 feet minimum
   8. Additional Requirements - Furnish hydrant complete with pipe and tee, 6 inch restrained mechanical joint gate valve and thrust blocks, integral Storz nozzle and flag. Hydrant shall be restrained to the hydrant tee by 0.75 inch Core Blue bolts protected from corrosion by the use of an approved bituminous coating. Furnish hydrant with bronze seat and lubrication reservoir. Either all thread or mega lugs can be used.
   9. Manufacturer's Reference – Mountain Spec Mueller Centurion
   10. Color - Hydrant to be painted red above the bury line.
   11. Pressure Rating - 250 psi

3.4.3 FIRE HYDRANT INSTALLATION

A. Hydrant Spacing:
   The development density and type of development shall determine the spacing of fire hydrants that each hydrant is to serve, in conformance with the International Fire Code. In a low-density residential area, the maximum spacing of fire hydrants shall not exceed 500 feet. In medium to high-density residential areas, the maximum spacing shall not exceed 400 feet. In commercial and high-risk areas, the spacing shall not exceed 300 feet. The maximum distance from commercial buildings to hydrants shall be 150 feet, and shall be based on hose length. A maximum spacing of 1000’ applies along roadways with no development.

B. Location:
   Fire hydrants shall be located whenever possible at an intersection and in a public right-of-way or a utility easement. There shall be a minimum of 1.5 feet between outlet nozzle and back of curb or sidewalk. In all cases, hydrants shall be located out of the direct flow of pedestrian and vehicular traffic. Wherever possible, hydrants located consecutively along a street shall be placed on opposite sides of the street so that stringing fire hoses across a street during a fire can be kept to a minimum. Hydrants shall be placed at all intersections, at end of cul-de-sacs and at all dead-
end runs. Hydrant location shall be approved by Granby Fire Protection District No. 1.

C. Installation:
The bury line shall be located at finished grade. If the previously mentioned conditions are not met after the hydrant is installed and the street is at final grade, the hydrant must be brought to proper grade by installing extensions or other modifications as required. Bag all hydrants that are not in service. If the hydrants have been accepted by the Town and the hydrant needs to be raised due to Homeowner landscaping problems, then the cost of the hydrant raising will be the responsibility of the homeowner. All hydrants shall be plumb.

3.4.5 HYDRANT APPURTEANCES

All fire hydrants shall be connected to the main line by means of a mechanical joint tee with 6 inch branch piping to hydrant. Each fire hydrant shall have a 6 inch valve on the branch pipe conforming to standards as outlined under Section V of these standards. The 6 inch gate valve shall not be located in the sidewalk, curb line, or gutter of the proposed street and shall be rodded to the main tee.

3.4.6 HYDRANT RERAINT

The hydrant shall be restrained to the main line with 0.75 inch all-thread rod extending from the main line tee to the 6 inch valve and then from the 6 inch valve to the hydrant. The 0.75 inch rods shall be tied to each joint with the use of eyebolts. A bitumastic coating (to prevent corrosion) shall be liberally applied to the all thread rod and eye bolts. In addition, the hydrant and main line tee shall be provided with concrete thrust blocks.

3.4.7 DRY BARREL TYPE DRAINAGE

All hydrants shall be provided with a minimum of 0.33 cubic yard of 0.75 inch screened, crushed rock and shall be placed under the weep hole outlet to assure proper drainage. The crushed rock shall be encased in separator fabric to prevent the mitigation of fines. Prior to the screened rock being placed under the weep hole outlet, the area around the weep holes on the hydrant will be covered with plastic sheeting allowing enough room under the sheeting for the hydrant to drain and also preventing concrete from entering the weepholes and covering any hardware.

3.4.8 INSPECTION

Prior to backfilling around the hydrant, a visual test shall be conducted to ensure the proper operation of the weep holes. The hydrant shall be partially opened and then closed. Water trapped in the hydrant barrel section should begin to drain. If water is not draining, the weepholes should be cleared of any obstructions restricting the flow of water.

3.4.9 AIR RELEASE

Fire hydrants shall be installed at high points within the water distribution system to provide air release.
SECTION 3.5
VALVES

3.5.1 GENERAL

This section shall include furnishing all materials, labor, equipment, and miscellaneous items necessary to install gate valves, air release and vacuum valves, and valve boxes as specified herein for the Town of Granby.

3.5.2 GATE VALVES

A. Materials:
1. Resilient seat.
3. Style - Iron body, resilient seat, parallel-seal conforming to AWWA C509 for buried service.
5. Wrench Nut - Two-inch square, open by turning to the left (counterclockwise).
6. Stem - Non-rising,
7. Epoxy coated.
9. All bolts shall be Core Blue
10. Mechanical joints shall be in accordance with ANSI A21.11 for valves connected to ductile iron pipe.
11. Butterfly valves can be substituted with approval by Town Water Department.

B. Location:
Whenever possible, water main valves shall be located at street intersections. Valves must be placed on all runs of a tee or cross. For instance, each cross shall have four valves located at the intersection while tees shall have three valves located at the intersection. Valves shall be located at the intersection within 3 feet of a tee, cross, or bend and all connections shall have Mega-Lug on the fitting. All mechanical joint fittings will have Mega-Lug fittings and concrete thrust blocks. Valves shall be located at the end of all dead-end intersections for future connections.

C. Valve Spacing:
Valves on cross-connecting or looped mains shall be spaced such that no single break shall require more than 500 feet of line or one hydrant to be out of service at one time. All distribution mains connecting to transmission mains must be valved at the tie-in. Valves shall be required every 1,000 feet on transmission mains where service is limited.

D. Installation:
All gate valves shall be installed with the 2 inch operating nut plumb and true with the vertical and centered within the valve box. Town personnel will inspect the valve and valve box after installation to ensure that a valve key can easily be set on the operating nut. The operating nut shall be offset 12” to 24” below finished grade with an extension bolted thru the nut. Only one extension may be used, no bolted connections shall be allowed for the extension.
3.5.3 VALVE BOXES

A. Materials:
1. Material - Cast iron.
2. Type - Two piece, screw type.
4. Cover - Deep socket type with the word "Water" cast in the top. Buried to an 8 feet minimum.
5. Base - No. 160 type with 20.5 inch wide oval base.
6. Valve Markers - For valves that fall outside of road pavement and shoulders, install a 6 foot long, blue "carsonite" marker or blue metal “T” stake on all new valves. Marker shall have valve decal at top.
7. Debris caps are required on all valve boxes.
8. Manufacturer’s Reference - Tyler.

B. Installation:
Valve boxes shall be installed plumb and true and centered over the 2 inch operating nut. Bricks shall be placed under the flange of the valve box bottom so that at no time loadings on the valve box will be transmitted to the valve. Valve box lid to be placed 0.75” – 1” below grade when located in asphalt or concrete. A debris cap shall be installed as close as possible to the cast iron cap without interfering with the operation of the cap. Valves that are greater than 9 feet in depth, extension rods with a rod centering ring and set screw are required to bring valve nut within 5 feet of final grade. In addition, for valves over 9 feet deep, solid pipe are required instead of sectional valve boxes, these will incorporate valve box tops with standard lid.
SECTION 3.6

HYDROSTATIC TESTING

3.6.1 GENERAL

This section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to perform pressure and leakage tests all distribution, transmission and service lines as specified herein for the Town as defined in latest version of AWWA C600.

3.6.2 HYDROSTATIC TESTS

A. Hydrostatic tests shall be conducted on all newly laid pipe and service lines. Contractor is to furnish all the necessary equipment and materials and conduct the test under the supervision of a Town engineer. Contractor shall test through fire hydrants if possible and will be responsible for installing the appropriate taps as approved by the Town engineer if a hydrant is not available used.

B. The test shall be conducted between valved sections of the pipeline, or as approved by the Town. Water service lines will be tested up to the closed curb stop.

C. Contractor furnished equipment and material for the tests:

<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Approved graduated containers.</td>
</tr>
<tr>
<td>2</td>
<td>Pressure gauges.</td>
</tr>
<tr>
<td>1</td>
<td>Hydraulic force pump approved by the Town.</td>
</tr>
<tr>
<td>1</td>
<td>Additional 0.75 inch pressure tap for Contractor’s gauge.</td>
</tr>
<tr>
<td>1</td>
<td>Suitable hose and suction pipe as required.</td>
</tr>
</tbody>
</table>

D. Conduct the tests after the trench has been backfilled. Where any section of pipe is provided with concrete reaction blocking, do not make the pressure tests until at least 5 days have elapsed after the concrete thrust blocking is installed. If High-Early cement is used for the concrete thrust blocking, the time may be cut to 2 days.

E. Conduct hydrostatic test in the following manner unless otherwise approved by the Town:

1. After the trench has been backfilled as specified, fill the pipe with water, expelling all air during the filling.

2. The test pressure shall be 1.5 times normal static system working pressure of the pipe at the point of lowest elevation (test minimum 150 psi).

3. The duration of each pressure test shall be two hours, unless otherwise directed by the Town.

F. Procedure:

1. Slowly fill the pipe with water and allow to stand for 24 hours. Expel all air from the pipe. Apply and maintain the specified test pressure by continuous pumping in necessary for the entire test period. The test pressure shall be calculated for the point of lowest elevation, or as specified by the Town. The
pump suction shall be in a barrel or similar device, or metered so the amount of water required to maintain the test pressure may be measured accurately.

2. Before the line is pressurized, the Town shall verify that all the necessary main line valves are open or closed with regard to the section of line being tested. In addition, the Town shall verify that all hydrant valves are open.

3. The test pressure shall not vary by more than +/-5 psi for the duration of the test. Test pressure shall be maintained within this tolerance by adding makeup water through the pressure test pump into the pipeline.

4. The amount of makeup water shall be accurately measured in gallons per hour by suitable methods and shall not exceed the applicable testing allowance as specified below.

G. Leakage Allowance:
1. Leakage allowance shall be defined as the maximum quantity of makeup water that can be added into a pipeline undergoing hydrostatic pressure testing, or any valved section thereof, to maintain pressure within +/-5 psi. The leakage allowance is exceeded if the quantity of makeup water is greater than that determined by the following formula:

\[ Q = \frac{L D \sqrt{P}}{148,000} \]

In the above formula:
- \( Q \) = Allowable leakage (gallons per hour)
- \( L \) = Tested length of pipe (feet)
- \( D \) = Nominal diameter of pipe (inches)
- \( P \) = Average test pressure during the test (psi)

H. Correction of Excessive Leakage:
Should any test of pipe laid disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage of a subsequent test is within the specified allowance.

I. Flow Test:
After new main has been leak tested, the line shall be flushed by opening 1 or more fire hydrants for approximately 10 minutes or until sediment has been flushed from system.
SECTION 3.7

DISINFECTION OF POTABLE WATER LINES

3.7.1 DISINFECTION

A. The procedure detailed in this section shall apply to all new pipelines and main extensions within the Town service area. Pipe extensions shall be chlorinated in accordance with AWWA C600 and C651 Standard for Disinfecting Water Mains. The intended high chlorine with any method of chlorination is to be 50 mg/l.

B. Before filling the pipe with water, the pipe shall be clean and free of debris to the satisfaction of the Town.

C. Disinfecting by chlorination of the pipe shall be performed prior to acceptance by the Town. Contractor shall use the tablet method for disinfection in accordance with AWWA C651. The Contractor shall provide material for disinfecting of water mains.

D. Placing of calcium hypochlorite tablets:
During construction, 5-g calcium hypochlorite tablets shall be placed in each section of pipe. Also, one tablet shall be placed in each hydrant, hydrant branch, and other appurtenance. Table 1 shows the number of tablets required for commonly used sizes of pipe. The tablets shall be attached by a food-grade adhesive. There shall be adhesive only on the broadside of the tablet attached to the surface of the pipe. Attach tablets inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section to indicate that the pipe has been installed with the tablets at the top.

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Number of 5-g Calcium Hypochlorite Tablets</th>
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<tbody>
<tr>
<td>in.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
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<td>12</td>
<td>7</td>
</tr>
<tr>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>

*Based on 3.35-g available chlorine per tablet; any portion of tablet rounded to the next higher integer.
3.7.2 TESTING

A. The Town will perform all chemical tests on the water system.

B. After the pipe is filled with water and chlorine, and unless approved otherwise by the Town, the chlorinated water shall be held in contact with the pipe for 24 hours. At the end of the 24 hour period, the water in the pipeline shall be tested by the Town to ensure a residual chlorine content of not less than 50 mg/L. The pipeline shall then be tested by the Contractor under Town oversight and thoroughly flushed to remove the heavily chlorinated water and/or debris to less than 2.0 mg/L. Care shall be taken in flushing the pipeline to prevent property damage and danger to the public. Discharge of highly chlorinated water shall not be released to any stream or watercourse. Samples of water will be collected for bacteriological examination and residual chlorine content testing before the pipeline is put into service. Testing of residual chlorine and bacteriological sampling and testing will be done by the Town. Contractor shall pay for the test, labor, and bottles. The Town will transport and test the samples.

C. No main which has been disinfected and flushed shall stand stagnant for more than 15 days without being re-flushed and a new disinfecting test performed, passed and approved by the Town.

3.7.3 DISCHARGING CHLORINATED WATER

After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system or that is acceptable for domestic use. The environment to which the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge will cause damage to the environment, a neutralizing chemical shall be applied to the water to be wasted to thoroughly neutralize the residual chlorine. Where necessary, federal, state, local, or provincial regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water. The chlorinated water shall not be discharged to the Town’s sewer collection system.

3.7.4 DISINFECTION PROCEDURES WHEN CUTTING INTO OR REPAIRING EXISTING MAINS

A. The following procedures apply primarily when existing mains are wholly or partially dewatered. After the appropriate procedures have been completed, the existing main may be returned to service prior to the completion of bacteriological testing in order to minimize the time customers are without water. Leaks or breaks that are repaired with clamping devices while the mains remain full of pressurized water may present little danger of contamination and therefore may not require disinfection.

1. Swabbing with hypochlorite solution. The interior of pipe and fittings (particularly couplings and sleeves) used in making the repair shall be swabbed or sprayed with a non-scented store bought bleach or 200 mg/L chlorine solution before they are installed.
2. Flushing. Thorough flushing is the most practical means of removing contamination introduced during repairs. If valve and hydrant locations permit, flushing toward the work location from both directions is recommended. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water is eliminated.

3.7.5 BACTERIOLOGICAL TESTS

A. After final flushing and before the new water main is connected to the distribution system, 2 consecutive sets of acceptable samples, taken at least 24 hrs. apart, shall be collected from the new main. (NOTE: The pipe, the water loaded into the pipe, and any debris exert a chlorine demand that can interfere with disinfection.) At least one set of samples shall be collected from every 1,200 ft of the new water main, plus one set from the end of the line and at least one set from each branch. Samples shall be tested for bacteriological (chemical and physical) quality in accordance with Standard Methods for the Examination of Water and Wastewater and shall show the absence of coliform organisms.

1. Special conditions. If trench water has entered the new main during construction or if, in the opinion of the Engineer, excessive quantities of dirt or debris have entered the new main, bacteriological samples shall be taken at intervals of approximately 200 ft, and the location shall be identified. Samples shall be taken of water that has stood in the new main for at least 16 hr. after final flushing has been completed.

2. Sampling procedure. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate, as required by Standard Methods for the Examination of Water and Wastewater. No hose or fire hydrant shall be used in the collection of samples. (NOTE: For pipe repairs, if no other sampling port is available, well-flushed fire hydrants may be used with the understanding that they do not represent optimum sampling conditions.) There should be no water in the trench up to the connection for sampling. The sampling pipe must be dedicated and clean and disinfected and flushed prior to sampling. A corporation cock may be installed in the main with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

3. Record of compliance. The record of compliance shall be the bacteriological test results certifying that the water sampled from the new water main is free of coliform bacteria contamination and is equal to or better than the bacteriologic water quality in the distribution system.

3.7.6 REDISINFECTION

A. If the initial disinfection fails to produce satisfactory bacteriological results or if other water quality is affected, the new main may be re-flushed and shall be Re-sampled. If check samples also fail to produce acceptable results, the main shall be Re-chlorinated by the continuous-feed method until satisfactory results are obtained—that being two consecutive sets of acceptable samples taken 24 hours. apart.

B. High velocities in the existing system, resulting from flushing the new main, may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is advisable to sample water entering the new main to determine the source of turbidity.
3.7.7 DISINFECTING

A. All water piping installed under this Contract shall be disinfected in accordance with AWWA C601 after all construction work has been completed.

B. Chlorine shall be added to the water at the necessary locations in the amount to form a 50 mg/l or ppm free chlorine residual.

C. The chlorine solution shall be left in the pipelines for not less than 24 hours, during which time all valves and fire hydrants shall be operated in order to disinfect the appurtenances. After that length of time, the chlorine residual of the solution at any place in the system shall not be less than 10 ppm.

D. As required, the Contractor shall make all necessary taps for inserting the chlorine solution in the pipeline and venting and draining pipelines using approved corporation stops.

E. After the disinfection has been completed and approved, the corporation stops shall be closed, left in place, and sealed with a cap. All chlorination work must be done under the supervision of the Engineer.

F. After approval of the disinfection operations, the Contractor shall flush the new system until the chlorine residual is less than 2.0 ppm and a clear water test made. After flushing a bacteriological test is to be performed and must be passed by the local health authority to insure adequate disinfection prior to the line being placed into service and approved.
SECTION 3.8
SPECIAL CONSTRUCTION

3.8.1 SCOPE

This section shall include the design and construction of aerial crossings, river crossings, storage tanks, pressure reducing vaults and booster stations. Because each of these structures will require an engineered design to meet field conditions and individual design criteria, this section will not attempt to provide complete design guidelines and specifications. Rather, it will provide a general listing of guidelines that must be followed unless the Town approves an equivalent alternative.

3.8.2 AERIAL CROSSING

A. General:
This section shall cover the design criteria to be used on aerial crossings, including water lines suspended from existing and proposed bridges, and lines aerially supported over steep canyons and arroyos. In both of the above crossings, an underground or river crossing will be required unless special circumstances render the below grade alternative prohibitive. If it is determined that a bridge crossing is acceptable to the Town, and then the following design criteria shall be followed.

B. Pipe Supports:
1. If pipe is to be supported from an existing bridge, a structural analysis shall be performed to determine if the bridge can withstand the additional loading. If being installed on a new bridge, then additional pipe loading should be included as a dead load consideration.
2. Pipe shall be supported with a pipe hanger that allows longitudinal movement. Support shall be an adjustable steel yoke pipe roll or approved equal. In addition, a horizontal support from pipe hanger to the bridge shall be provided so that the pipe assembly will not move horizontally due to wind loads, etc. The spacing of the pipe hangers shall depend upon the maximum recommended load of hanger.

C. Pipe Insulation:
Aerial pipelines shall be prevented from freezing by pipe insulation. The insulation R-value and thickness shall be designed to a generally accepted standard for the Town of Granby area. The insulation should have a minimum R-value of 20. The insulation shall be non-absorbing to water.

D. Insulation Protection:
Provide an aluminum jacket with moisture barrier strapped with stainless steel bands. Jacketing thickness shall be a minimum of 16 mil. Provide insulation protection shields.

E. Pipe:
Rigid joint pipe to be approved by Town for specific application.

F. Expansion Coupling:
Provide a restrained expansion coupling between each rigidly supported point of the
pipe. Follow all manufacturers’ recommendations when installing. Expansion couplings shall be accessible to water department personnel for maintaining and making adjustments in couplings.

G. Air and Vacuum Vaults:
If bridge crossing is at a high point in line, install all air and vacuum valves appropriate for design conditions.

H. Isolation Valves:
An isolation valve shall be provided on either end of the bridge.

I. Accessibility:
Generally, the pipe should be placed in a location where personnel can easily access and maintain the pipe.

3.8.3 RIVER CROSSINGS

A. General:
This section covers the design criteria to be used on river crossings.

B. Encasement:
Pipe shall be encased in concrete for the length of pipe underneath high water mark.

C. Pipe:
Restrained joint pipe as approved by Town for specific application.

D. Bend Restraint:
All vertical bends shall be restrained with megalugs and vertical reaction blocks and all thread rods between bends or between bends and concrete thrust tie.

E. Permits:
Generally, a river crossing will require a 404 Permit or Nationwide Utilities Permit from the Army Corps of Engineers. The Applicant should begin the permit process as soon as possible, as the process can take from 30-90 days to secure the permit. Consultation with the Colorado CPW may also be required.

3.8.4 STORAGE RESERVOIRS

A. General:
This section covers the design criteria to be used on storage reservoirs. The Town requires either a buried pre-stressed or post-tensioned concrete. Town shall determine the size and location of the storage tanks.

B. Foundation Design:
A soil and geological report shall be provided which makes recommendations on the required foundation.
C. Structural Design:
Complete structural design, with calculations and shop drawings submitted by a professional engineer shall be provided.

D. CDPHE Requirements:
All Colorado Department of Public Health and Environment, Water Quality Control Division "Design Criteria for Potable Water Systems" shall be followed.

E. Re-Circulation Pump/Mixer:
A recirculation pump or mixer will be required.

F. Telemetry, SCADA:
The reservoir shall be fitted with telemetry that will communicate with the Town’s existing SCADA system.

I. Drain and Overflow:
Need to discharge in a non-destructive manner to a suitable location.

3.8.5 PRESSURE REDUCING VAULTS (PRV)

A. General:
This section shall cover the design criteria to be used on pressure reducing vaults. The Town shall determine the location of PRV's. See Detail W10.

B. PRV Valve:
The PRV valve shall be as manufactured by the Cla-Val Company. The main valve shall be a single seated, hydraulically operated, pilot controlled, diaphragm-type globe valve.

C. Pilot Control System:
Stainless steel. Install isolation cocks, closing and opening speed control and strainers on pilot controls.

D. Pressure Gauges:
Install two stainless steel, liquid-filled, hermetically sealed pressure gauges with pressure snubbers, and isolation cocks. Locate at main inlet and outlet of vault so that if one PRV is isolated, gauges will still register.

E. Bypass Piping:
Install a bypass around main PRV valve so that mainline can be filled and service maintained with PRV valve out of service. Bypass shall be installed with an isolation valve.

F. Pressure Relief Valve:
If damaging downstream pressure can result when PRV is stuck in open position, then a pressure relief valve, that drains to an acceptable location, shall be installed on downstream side of PRV on either the main line or bypass line. Pressure relief valve shall be piped to daylight and appropriate flow dissipation.

G. Isolated Valves:
Install isolation resilient seat gate valves inside of vault so that main PRV valve can
be isolated outside of vault.

H. PRV Vault:
All valves, appurtenances and pipe to be enclosed in a concrete or steel vault. Install
link seal or equivalent between pipe inlets, outlets and vault wall. Provide frost-proof
aluminum 3’ x 3’ hatches on concrete vaults. Plastic covered steel MH rungs shall be
provided on concrete vault with the first step not being greater than 18 inches from
finished grade. Install concrete supports under PRV and tees. All vaults to be
provided with one 110-volt outlet and a drain that daylight or a sump with a pump.

I. Fittings:
All main line fittings shall be ductile iron flanged fittings with Core Blue bolts.

J. Rising stem where telemetry exists.

3.8.6 WATERLINE INSULATION

A. General:
This section shall cover the installation to be used on water lines when insulation is
required. The Town engineer will approve the use of “top hat” insulation on
waterlines if the conditions will not allow the waterline to be buried deep enough to
obtain 8 feet of depth below grade or for crossing below storm drain pipes.

B. Installation:
In areas where 8 feet of depth is unable to be obtained, insulation can be approved
by the Town engineer. The insulation shall encase the waterline 4 feet in either
direction of the crossing. Four inch thick polystyrene shall be installed 1 foot away
from the pipe on both sides and the top. Contractor shall provide a minimum of 18
inches between the top of the insulation and the invert of the storm drain.
SECTION 3.9

SEWER

3.9.1 GENERAL

Reference Granby Sanitation District Rules and Regulations and the sewer detail drawings for sewer information. The Town is responsible for the sewer collection system in the South Service Area.
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## Division 4 Streets

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<th>Section</th>
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<tr>
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<td>4.3</td>
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</tbody>
</table>
SECTION 4.1

STREETS

4.1.1 GENERAL

A. All curb, gutter, sidewalk and street design, rights-of-way and street widths shall conform to the minimum requirements of the Town of Granby Standard Specifications and Drawings for Design and Construction and the Town of Granby Municipal Code and the current edition of the AASHTO Policy on Geometric Design of Highways and Streets. Definition of streets shall be as defined therein. Specific road standards may be approved by the Town as part of the development review process. Care shall be taken to ensure continuity of grades, widths, etc., of proposed, existing and future installations. Private non-commercial streets and parking lots shall be built to these standards, including curbs, gutters and sidewalks, unless otherwise approved by the Town Engineer.

4.1.2 GEOMETRICS AND GRADES

A. Street widths shall conform to Town of Granby Municipal Code and Standard Drawings. Streets having a percentage of grade along the centerline stationing equal to or greater than one (1) percent shall be designed with two (2) percent crown. Where percentages of grade along centerline stationing are less than one (1) percent, crown shall be increased to three (3) percent. Back of walk elevations shall be set equal on all streets. Where an intersection is encountered in the design, the cross section of the street approaching another shall be transitioned (for seventy-five (75') feet) from a crown slope to a cross-slope condition, matching the intersecting streets flowline grade. In no case shall a flowline slope at an intersection.

B. The following shall be the maximum and minimum grades and minimum length of vertical curves for all street design. The Town Engineer may permit deviations from these requirements when, in his judgment, terrain conditions are such that minimum or maximum grades as set forth are not feasible. Absolute minimum grade that may be considered by the Town will be 0.5% and shall be carried in continuous intervals not to exceed 100 ft. as indicated by centerline stationing. Percentage of grade along the centerline through intersections shall not exceed five (5) percent. Centerline street profiles shall be extended for future construction, beyond the limits of the project being designed, for a distance of 1000 feet or to connect to an existing improved street, whichever is the lesser.

<table>
<thead>
<tr>
<th>Design Geometrics</th>
<th>Notes</th>
<th>Unit</th>
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<th>Collector</th>
<th>Arterial</th>
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<tbody>
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<td></td>
<td>MPH</td>
<td>20</td>
<td>20</td>
<td>35</td>
</tr>
<tr>
<td>Maximum Grade</td>
<td></td>
<td>%</td>
<td>10</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Minimum Grade</td>
<td>(1)</td>
<td>%</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Vertical Curve @ Crest</td>
<td>(1) (2)</td>
<td>K</td>
<td>25</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Vertical Curve @ Sag</td>
<td>(1) (2)</td>
<td>K</td>
<td>35</td>
<td>50</td>
<td>80</td>
</tr>
<tr>
<td>Centerline Radius</td>
<td>(1)</td>
<td>Ft.</td>
<td>100</td>
<td>175</td>
<td>350</td>
</tr>
<tr>
<td>Sight Distance – Stopping</td>
<td>(1) (3)</td>
<td>Ft.</td>
<td>200</td>
<td>250</td>
<td>375</td>
</tr>
<tr>
<td>Sight Distance – Intersection</td>
<td>(1) (4)</td>
<td>Ft.</td>
<td>300</td>
<td>350</td>
<td>450</td>
</tr>
<tr>
<td>Tangent Section between</td>
<td></td>
<td>Ft.</td>
<td>50</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Reverse Curves</td>
<td>(1)</td>
<td>Ft.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. All values are minimums.
2. Length of vertical curve \( L = KA \), \( A \) = Algebraic difference in grade.
3. Measured from height of eye 3.75 ft. to a height of six (6) inches on pavement.
4. Measured from a point on the minor road at least 15 ft. from the edge of the major road pavement and measured from a height of eye of 3.75 ft. to a height of object of 4.5 ft. on the major road.

C. All subdivision streets shall comply with the "Chapter 17.25 Design Standards", of the Town of Granby Municipal Code (GMC) and shall meet the following criteria for Right-of-Way. Street widths and grades shall be as follows:

<table>
<thead>
<tr>
<th>Classification</th>
<th>Right-of-Way Width</th>
<th>Surface Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Highways</td>
<td>150'</td>
<td>70'</td>
</tr>
<tr>
<td>Major Roads</td>
<td>100'</td>
<td>50'</td>
</tr>
<tr>
<td>Collector Streets</td>
<td>80'</td>
<td>40'</td>
</tr>
<tr>
<td>Local Streets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>More than 1 lot/acre</td>
<td>60'</td>
<td>30'</td>
</tr>
<tr>
<td>Less than 1 lot/acre</td>
<td>60'</td>
<td>20'</td>
</tr>
<tr>
<td>Marginal Access Streets</td>
<td>60'</td>
<td>20'</td>
</tr>
<tr>
<td>Alley where Permitted</td>
<td>20'</td>
<td>20'</td>
</tr>
<tr>
<td>Sidewalks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td></td>
<td>10'</td>
</tr>
<tr>
<td>Residential</td>
<td></td>
<td>4'</td>
</tr>
<tr>
<td>Easements</td>
<td></td>
<td>20'</td>
</tr>
</tbody>
</table>

4.1.3 STREET DESIGN

A. The street pattern shall conform to any applicable transportation plan or comprehensive plan including CDOT Access Management and Control; Plans adopted by the Town Council and shall afford safe and convenient access to all lots within the subdivision.

B. Streets shall be designed to join with planned or existing streets.
1. Intersections of streets shall be at right angles unless otherwise approved by the Planning and Zoning Commission and the Town Engineer.
2. No more than two streets shall intersect at one point.
3. Two local streets meeting a third street from opposite sides shall meet at the same point, or their centerlines shall be offset at least one hundred thirty five feet (135’).
4. Arterial or collector streets meeting a third street from opposite sides shall meet at the same point, or their centerlines shall be offset at least one hundred feet (135').

5. Drainage easements, ten feet (10'), or larger if so required by the Town Engineer.

6. Half-streets shall not be permitted, except when required to complete a half street already in existence;

7. Where a street classified as arterial intersects with any other arterial street, no on-street parking shall be allowed on the arterial street within thirty feet (30') of the intersection. If the arterial street consists over its general length of only two traffic lanes, then a third lane shall be provided, and stripes painted to the specifications of the Town Engineer to enable vehicles to make left turns at such intersections without impeding other traffic;

8. All utilities shall be installed before streets or alleys are surfaced;

9. Subdivision as-builts shall show dedicated right-of-way

10. The Town Engineer may approve exceptions to the provisions of this subsection in extraordinary circumstances where safety is not compromised.

C. Streets shall have the names of existing streets which are aligned in the Town and County, or as specified by the Town of Granby Public Works Manual.

D. Streets which are an extension of existing or platted streets shall bear the same classification as that assigned to the existing or platted street in any adopted transportation or comprehensive plan and shall conform to any special standards pertaining to such classifications.

E. Local residential streets shall be laid out to discourage through traffic, and where a proposed subdivision borders on or includes a street designated arterial intersections of proposed streets with such arterial shall be held to a minimum. Lots bordering arterial roadways may be either reverse facing on an interior street within the subdivision or served by a frontage road.

F. Streets shall be designed to bear a logical relationship to the existing topography.

G. A street may end in a permanent cul-de-sac providing that the street is no longer than five hundred feet (500') and that the radius of the turning areas be at least forty-five feet (45') to the curb, and fifty feet (50') to the edge of the right-of-way. Adequate space shall be provided for plowed snow storage by providing a T-shaped turnaround with a minimum turning radius of fifty feet (50') for a residential development and seventy-five (75') for commercial or industrial developments where tractor-trailer trucks will be using the street. Efforts must be made to construct streets that are through streets to maintain connectivity through Town whenever feasible.

H. All roads shall be constructed to carry the 20-year design Equivalent Single-Axle Load (ESAL) as determined in the Traffic Report, see Section 4.2.2.

I. Minimum clearance above all roads shall be 13.5 feet.

J. Streets shall not exceed a gradient of four percent (4%) within one hundred feet (100') of an intersection.
K. Vertical curves shall be used at changes of grade exceeding one percent (1%) and shall be designed to provide a minimum sight distance of two hundred feet (200') except for arterial streets which shall be subject to state and federal standards.

L. When street roadway lines deflect, connection shall be made by horizontal curves.

M. Granby Ranch Road Standards and Details have been developed for the Granby Ranch Planned Development Overlay District. The Town shall use these as a reference standard for future developments.

4.1.4 ALLEYS AND EASEMENTS

A. Alleys in residential subdivisions shall be prohibited unless they are necessary to continue an existing pattern.

B. Alleys shall be provided in commercial and industrial areas, except that this provision may be waived when no other provisions are made and approved for service access.

C. Easements of not less than 20 feet in width shall be provided along all rear lot lines and along certain side lot lines for utilities when alleys are not provided. Such easement may be provided by 10-foot easements on each of the adjoining lots. Utility easement at different locations may be provided upon recommendation by the affected utility companies and approval of the commission.

4.1.5 STREET IMPROVEMENTS

A. All street improvements described in the Town of Granby Public Works Manual are the financial responsibility of the Applicant, subject to the provisions of the Town of Granby Public Works Manual, unless specifically exempted through written agreement with the Town Council.

B. Streets that are constructed and accepted at the time of the acceptance of the Public Works Manual shall be grandfathered in without these improvements, but if those streets are reconstructed the required improvements within the Public Works Manual must be completed unless a waiver is issued.

C. All streets and alleys proposed for dedication to the public shall be laid out, graded and paved from curb to curb, and painted to the specifications of the Town.

D. Curb and gutter and sidewalks shall be installed on all streets unless special circumstances warrant the Town Council to specifically waive installation in writing. In cases where a previously existing street which has not been brought up to Town specifications is located within a subdivision, such street shall be paved with curb and gutter; sidewalk and other improvements shall be installed in order to meet Town specifications.

E. If any subdivision is located adjacent to any existing street right-of-way, the Applicant shall provide such street with improvements as required to bring such street up to Town specifications.

F. The Applicant shall provide and install street signs to all street intersections and traffic control signs as requested by the Town Council through their designated representatives or shall reimburse the Town for their initial installation.
G. Permanent reference monuments and monument boxes shall be installed by the Applicant to Town specifications, as shall bicycle paths where they are required by Town regulations.

H. Streetlights, when required by Town regulations, shall be installed.

I. All work being performed to Town streets must adhere to MUTCD standards for traffic control and signage.

4.1.6 CURBS, GUTTERS, SIDEWALKS AND CROSSPANS

A. All curbs, gutters, sidewalks and crossspans shall conform to the Town of Granby Standard Drawings. Standard combination curb, gutter and sidewalk sections shall be six and a half foot (6'6") wide in locations noted as follows:
   1. On individual streets where the obsolete section exists intermittently along 50% of the total frontage of both sides of the street, or where it is reasonable and practical to continue the obsolete section as determined by the Town Engineer. (Intermittently shall be interpreted to mean at least three (3) different sections with at least one (1) section on each side of the street).
   2. Where obsolete sections exist to boundary of earlier subdivision, this section shall be continued in new subdivision to first radius point.
   3. Where existing obsolete section is being replaced.
   4. Sidewalks are required on both sides of all streets, unless special circumstances warrant the Town Board to specifically waive the installation in writing. Sidewalks shall be at least four feet (4') wide in residential areas and eight feet (8') wide in commercial areas. All streets shall have mountable curb and gutter and attached sidewalk. In residential areas, sub arterial streets shall have a mountable curb and detached sidewalk at least five feet (5') in width separated from the curb by a minimum of four and one-half feet (4 1/2').

B. Design of streets in commercial and industrial areas shall be approved by the Planning and Zoning Commission.

C. Construction of sidewalks shall be to specifications set by the Town Board through their designated representatives.

D. All sidewalks shall be ramped at all street intersections or other pedestrian crossing areas. The design and construction of sidewalk ramps must meet the applicable requirements of the "Americans With Disabilities Act" (ADA).

4.1.7 UTILITIES

All house service lines, main lines, etc., shall be installed according to Town of Granby Standard Specifications prior to paving of any street.

4.1.8 DRAINAGE

A. All streets shall be designed to provide continuous surface drainage directed to storm drain inlets and drainage courses. Grades shall permit flow without ponding.

B. Eight (8) feet concrete crossspans shall normally be installed across those streets at intersections carrying traffic, which must stop.
C. Installation of pans between intersections or across streets carrying through traffic at intersections shall be avoided in all possible cases.

D. A check shall be made to be sure of continuity of drainage design between the proposed construction and existing or future construction. In no case shall surface drainage be permitted to be disposed of overland except by approved storm drainage facilities.

4.1.9 FLEXIBLE PAVEMENTS

A. Flexible pavement shall consist of deep strength asphaltic concrete or a combination of asphaltic concrete and granular base course.

B. Pavement thickness shall be determined by use of underlying soil group index values. These values shall be determined by recognized soils testing laboratories under direction of professional engineers. The minimum thickness of base and asphaltic pavement combinations shall be four (4) inch asphaltic concrete, six (6) inch Class 6 road base and twelve (12) inch Class 2 road base for collector and local streets, or structural section of equivalent strength as approved by the Town Engineer.

C. Samples for group index value determinations shall be taken between gutter lip lines of proposed streets at 300-foot intervals for all new streets. Where the length of the proposed new street is less than 300 feet, two (2) group index determinations shall be made. Test results shall be interpreted in such a manner as to insure adequate pavement thickness in all cases.

4.1.10 STREET LIGHTS

A. The developer shall install street lights at points designated by the Town or electric company.

B. The design of both lights and poles shall meet specifications established in the Municipal Code.

C. As-built documentation must be provided to the Town including, but not limited to, routing of power supplies, meters, break/shut-off locations, timer specifications/locations, pole specifications, and fixture specifications.

4.1.11 BICYCLE PATHS

A. Developers, when required, shall install a bicycle path at least eight feet (8') wide along the right-of-way of any sub-arterial street and any arterial street which is not bordered by a frontage road.

B. The initial site of the path along any street shall be determined by the Planning Commission and the Town’s Engineer.

C. Each developer that extends the path shall keep the path continuous and with as little change in grade as possible. If topography necessitates that the path change from one side of the street to the other, or if the path intersects with another arterial or sub-arterial street, crossways shall be provided.
D. Bicycle paths shall be ramped at intersections.
E. Paths and crossways shall meet construction and design standards set in the Municipal Code.

4.1.12 SNOW STORAGE

A. See Section 2.5 of the Public Works Manual for full snow storage requirements.
B. In general, 15% of the area to be plowed shall be set aside for snow storage.

4.1.13 CROSSWALKS

A. All crosswalk designs require Town approval. Use of pavers, decorative concrete, etc. is not acceptable across a roadway.
SECTION 4.2

SUBMITTAL REQUIREMENTS

4.2.1 STREET DESIGN REPORT

A complete engineering design report, sealed by an Engineer, shall be submitted to the Town. Submittal of a preliminary version of this report shall be required at Preliminary Plat. The final version shall be submitted no later than concurrently with the submittal of engineering plans at Final Plat. This review is to assure that the engineer has dealt with all development problems and had offered solutions which conform to the approved site plan and to Town Standards. If, in preparation of the report, the engineer finds that substantial changes from the preliminary plat are required to produce an economical development, he shall prepare a revised Preliminary Plat for submittal by the developer. Forcing engineering solutions to conform to an approved plat is strongly discouraged. The following reports shall be included:

A. Soils Report:
   1. A soils report shall be prepared by an Engineer, specializing in soils analysis. This soils report will be used to substantiate street pavement design and grading plan designs, or for any other plans needing such analysis for a site, and should include base courses recommended beneath sidewalks, curbs and gutter, and pavement.
   2. Material specifications and compaction requirements should be addressed for all roadway materials (subgrade, select, ABC, AC, seals, etc.).
   3. The pavement section is to be designed for a 20-year life and include considerations for construction traffic as determined by the Traffic Report. Pavement thickness design method shall be as described in Section B, or other method acceptable to the Town Engineer.
   4. If cut and fill slopes are proposed which exceed those allowed by Town standards, a slope stability analysis establishing maximum stable slope grades or stabilization methods must be included. Any cut or fill section exceeding two (2) feet in height or depth shall be stabilized and revegetated. If problem areas are found, further surveys may be required in those specific areas.
   5. The soils engineer shall address the following problems. Shrink-swell potential, ground water, wetness, depth of rock, erosion, flood hazard, allowable velocity in earth drainage channels, bearing capacity, corrosion potential, organic layers, ease of excavation and other pertinent issues.

B. Street Report:
   1. A typical cross section will be shown for each type of street included in the subdivision. If surface drainage is to be carried in the street, then the drainage report shall show that the drainage for the design storm can be handled by the existing and proposed drainage facilities system.
   2. For the "Standard Street Cross Sections", the designs will have the entire road/street prism (toe of fill to top of cut) within the necessary right-of-way width where possible. In situations where widths of right-of-way beyond the standard minimums would substantially reduce developable areas (lot square footage), then the Town may accept "Easements" for that area outside the required right-of-way but necessary for utility accommodations and maintenance purposes.
3. For those details concerning sidewalks and sidewalk ramps, all design and construction must meet the applicable requirements of the "Americans With Disabilities Act" (ADA).

4. Base thickness and pavement thickness (pavement sections) are to be determined by an Engineer's report on soils analysis (CBR or "R" values) and asphalt thickness based on anticipated traffic loads including construction truck traffic during the period (usually first 2-3 years) when buildings are being constructed in the development thereby generating concrete redi-mix trucks, rock and gravel delivery trucks, building block delivery trucks, lumber delivery trucks, utility installation equipment, furniture delivery vans, etc. Solid Waste collections trucks must be considered throughout the service life of any street.

5. Asphalt pavement design shall be in accordance with "Guideline for Design and Use of Asphalt Pavements for Colorado Roadways" by the Colorado Asphalt Pavement Association, latest edition.

6. Pavement structural sections must be justified in writing by the Design Engineer and to the satisfaction of the Town Engineer.

7. The geometric designs (especially horizontal and vertical curves) will adhere to the criteria as set out in the following sources:
   c. The Town of Granby Zoning and Planning and Subdivision Ordinance" and this "Public Works Manual".
   d. Granby Ranch Road Standards.

8. All designs shall be subject to the approval of the Town Engineer, Board, and Staff who shall have the authority to approve less stringent or require more stringent design criteria in the interest of public safety.

9. In situations where the geometric design criteria as set out in the above referenced books cannot be met* for the normally applicable design speed on a given type of street(local, arterial, etc.), then the design speed may be lowered to a design speed suitable for the type terrain and the anticipated traffic volumes. However, all efforts shall be made to ensure that a "balanced" street network evolves by providing enough streets with 25 mph or higher design speeds to counteract the effect of lowering the speed limits on some streets thereby restricting traffic flow capacities.

10. In cases where meeting the design criteria would create inordinately deep cuts or high fills making access to adjoining properties unreasonably difficult either from the standpoint of construction or cost. Also, to be considered is the fact that very steep approaches (side street or driveway) can be unsafe for driver control of vehicles.

11. At the points where developments tie into existing streets, the design plans shall show the horizontal and vertical alignment of the existing streets for a distance of 300 feet from the point of intersection.
4.2.2 TRAFFIC REPORT

Recognizing that a balance must be reached between the need for vehicular traffic efficiency/safety (multiple streets and accesses) and the desires of a community for security (restricted access), the Town may require the developer to design the subdivision and street networks based upon an in-depth "Traffic/Access Impact Analysis" which is to be prepared by an engineer registered in the State of Colorado and who shall have an established proficiency in preparing traffic/access impact studies.

The results and recommendations of the "Traffic/Access Impact Analysis" shall set out the minimum traffic flow requirements while not unreasonably sacrificing the security of a neighborhood or community. The safety and convenience of the traveling public, especially ingress and egress during emergency situations, must be weighed against the need for security.

A. Traffic/Access Impact Analysis Criteria:
Impact of traffic generated by developments shall be analyzed. The developer shall submit a traffic/access impact report, prepared by an engineer, which addresses the impact of the traffic generated by the development upon the traffic flow, congestion, and safety of the surrounding streets and other traffic facilities. The report shall also identify the steps to be taken as part of the development to mitigate any adverse effects of the traffic generated by the development. For "phased" developments, the "Traffic/Access Impact Analysis" shall consider all phases through final build-out.

B. A traffic/access impact analysis and report is required as part of the submittal for a development which meets any of the following criteria:
1. A request for annexation to the Town of an area greater than one acre.
2. An area plan for which zoning and general land use types are proposed, but for which specific land uses and densities are not known.
3. A specific plan where specific land uses are known, and which will generate threshold level traffic.
4. A subdivision plan which generates threshold level traffic. Threshold level traffic is defined as 100 or more peak direction trips to or from the site during either the peak hour of traffic on the adjacent roadway or the peak hour of traffic generation of the site itself.
5. A request for change of zoning where the development allowed by the new zoning will generate threshold level traffic.
6. A site plan submittal for a single development which will generate threshold level traffic. This analysis need not be made if the site has previously been included in a complete traffic impact analysis for a larger area and the land use and intensity assumed for the site in that previous analysis is the same as that of the proposed development.
7. An analysis and report may also be required for development master plans or other developments to address localized safety and capacity deficiencies, or impact on adjacent neighborhoods. The Town Engineer or Board shall determine the cases in which such an analysis is required and the points which need to be addressed.
8. Any development for which a "Development Agreement" is adopted.
9. Prior to consideration of a preliminary plat by the Planning and Zoning Commission.
C. In the event that a traffic/access impact analysis determines that additional ingress, egress, dedication, signalization, or other action is required to mitigate the impact of the development upon traffic flow, the applicant or developer may be required to take such action or contribute financially to said action in proportion to the nature and extent of the impact of the proposed development prior to any approvals being granted by the Town, or as a condition of any such approvals.

D. This analysis and report will include roadways and intersections immediately adjacent to the development and those roadways on which at least 5% of peak hour capacity at an intersection approach will be composed of trips predicted to be generated by the new development.

E. If the Town of Granby prepares a transportation plan for a specific area which is used as the basis of major street layout and area ingress and egress, any subsequent development proposed within that specific area will reimburse the Town a proportionate share of the cost of the study.

F. The traffic/access impact analysis shall be performed as a part of the site design process. At a minimum, the following factors shall be analyzed:
   1. Study purpose and objectives.
   2. Description of the site and study area.
   3. Existing conditions in the area of the development.
   4. Capacity analysis of the major street and project site access intersection locations within the study area.
   5. Safety, including intersections and driveway sight distance.
   7. Traffic control needs.
   8. Transit needs or impacts
   9. Transportation system management.
   11. Adequacy of on-site and off-site parking facilities.
   12. Pedestrian and bicycle movements.
   13. Service and delivery vehicle access.
   15. Accident Summary/History.
   17. Trip generations, trip distribution, and modal split.
   18. Projected future traffic volumes(20 year projections).
   19. An assessment of the change in roadway operations resulting from the development traffic.
   20. Recommendations for site access and transportation improvements needed to maintain traffic flow to, from, within, and past the site at an acceptable and safe level of service.
   22. Calculation of 20-year ESAL for use in structural pavement section design, to include effect of construction traffic as described in section 4.2.1 B 4,

G. Criteria for Secondary and/or Emergency Access in Subdivision/PUD/PDOD:
   Traffic analysis for all subdivisions or PUD/PDOD must include an analysis, which includes but is not limited to the following criteria to determine whether secondary
and/or emergency access is needed:

1. Population density projections
2. Roadway widths
3. Topography
4. Vegetation(fuel) types in area
5. Response times
6. Distance/location of closest major arterial
7. Roadway surface
8. Layout of roads in subdivision
9. Parking along streets or other possible restrictions
10. Reliability of primary access point (potential flooded areas, etc.)

H. Note: The Town Board, during the plat approval process, will make the final decision regarding the need for secondary and/or emergency access based upon the recommendations of the development traffic/access impact analysis and recommendations from the Planning and Zoning Commission, the Town Engineer, and Town Staff.

4.2.3 SIGNING AND STRIPING PLANS

A. A complete signing and striping plan shall be submitted as part of the construction drawings. This plan shall include all project streets and intersections with existing streets.

B. The design of these improvements shall be in accordance with the latest version of the Manual of Uniform Traffic Control Devices (MUTCD) and shall include all necessary traffic control signage.

C. Street name signs shall be installed at all intersections. The developer will be responsible for their installation.
SECTION 4.3

STREET ACCEPTANCE STANDARDS

4.3.1 FIELD QUALITY CONTROL

A. Construction Oversight
   1. The Town Engineer and designated Town Staff shall be involved in weekly construction meetings to be kept abreast of construction progress, construction inspection reports and any field issues that may result in a change in approved construction documents or methods. The Town Engineer shall approve any deviations to construction, and the amount of oversight necessary to ensure construction is being completed in accordance with approved plans and specifications.
   2. The Contractor will engage a testing agency to perform field testing to determine compliance of excavation and embankment materials, placement methods and compaction to ensure acceptable structural subgrade. Testing Agency will test in-place pavement for density and thickness.

B. Earthwork
   1. Work shall be completed in accordance with Technical Specification Section 02200 - Excavation and Embankment.
   2. Compaction and Testing
      • Compact fill materials to following densities at optimum moisture content based on ASTM D698 or AASHTO T99:
      • Structure fill under or within 5' horizontally of all concrete structures: 95%.
      • Backfill beneath or within 5' horizontally or within the area defined by a line extended at an angle of 1:1 of existing or proposed pavements, roadways, sidewalks, curbs, utility lines, retaining wall bases, or other improvements: 95%
      • Backfill within public or designated rights-of-way: 95% or as shown on the Drawings.
      • Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99.
      • Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.
      • Frequency of Testing. Frequency of testing to be done at the direction of the Engineer.
      • Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by Geotechnical firm approved by the Engineer.

C. Aggregate Base Course
   1. Work shall be completed in accordance with Technical Specification Section 02222 - Embedment and Base Course Aggregate.
   2. Compaction and Testing
      • Rolling will be continuous until the base material has been compacted to not less than 95% of maximum density as determined by ASTM D698 or AASHTO T99. Water shall be uniformly applied as necessary during compaction to obtain optimum moisture content and to aid in consolidation. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly keyed.
The finished base course surface shall be smooth and free of ruts and irregularities and true to grade and crown as shown on the plans or as directed by the Engineer. The final surface shall be finished with a surface smoothness tolerance of ¼ inch, measured as vertical ordinate from the face to a ten-foot straight edge. The base course shall be maintained in this condition by watering, drying, rolling or blading as necessary, or as the Engineer may direct, until the surface material is placed.

Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance to these Specifications.

Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or ASSHTO T99.

Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.

Frequency of Testing. Conduct a minimum of one test for each layer of specified depth of fill or backfill as follows:
- Foundations: For each 100 lineal feet or less of trench.
- Slabs on Grade: For each 2,000 square feet or less of building area.
- Pavement and Walks: For each 2,000 square feet or less.
- All Other Areas: For each 5,000 square feet or less.
- Utility Trenches: For each 250 lineal feet or less of trench.

D. Asphalt
1. Work shall be completed in accordance with Technical Specification Section 02612 - Hot Bituminous Paving.

2. Contractor to verify final surfaces are of uniform texture, conforming to required grades and cross sections.

3. Testing agency will take not less than 4-inch diameter pavement specimens for each completed course from locations as directed by Town.

4. Repair holes from test specimens as specified for patching defective work.

5. Minimum acceptable density of in-place course materials is 95 percent of the recorded laboratory specimen density. Immediately re-compact asphaltic concrete not conforming to acceptable density. Remove and replace all sections not in conformance density requirements.

6. Thickness: Variations from drawings
   - Base course: 1/4-inch +
   - Remove and replace paving less than minimum thickness

7. Surface Smoothness
   - Test using a 10-foot straight edge applied parallel to direction of drainage.
   - Advance straight edge five feet, maximum 1/4-inch per foot from nearest point of contact.
   - Do not permit pockets or depressions where water may pool.
   - Remove and replace areas, deficient in smoothness. Overlay corrections may be permitted only if acceptable to Town.
8. Inspection: The work of this section is subject to the inspection and approval of the Town. The following inspections are required:
   • Protection of adjacent property
   • Staking and establishment of elevations
   • Establishment and compaction of subgrade
   • Placement and compaction of bituminous base course and wearing surface
   • Final inspection
   • Obtain approval of each element of work listed above in sequence of its completion before proceeding with the next item

E. Concrete Pavement
   • Work shall be completed in accordance with Colorado Department of Transportation Standard Specifications for Road and Bridge Construction current version, Section 412 – Portland Cement Concrete Pavement.
   • Concrete strength shall be Class P with minimum 4500 psi in accordance with Section 601 – Structural Concrete
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DIVISION 5

LANDSCAPING AND IRRIGATION
## Division 5 Landscaping and Irrigation

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SECTION 5.1

PLANT LANDSCAPING

5.1.1 GENERAL

Fertilizing, seeding, mulching, sodding, planting or transplanting of trees, shrubs, or other plants required to provide landscaped areas for the Town shall be supplied and installed using current approved horticultural practices, these specifications and the contract documents.

5.1.2 MATERIALS

Materials to be incorporated into the landscaped areas shall conform to the minimum standards hereinafter referred to in the following (or approved equals).

5.1.3 SHRUBS, TREES AND OTHER PLANTS

A. All plants shall be nursery grown, for a minimum of one year, in U.S. Department of Agriculture recognized hardiness zones two, three, four and five only; conform to the requirements of the USDA Standards, AAN Standardized Specifications, and the Colorado State Nursery Act of 1965. Plants imported shall comply with all nursery inspection and quarantine regulations of the state of origin and destination, as well as all federal regulations governing interstate shipment of nursery stock.

B. Plants shall be healthy representatives of the specified species or variety with well-developed branch and root systems that are free of all objectionable features, diseases and insect pests. The minimum sizes and/or heights of all plants will be specified in the bid documents. Plant materials shall be measured as indicated in the plans by container size, height, and/or caliper. Caliper is the measured diameter of the tree at a six inch height above the root ball. In trees above three inches in diameter the caliper measurement is made at a height of twelve inches above the root ball of the tree.

C. The contractor shall be responsible for and furnish the Town a certificate of inspection for all materials, as required by federal, state or other authorities. A certificate of inspection will be supplied for each package, box, bale shipped or otherwise delivered. Contractor will provide a Grower’s Certificate showing the origin of each plant. Each plant shall have a grower’s label affixed to the plant which identifies the plant with the necessary dates to conform to these specifications.

D. The contractor’s successful procurement arrangements for all plant material shall be evidenced by his/her act of submitting a Bid Proposal.

E. Planting Pit Backfill – Backfill for each planting pit will be an improved soil consisting of three parts on-site topsoil and one part sphagnum peat, thoroughly blended and free of inorganic foreign substances.

F. Tree Wrap – The contractor will wrap each tree in crepe nursery wrap, spirally applied with one (1) inch overlap and double wrapped at top and bottom. Waterproof tape will be used to hold the wrap in place.
G. Plant Anchorage – Trees will be anchored by the use of double strands of twelve gauge galvanized steel wire anchored to the plant through new or non-fractured garden hose. This wire will be attached to metal tee-posts. The number of stakes or posts and the specific methods of anchorage will be indicated in the plans or specifications.

H. Soil Conditioners For Trees And Shrubs – The desired soil conditioner and fertilizer will vary per project. Consult plans and project specifications for specific application of mulches and soil mixes desired.
1. Agriform planting tablets (twenty-one grams/tablet) containing a 20-10-5 NPK ratio, as manufactured by the Sierra Chemical Company or approved equal.
2. Liquid commercial fertilizer containing a 20-30-10 NPK ratio and chelated iron applied in accordance with the Colorado Nurseryman’s Association’s recommendation on trees three (3) inches and larger in caliper.
3. Sphagnum peat certified to have a pH less than five and containing ninety-five percent organic matter when supplied to six to seven and one half cubic feet compressed bales.
4. Mountain peat shall have a pH less than six and one-half and contain a minimum of 50 percent organic matter, subject to specific testing and approval by the project manager prior to delivery.
5. Miracle Compost as manufactured by Majestic Mushroom Company, Golden, Colorado or approved equal.

5.1.4 PLANTING PIT MULCH AND COVER

A. Tree pits shall be covered with an approved four (4) inch thick chipper chip, or designated mulch material, in seeded areas and sodded areas. Edging, if included, will be shown on the drawings.

B. Shrub beds shall be covered with a four (4) inch compressed thickness of two to three inch long chipper chip or designated mulch material placed directly on the dirt around the plants. Edging, if included, will be shown on the drawings.

C. Weed Barrier, a layer of approved non-woven filter fabric (Mirafi 140 or equal) will be used in shrub beds or tree pits if designated on the drawings.

5.1.5 GRASS MATERIALS

A. Seed – Seed shall be furnished in containers that are labeled in conformance with applicable state and federal regulations and showing at least the name and address of supplier, seed name, lot number, net weight, percent of seed content, guaranteed percent of purity and percent of germination. All seed furnished shall be free from noxious weed seeds. Containers whose contents become wet, moldy or otherwise damaged will not be acceptable. All seed labels will be received by the project manager prior to acceptance of the seeding. Final or finish grade will be accepted by the project manager prior to seeding. All seed shall be applied via hydroseeding.

B. Sod – Sod produced from the type of seed previously described shall be live nursery-grown grass actively growing or capable of renewing growth after
dormancy. Sod shall be free of all undesirable perennial or annual grasses, plants, stones or any other material detrimental to growth or future maintenance. Grass shall be mowed to a height of two inches in the field. The sod will be machine cut in rectangular sections having a minimum soil thickness of five-eighths of an inch and sized to allow lifting and rolling without breaking. No netting or other material can be used to lift new sod.

C. Soil Conditioner for Grass or Sod. A commercial fertilizer certified as to containing an NPK ratio of 20-10-5 unless otherwise specified in the Special Conditions.

D. Mulch for Seeded Grasses – Mulch shall be placed via hydroseeding.

E. Topsoil – Loose, friable loam that is free from admixtures of subsoil, refuse, stumps, rocks, roots, brush, weeds or other material which would be detrimental to the proper development of vegetative growth. If needed, as determined by the Town, improved top soil shall be imported.

5.1.6 TREE, SHRUB AND PLANT LANDSCAPING

Final or finish grade must be approved by the project manager prior to planting.

5.1.7 TRANSPLANTING OF PLANTS

A. Handling plants shall be done according to recognized standard practices at all times. Plants shall be properly dug, pruned, inspected and tagged. The root system will be kept moist and the plant protected from all adverse conditions until planting is complete.

B. Plants may be furnished in non-biodegradable containers, which must be removed prior to planting or with the root system balled and burlapped. Balling and burlapping must conform to the “American Standard for Nursery Stock” specifications. The plant ball shall be natural, not man-made, and used for handling the plant at all times. Plants having a trunk loosened from the root ball or a broken ball will be rejected.

C. All plants will be inspected and approved by the project manager on site before they are planted. The project manager or a designated representative will select and reject plants at the nursery, if possible. Leaders on central trunks will be healthy. All plants that are found to be stressed damaged, drying out, insect infested, diseased or otherwise failing to meet the specifications or which appear incapable of normal growth will be rejected. All trees and shrubs will be tagged for genus and species. Plants not tagged will be rejected.

D. Deciduous tree trunks shall be wrapped from the top of the ball to the first branch, after pruning, then tape with waterproof tape securely at top and bottom.

E. Locally grown trees not to exceed a six caliper inch trunk diameter will be machine transplanted. However, the lapsed time between digging and placing in the tree pit shall not exceed twelve hours.
5.1.8 PRUNING

A. All pruning will conform to currently approved horticultural practices. Pruning evergreens shall be limited to the removal of damaged or dead foliage. Other plants shall have all damaged or dead roots or branches pruned to slightly above the nearest healthy side bud, at an angle not to exceed 45 degrees from the remaining portion. Leaders shall not be pruned. Other pruning, as required by the project manager, may be required.

B. Within ten days prior to transplanting, locally grown deciduous trees and shrubs shall be pruned to reduce their foliage spread by one-third unless otherwise directed.

5.1.9 EXCAVATING FOR PLANTING PITS

A. Planting pits shall be flat bottomed, circular in outline and excavated with vertical sides. No glazed smooth holes will be accepted. The contractor will, at the request of the project manager, roughen the surfaces of the plant pits. Pits shall have a diameter eighteen (18) inches greater than the earth ball diameter for trees and twelve (12) inches greater than the earth ball diameter of bare root or container shrubs. A minimum layer of select backfill will be placed below the bottom of the earth ball or root system. The backfill will be at least nine (9) inches deep under trees and six (6) inches deep under shrubs. Areas to be planted with ground cover shall be suitable furrowed using select backfill to a depth of six (6) inches. Pits shall be free of underground obstructions such as pipes, wires, rock formation, debris or contaminants.

B. The contractor shall protect and maintain in service all existing underground utilities, sprinkler system equipment, piping and amenities or structures, whether or not shown on the drawings during the performance of the work. He/she shall adequately barricade any pit or hole which is to remain open in excess of four hours.

5.1.10 PLANTING TREES AND SHRUBS

A. Planting of trees, shrubs and other plants shall be done at a time of year that is favorable to plant growth and in accordance with good horticultural practice.

B. Excavation for planting shall not commence until the project manager has staked all plant beds. Under no circumstances shall plant material be installed which interferes with the operation or coverage of the sprinkler system equipment or which will be damaged by the irrigation spray.

C. Following excavation of the planting pit, the contractor shall place the specified depth of improved planting mix into the hole before setting any tree or shrub. Upright plants shall be set plumb. Prostrate plants shall be set at the same depth to the ground surface as originally grown. The ball of each tree shall be set so that the top of the ball is parallel to the slope of the plant bed.

D. In irrigated areas all deciduous trees will be planted two (2) inches above finished grade, evergreen trees will be placed with the top of the ball three (3) inches above
finished grade. In non-irrigated areas, the top of the ball shall be surrounded by a saucer, the diameter of the plant pit, that will hold water; and the top of the ball will be set one (1) inch above ground level. All wire baskets or any synthetic material must be totally removed from the root ball of all plants. Remove all cord and peel burlap back from the top one third of the root ball. The wire and cord removed from each tree will be set to the side of the newly planted tree for inspection by the project manager.

E. During the setting of the plant, the contractor shall partially backfill the pit to within six (6) inches of finish grade by carefully placing and compacting as specified planting pit backfill around the ball of the plant. The plant shall then be fertilized by meeting Agriform tablets, equally spaced, eight (8) inches below finish grade. Four tablets shall be placed in the pits for each tree with a caliper three (3) inches and larger; three (3) tablets shall be placed in the pits for each tree with a one and one-half (1½) inch caliper. Shrubs shall have two (2) tablets each placed 180 degrees apart in the pit.

F. Following fertilization, the placement and gentle compaction of planting pit backfill around the ball shall continue until the hole is completely backfilled. Water shall then be placed in the pit by means of a water lance so that the hole is irrigated from the bottom upward.

G. When water has disappeared, the pit shall be filled with more Planting pit backfill until stabilized to the desired finish grade.

H. Trees shall then be anchored by means of stakes and wire. Stakes shall be metal tee-posts placed in undisturbed soil outside the pits; and guy wires shall be anchored to above the first and second limb crotch of the tree. The guy wire will be threaded through rubber hose so that no wire contacts the tree. The wire shall then be tightened sufficiently by twisting the wire to anchor the tree in a true vertical plumb, allowing the plant one inch play in each direction. Two guy wires 180 degrees apart in an east-west orientation will be used for each tree two (2) inches in caliper or smaller.

5.1.11 MULCHING PLANT PITS

All single trees, clusters of trees and/or shrubs, including row patterns, shall be mulched with chipper chip shredded wood or designated mulch material. Mulch shall cover the tree pit around each tree and shrub. Shrub and ground cover beds shall be mulched unless otherwise stated or shown on the drawings.

5.1.12 GRASS LANDSCAPING

A. Prior to seeding or sodding and in accordance with the requirements of the applicable section of the Town Standard Specifications, the area to be landscaped shall be cleaned, grubbed and graded to within one-half inch of finish grade.

B. All irregularities in the ground surface, except the saucers for trees and shrubs in rough grass seeding areas, shall be removed. Special measures shall be taken to eliminate all low spots and pockets that would trap water and to clear the area of one to one and one-half inch and larger rocks or other debris.
5.1.13 SEASON FOR PLANTING GRASS SEED

A. Seeding seasons in any calendar year shall be limited to those periods of time favoring a healthy growth of grass by accepted horticultural practices. Unless otherwise approved by the project manager, seeding shall be accomplished within the following time periods:

<table>
<thead>
<tr>
<th>Grass Area</th>
<th>Early Season</th>
<th>Late Season</th>
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<tbody>
<tr>
<td>Sprinkler Irrigated</td>
<td>March 1 to April 15</td>
<td>September 1 to October 1</td>
</tr>
<tr>
<td>Non-Irrigated</td>
<td>March 1 to April 15</td>
<td>September 1 to October 1</td>
</tr>
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B. Seeding shall not be performed during windy weather or when the ground is frozen or otherwise untellable. Seeding portions of the designated areas may be permitted before construction is complete in order to take advantage of the growing season, with prior approval of the project manager.

5.1.14 BED PREPARATION FOR SEEDING OR SOD PLACEMENT

A. Commercial fertilizer at the rate of 300 pounds per acre shall be applied and then be spread and tilled into the top two inches of the soil. The ground surface shall be graded and worked by hand, if necessary, to within one-half inch of finish grade to prepare for seeding or sod placement. Areas to be seeded or sodded which are contiguous with curbs, sidewalks or other architectural structures shall be sloped and graded to a level one inch lower than the structural surface grade, on the uphill side of the paved surface. On the downhill side of the structured surface, the finish grade, after seeding or sodding, will be flush with the top of the paved surface.

B. All areas that have set for any period of time after fertilizing, which become firm or leaked over for whatever reason, shall be retiled to a depth of one inch prior to seeding.

5.1.15 SEED PLANTING RATE

Seed shall be sown to provide the coverage of “Pure Live Seed” (PLS) mixture, as determined in accordance with the following formula:

\[ \text{Lbs. (PLS)} = \text{lbs. seed} \times \% \text{ Purity} \times \% \text{ Germination} \]

5.1.16 PLANTING SEED

A. The contractor will seed over fertilized ground using approved mechanical power-drawn drills followed by packer wheels. Contractor shall submit seed mixture.

B. Fertilizer type and method of application may vary with each project. Consult the project plans and specifications for any modifications in the fertilization or bed preparation process.

C. The power-drawn drill shall be set to maintain a seed planting depth of one-fourth (1/4) inch. Seed sown by broadcast type seeders or by hand shall be “raked in” or
otherwise covered with soil to a depth of one-quarter (1/4) inch. The hand-broadcasting method of seeding shall be limited to those areas not accessible by machine methods.

5.1.17 MULCHING SEEDED AREAS

A. Mulching seeded areas shall be accomplished by the hydraulic method using wood cellulose fiber mulch. Hydraulic mulching in slurry form shall be applied to all seeded areas. Proportionate quantities of water and other approved materials shall first be placed in the slurry tank and mix. Cellulose fiber mulch shall be added and mixing continued until the slurry is homogeneous. The slurry mixture shall then be uniformly spray applied at the rate of 1,400 pounds/acre over the designated area, using the color of the mulch as a metering agent. Hydraulic mulching shall not be performed in the presence of free surface water. Seed shall not be included in the hydraulic mulch. Mulch shall be Weyerhaeuser Silva-Fiore or approved equal.

B. Areas not properly mulched or damaged due to contractor’s negligence, shall be repaired and remulched in an acceptable manner at the contractor’s expense. Mulch removed by wind or water erosion prior to acceptance shall be reseeded and remulched by the contractor at his expense.

5.1.18 PLACING SOD

A. Sod placement may start after the sod bed or finished grade has been fertilized and prepared as previously specified. Special care shall be taken to prepare the surface to the specified elevations and to neatly rake the finished grade near fences, curbs, sidewalks, buildings, etc. Sod shall be transplanted within twenty-four hours after lifting, unless weather conditions prohibit normal operations. Sod shall be laid smoothly, edge to edge, perpendicular to slope, with staggered joints and pressed firmly into contact with the sod bed by tamping. All holes in the sod, frayed edges and missing strip corners shall be trimmed to straight lines and patches to completely fill all voids in the surface. Sod laid in slopes of 3:1 or greater will be secured with six (6) inch long wood stakes, as needed, until growth is established.

B. Once in place, the sodded area shall be lightly watered and rolled to insure full contact with the soil. After rolling, water shall continue until the added moisture penetrates the subsoil to a depth of not less than two inches.

C. Sod that becomes withered, moldy or yellow from heating, or has been allowed to dry out or freeze, will be rejected.

5.1.19 CARE AND MAINTENANCE

All trees, shrubs, other plant materials and seeded or sodded areas shall be cared for, watered, maintained and if necessary, barricaded and protected from damage from whatever cause until their acceptance. By the time of final inspection for acceptance, plant grower tags shall be removed. The landscaping shall be finally accepted for warranty and guaranteed by the contractor, after the following conditions have been met.

5.1.20 TREES, SHRUBS AND OTHER PLANTS
A. All plants shall be cared for, watered and maintained by the contractor until final project acceptance. The contractor shall not request an acceptance inspection until all plants that are dead or damaged due to his operation or vandalism or any other reason are replaced with like size and species.

B. All planting trees adjacent to Town-owned infrastructure (sidewalks, trails, etc.) shall be installed with a root barrier between the tree and the infrastructure.

5.1.21 SEEDED GRASS AREAS

A. Seeded areas shall be mowed to a two inch height at least once by the contractor and be free of weeds. The contractor will otherwise maintain seed until there is an acceptable uniform plant growth. Areas that are not producing a uniform plant growth within five weeks following seeding shall be reseeded.

B. Unacceptable uniform plant growth shall be defined as scattered bare spots, greater than one square foot, exceeding three percent of the seeded area. However, for seeded areas under irrigation it shall also include producing a uniform plant growth to a height of two inches. Irrigated areas that are seeded late in the fall planting season which are not producing an acceptable uniform plant growth, as previously defined, shall be reseeded during the following spring planting season. If such a condition exists and the contractor has diligently pursued the performance of his work, the Town, at its option, may extend the contract completion date and reduce the contract retainage. Retainage may be reduced to less than five percent of the total contract amount but shall be at least double the estimated or contracted cost of obtaining the required growth in the indicated areas, plus those areas which are susceptible to damage by winter kill, washout or other causes.

5.1.22 SODDED AREAS

A. Sodded grass areas shall be watered as needed and mowed at least once, and otherwise maintained for a period of thirty days after transplanting the sod.

B. Any areas that fail to sustain a healthy growth of grass during this period or appear susceptible to negative drainage shall be reworked and resodded before acceptance by the contractor.

5.1.23 GUARANTEE AND WARRANTY OF PLANTS

A. The contractor will replace all plants which die during the two year warranty. Exception will be made for plants which die during this period due to vandalism or neglect. Replacement will be limited to one time only. Replacement materials will be identical in size and species to the original plants specified. Replacement materials will be high quality. The project manager reserves the right to reject any replacement materials not meeting Town standards.

B. Contractor agrees to replace dead plants within two weeks after notification by the Town. The Town will maintain an accurate copy of the planting plan indicating which specimens were removed and/or replaced. The Town maintains the right to reject substandard landscaping and installation procedures.
SECTION 5.2
IRRIGATION SYSTEMS

5.2.1 GENERAL

A. All sprinkler irrigation systems installed as Capital Improvements within the Town of Granby shall conform to approved design plans and these specifications.

B. The Contractor shall insure and guarantee complete coverage of the areas shown on the drawings to be irrigated. The Contractor shall verify actual job site conditions and available water pressure as needed for the coverage guarantee. It shall be the Contractor’s responsibility to report to the Town Engineer any deviations between the drawings, specifications and the site. Any inconsistencies shall be noted by the Town Engineer and a written copy of the corrections shall be given to the Contractor.

C. When the Contractor is satisfied that the system is operating properly, that it is balanced and adjusted and that all work and cleanup is completed, he shall notify the Town Engineer for final inspection with date and time given, at least seventy-two hours in advance.

5.2.2 DRAWINGS

A. The specifications and drawings are intended to specify an efficient and complete sprinkler irrigation system. Use of the sprinkler irrigation system will follow the manufacturer’s recommendations and meet the Town’s approval without further cost to the Town.

B. All plot dimensions are approximate. Before beginning any phase of work, the Contractor shall check all dimensions on the drawings, verify the accuracy of each dimension and notify the Town of any discrepancies between the drawings and the site.

C. All work noted on the drawings or details shall be furnished and installed by the Contractor whether or not the work is mentioned in the specifications.

D. Omissions from the specifications or drawings or any mis-description of detail work which is absolutely necessary to carry out the intentions of the drawings or specifications shall not relieve the Contractor from performing such omitted detail work. The detail work shall be executed by the Contractor as if fully set forth and described in the specifications and drawings.

E. The Contractor will supply the Town with four sets of drawings and specifications. The drawings and specifications will indicate the work related to this contract. The Contractor shall record all changes in the work which constitutes departures from the original contract drawings, on one set called the Record Drawings. These Record Drawings (or As-Built Drawings) will become the property of the Town at the time of acceptance. Contractor shall supply to the Town Engineer two 24” x 36” hard copy drawings of the as-built and an electronic copy in both PDF and ACAD of the final as-built drawings.
F. The Contractor shall dimension from two permanent reference points (such as sidewalks, road intersections, manholes, abutment walls, etc.) the location of the following items:
   1. Connections to existing water lines.
   2. Public Service electric supply connections.
   3. Sprinkler control valves.
   4. Valve boxes (shut-off valves, isolation valves, etc.)

G. The Contractor shall deliver, on or before the date of final inspection, the corrected and completed Record Drawings to the Town or Town Engineer. Delivery of the Record Drawings will not relieve the Contractor’s responsibility to provide location information during the two year warranty period.

5.2.3 RULES AND REGULATIONS
   A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing officials Association, and applicable laws and regulations of the governing authorities.
   B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
   C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor’s responsibility to determine the actual quantities of all material, equipment and supplies required by the project and to complete an independent estimate of quantities and wastage.

5.2.4 DEMOLITION
   A. Remove existing sprinklers, valves, automatic controllers and other existing irrigation components indicated on the drawings. Remove items in a manner that minimizes damage to the components. Deliver only salvageable items to Town’s Representative. All other items shall be disposed of by the Contractor.
   B. Existing pipelines shall be abandoned in place. If an existing pipeline is encountered during the installation of a new pipeline, a section of the existing pipeline shall be cut and removed. Remove two (2) feet of the existing pipeline on either side of the new pipeline.
   C. Removal and disposal of existing asbestos-concrete (transite) pipelines shall be in accordance with the General Conditions, Special Conditions and the environmental Protection Agency rules and regulations.

5.2.5 TESTING
   A. Notify the Town’s Representative three days in advance of testing.
   B. Pipelines jointed with rubber gaskets or threaded connections may be subjected to a pressure test at any time after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints shall be allowed to cure at least 24 hours before testing.
   C. Subsections of mainline pipe may be tested independently, subject to the review of the Town’s Representative.
   D. Furnish clean, clear water, pumps, labor, fittings and equipment necessary to conduct tests or retests.
   E. Hydrostatic Pressure Test:
      1. Subject mainline pipe to a hydrostatic pressure equal to 120 psi for two hours. Test with mainline components installed.
2. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
3. Leakage will be detected by inspection. Replace defective pipe, fitting, joint, valve or appurtenance. Repeat the test until the pipe passes test.
4. Cement or caulking to seal leaks is prohibited.

F. Hydrostatic Pressure Test (Gasketed Pipe):
1. Close tightly all isolation valves and sprinkler lateral isolation valves on mainline for tests. Backfill trenches with enough material to prevent pipe from moving under pressure.
2. Test each section of pipe between isolation valves on the mainline pipe separately.
3. Purge all air from the pipeline before test. Attach pressure gauge to pipeline in test section. Attaching pressure gauge to quick coupling valve between mainline isolation gate valves in the test section is acceptable.
4. Subject mainline pipe to the anticipated operating pressure of 165 psi for two hours. Observe pressure loss on pressure gauge. If pressure loss is greater than 2 psi, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve or appurtenance. Repeat the test until the pressure loss is equal to or less than 2 psi.
5. Cement or caulking to seal leaks is prohibited.

G. Operational Test:
1. Activate each remote control valve in sequence from controller after backfilling. The Town’s Representative will visually observe operation, water application patterns and leakage.
2. Replace defective remote control valve, solenoid, wiring or appurtenance to correct operational deficiencies.
3. Replace, adjust or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler or appurtenance to correct leakage problems. Cementing or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components and correct deficiencies at no additional cost to the Town.

H. Control System Acceptance Test:
1. Upon completion of construction, a System Acceptance Test must be passed.
2. Following construction completion and a Review by the Engineer, an evaluation period will begin. After 30 days of continuous service without major system problems, the system will be accepted and the guarantee/warranty period will begin. If at any time during the 30-day evaluation period, a major system problem occurs, the source of the problem will be determined and corrected and the 30-day evaluation period will start again. Equipment will not be accepted until such time as the System Acceptance Test is passed.
3. If successful completion of the System Acceptance Test is not attained within 90 days following commencement of the evaluation period, the Town’s Representative has the option to request replacement of equipment, terminate the order, or portions thereof, or continue with the System Acceptance Test. These options will remain in effect until such time as a successful completion of the System Acceptance Test.
4. Final payment will be made after successful completion of the System Acceptance Test.

I. Control System Grounding:
1. Test for proper grounding control system per manufacturer’s recommendations. Test results must meet or exceed manufacturer’s guidelines for acceptance.

2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer’s guidelines are met.

5.2.6 CONSTRUCTION REVIEW

A. The purpose of on-site reviews by the Town’s Representative is to periodically observe the work in progress, the Contractor’s interpretation of the construction documents and to address questions with regard to the installation.

B. Scheduled reviews such as those for irrigation system layout or testing must be scheduled with the Town’s Representative as required by these specifications.

C. Impromptu reviews may occur at any time during the project.

D. A review will occur at the completion of the irrigation system installation and Project Record (As-Built) Drawing submittal.

5.2.7 WARRANTY AND REPLACEMENT

A. The purpose of this warranty is to insure that the Town receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.

B. For a period of two years from commencement of the formal maintenance period, guarantee/warranty irrigation materials, equipment, and workmanship against defects. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Town’s Representative. Conversely, the Town can make the repairs and bill the Contractor.

C. Contract documents govern replacements identically as the new work. Make replacements at no additional cost to the contract price.

D. Warranty applies to originally installed materials and equipment and replacements made during the warranty period.

5.2.8 QUALITY

Use materials which are new and without flaws or defects of any type and which are the best of their class and kind.

5.2.9 SUBSTITUTIONS

A. Acceptable sprinkler equipment manufacturers are Rain Bird, Hunter, Weather-Matic and others indicated on irrigation plans, details and special conditions. Alternative equipment must be approved in writing by the Engineer or Town prior to bidding. The Contractor is responsible for making any changes to the design to accommodate alternative equipment.

B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.

5.2.10 SLEEVEING
A. Install separate sleeve beneath hardscape areas to route each run of irrigation pipe or wiring bundle.

B. Sleeving material beneath drives, streets and pedestrian pavements shall be SCH40 PVC pipe with solvent welded joints.

C. Sleeving diameter shall be as indicated on the drawings and installation details or equal to a minimum of twice that of the pipe or wiring bundle.

5.2.11 PIPE AND FITTINGS

A. Mainline Pipe and Fittings:
   1. Use rigid, unplasticized polyvinyl chloride (PVC) National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-13, ASTM Standard D1785.
   2. Use SCH40 PVC pipe conforming to the dimensions and tolerances established by ASTM Standard D1785.
   3. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe with a nominal diameter greater than or equal to 3 inches. Gasketed pipe joints must conform to the “Laboratory Qualifying Tests” section of ASTM D3139. Gasket material must conform to ASTM F477. Use rubber gasketed deep bell ductile iron fittings conforming to ASTM A-536 and ASTM F-477. Use lubricant approved by the pipe manufacturer.
   4. Use solvent weld pipe for mainline pipe with a nominal diameter less than 3 inches or where a pipe connection occurs in a sleeve. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564.
   5. No plowing/pulling of mainline or control wire accepted.
   6. One inch meter is required on all irrigation systems.
   7. All systems will require a backflow preventer as detailed in section 3 of the PWM.

B. Lateral Pipe and Fittings:
   1. Use rigid, unplasticized polyvinyl chloride (PVC) National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-13, ASTM Standard D1785.
   2. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of a type approved by the pipe manufacturer.
   4. For drip irrigation laterals downstream of riser connections, use ¾ inch UV radiation resistant polyethylene pipe with self-flushing, pressure-compensating bubblers with the following: 1) shrubs – 1 bubbler; 2) 2” trees – 2 bubblers; 3) trees over 2” – 3 bubblers.
   5. No plowing or pulling of lateral lines accepted.

C. Specialized Pipe and Fittings:
1. Low Density Polyethylene Hose:
   a. Use pipe specifically intended for use as a flexible swing joint.
      Inside diameter: 0.490+0.010 inch
      Wall thickness: 0.100+0.010 inch
      Color: Black
   b. Use spiral barb fittings compatible with the nominal size of the hose.
2. Assemblies calling for threaded pipe connections shall utilize PVC Schedule 80 nipples and PVC Schedule 40 or 80 threaded fittings.
3. Joint sealant: Use only Teflon-type tape or Teflon based paste pipe joint sealant on plastic threads. Use nonhardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

D. Thrust Blocks:
   1. All thrust blocks shall comply with Town’s water standards as detailed in section 3 of PWM.
   2. Use thrust blocks for fittings on pipe greater than or equal to 3 inch diameter or any diameter rubber gasketed pipe.
   3. Use 4,000 psi concrete.
   4. Use 2 mil plastic.
   5. Use No. 4 Rebar wrapped or painted with asphalt tar based mastic coating.

E. Joint Restraint Harness:
   1. Use a joint restraint harness wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or thrust blocks.
   2. Use a joint restraint harness with transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks, or where extra support is required to retain a fitting or joint.
   3. Use bolts, nuts, retaining clamps, all-thread or other joint restraint harness materials which are zinc plated or galvanized.
   4. Use on pipe greater than or equal to 3 inch diameter or any diameter rubber gasketed pipe.

5.2.12 MAINLINE COMPONENTS

A. Main System Shutoff Valve as per local practice and in compliance with local code.

B. Winterization Assembly: Remove backflow preventer and blow lines out with air at this location.

C. Master Valve Assembly: as presented in the installation details.

D. Isolation Gate Valve Assembly with square key: as presented in the installation details. Install a separate valve box over a 3 inch depth of ¾ inch gravel for each assembly with a 2 inch operator.

E. Quick Coupling Valve Assembly: ¾” minimum quick coupling valve required at main shut off and connection manifold.

5.2.13 SPRINKLER IRRIGATION COMPONENTS
A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals: Provide Rain Bird PEB or PESB Series brass valves or approved equal as presented in the installation details. Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background. Install a separate valve box over a 3 inch depth of ¾ inch gravel for each assembly.

B. Sprinkler Assembly: Provide Rain Bird 5000 series rotors or approved equal as presented in the drawings and installation details. Use the sprinkler manufacturer’s pressure compensating screens to achieve 30 psi operating conditions on each sprinkler and to control excessive operating pressures.

5.2.14 DRIP IRRIGATION COMPONENTS

A. Remote Control Valve (RCV) Assembly for Drip Laterals: as presented in the installation details. Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background or approved equal. Install a separate valve box over a 3-inch depth of ¾ inch gravel for each assembly.

B. Combination Pressure Regulator/Filter Assembly: as presented in the installation details. Install a separate valve box over a 3-inch depth of ¾ inch gravel for each assembly.

C. Zone Control Valve Assembly: as presented in the installation details. Install a separate box over a 3-inch depth of ¾ inch gravel for each assembly.

D. Air/Vacuum Relief Valve Assembly: as presented in the installation details. Install at finish grade at high point of each Techline grid layout.

E. Line Flushing Valve Assembly: as presented in the installation details. Install a separate box over a 3-inch depth of ¾ inch gravel for each assembly.

5.2.15 CONTROL SYSTEM COMPONENTS

A. Irrigation Controller Unit:
   1. As presented in the drawing specifications and installation details. Utilize 2-wire/decoder system.
   2. Lightning protection: Provide 8-foot copper-clad grounding rod or grounding plate at controller location. Use American Wire Gauge No. 6 bare copper wire between the controller and grounding rod assembly. Ground following ASIC standards.
   3. Wire Markers: Pre-numbered or labeled with indelible non-fading ink, made of permanent, non-fading material.
   4. Switch/Outlet: Use 120 VAC, 15 amp combination switch / GFCI outlet.

B. Control Wire:
   1. Use American Wire Gauge (AWG) No. 14-1 solid copper, Type UF or PE cable, UL approved for direct underground burial for individual control wires and spare wires from the controller unit to each remote control valve or stub-out location. Use American Wire Gauge (AWG)
No. 12-1 solid copper, Type UF or PE cable, UL approved for direct underground burial for common ground wire from the controller unit to each remote control valve or stub-out location. Contractor will run electrical power to irrigation controller from the nearest approved power source.

2. Contractor will pour concrete pad that provides a minimum collar of concrete around the irrigation controller at least 6 inches wide and set irrigation controller in the center of the concrete pad.

3. Color: Wire color shall be continuous over its entire length.

4. Splices: Use wire connector with waterproof sealant. 3M DBY. All splices must be placed with a valve box.

5. Mark wire routing not located near PVC irrigation pipe with warning tape as described in these specifications. Contractor will hook valve wires to controller. Four spare wires are needed to run from barmaid master valve to Controller “B”. These four wires need to be two different colors. Contractor must numerically label all valve wires.

6. Warning tape: Inert plastic film highly resistant to alkalis, acids or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red, and imprinted with “CAUTION: BURIED ELECTRIC LINE BELOW.”

7. Provide spare control wire and quick coupler valve at each controller.

C. Existing Control Wire: It is assumed that existing low voltage control wire between existing controller and solenoid valves is in workable condition. Field verify quantity, location and proper operation prior to construction. Any concerns are to be brought to the attention of the Owner’s Representative prior to installation of the replacement controller.

D. Controller Enclosure:
   1. As presented conceptually in the installation details or noted in the special conditions.
   2. Constructed of stainless steel with free-flow ventilation. The key system is to be common to all enclosures made part of this project.
   3. Prepare shop drawings to show the exact placement of all components housed in the enclosure.
   4. Electrical conduit: Use PVC Schedule 40 conforming to the dimensions and tolerances established by ASTM Standard D-1 785.
   5. Lightning protection: Provide 8-foot copper-clad grounding rod or grounding plate at each controller location.
   6. Wire markers: Pre-numbered or labeled with indelible non-fading ink, made of permanent, non-fading material.

E. Power Wire:
   1. Electric wire from the power source to controller shall be solid or stranded copper, Type UF single conductor cable or multi-conductor with ground cable, UL approved for direct underground burial. Power wires shall be black, white and green in color. Size as presented in the drawings. The Contractor is responsible for verifying that the power wire sizes shown on the drawings are compatible and adequate for the control system being used.
   2. Splices: UL approved connectors.
4. Warning tape: Inert plastic film highly resistant to alkalis, acids or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red and imprinted with “CAUTION: BURIED ELECTRIC LINE BELOW.”

5.2.16 OTHER COMPONENTS AND MATERIALS

A. Tools and Spare Parts: Provide operating keys, servicing tools, test equipment, spare parts and other items indicated in the General Notes of the drawings.

B. Sod and Fertilizer: Provide sod and fertilizer as required by the Town and as described in these specifications.

C. Other Materials: Provide other materials or equipment shown on the drawings or installation details which are part of the irrigation system, even though such items may not have been referenced in these specifications.

5.2.17 INSPECTIONS AND REVIEWS

A. Site Inspections:
   1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Owner’s Representative prior to beginning work.
   2. Beginning work of this section implies acceptance of existing conditions.

B. Utility Locates (“Call Before You Dig”):
   1. Coordinate with Parks Representatives and all appropriate local authorities to arrange for the location and marking of all underground utilities.
   2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.

C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking of sprinkler head locations and Techline grid alignments have been completed. Notify the Owner’s Representative one week in advance of review. Modifications will be identified by the Town’s Representative at this review.

5.2.18 LAYOUT OF WORK

A. Stake out the irrigation system. Items staked include: sprinklers, grid alignment, sleeving, mainline and lateral line pipes, control valves, line flushing valves, air/vacuum relief valves, controllers, and isolation valves.

B. Install all mainline pipe and mainline components inside of project property lines.

5.2.19 EXCAVATION, TRENCHING, BACKFILLING AND SOD REPLACEMENT

A. Excavate to permit the pipes to be laid at the intended elevations and to permit work space for installing connections and fittings.

B. Minimum cover (distance from top of pipe or control wire to finish grade):
1. 18” minimum over mainline pipe and over electrical conduit.
2. 18” minimum over control wire.
3. 15” minimum over lateral pipe to sprinklers and over supply header lateral pipe to drip system riser connections.
4. Dripperline grids shall be installed directly on the soil surface and secured to grade with approved stakes.

C. Backfill only after lines have been reviewed and tested.

D. Excavated material is generally satisfactory for backfill. Backfill shall be free from rubbish, vegetation matter, frozen materials and stones larger than 2-inches in maximum dimensions. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects which may damage the pipe.

E. Backfill unsleeved pipe and sleeves in either of the following manners:
   1. Backfill and puddle the lower half of the trench. Allow to dry 24 hours. Backfill the remainder of the trench in 6-inch layers. Compact to density of surrounding soil.
   2. Backfill the trench by depositing the backfill material equally on both sides of the pipe in 6-inch layers. Compact to density of surrounding soil.

F. Enclose pipe and wiring beneath roadways, walks, curbs and other hardscape conditions in sleeves. Minimum compaction of backfill for sleeves shall be 95% Standard Proctor Density, ASTM D698-78. Use of water for compaction around sleeves, “puddling”, will not be permitted.

G. Dress backfilled areas to original grade. Dispose of excess backfill off site.

H. Where utilities conflict with irrigation trenching and pipe work, contact the Town’s Representative for trench depth adjustments.

I. Any and all turf grass areas disturbed during the construction process shall be repaired as follows:
   1. At any location where it is necessary to cross over a sidewalk or any other concrete or asphalt areas, every effort shall be made to protect said concrete and/or asphalt from damage. In the event that any concrete or asphalt does become damaged, it is the responsibility of the Contractor to repair or replace the damage.
   2. All affected areas will have sod removed, with a sod cutter or other appropriate equipment to provide a uniform edge for sod replacement. All stripped sod shall be removed from the site and properly disposed of.
   3. Fill soil added to raise the soil level in any area shall be placed in no greater than six inch (6”) lifts and then compacted to eliminate future settling.
   4. These areas will then be rough graded. Clear the prepared area of clods, stones, wood, rubbish and all debris that will not pass through the tines of a garden rake, final approval by the Town.
   5. The area should then be rolled to reduce future settling.
   6. The prepared areas should then be fertilized at the rate of twenty pounds per 1,000 square feet of 5-20-5 fertilizer or approved other. Submit manufacturer’s analysis.
7. Notify the Town 24 hours prior to sodding to obtain approval of grade and sod bed prior to sodding. To avoid ponding, no tolerance in sod area grading is permitted. If determined by the Town to be necessary the area will be regarded and/or fill dirt added to provide a smooth, even, uniform transition from the undisturbed areas to the disturbed areas.

8. Sod shall be Colorado grown, 100% certified blended Kentucky Bluegrass of 3 to 4 types, or a mixture approved by the Town, complying with applicable Colorado and Federal regulations, having a healthy root system, regularly fertilized, watered, mowed, sprayed and free from objectionable weeds and/or grasses. Sod strips shall have from 5/8” minimum to 1” maximum thickness of soil adhering to the root system, cut into strips 18” maximum width by 24” minimum length. Sod which has dried out, or sod with adhering soil which breaks, tears or crumbles away will not be accepted. Sod cut for more than twenty-four (24) hours will not be accepted. Sod rolls shall be kept moist, protected from sun, heat and wind, and properly protected in transport. The sod source shall be made known to and approved by the Town after contract signing.

9. Sodding dates must be approved by the Town.

J. No plowing or pulling of pipe or control wire will be allowed.

5.2.20 SLEEVING AND BORING

A. Install sleeving at a depth which permits the encased pipe or wiring to remain at the specified burial depth.

B. Extend sleeve ends one foot minimum beyond the edge of the paved surface. Cover pipe ends and mark with stakes.

C. Bore for sleeves under obstructions which cannot be removed. Employ equipment and methods designed for horizontal boring. At locations where pavers are installed and set in sand base, remove the pavers and sand for surface trenching of sleeving and conduit crossings. Reset sand and pavers after backfilling sleeve or conduit to original condition as directed by Town’s Representative.

5.2.21 ASSEMBLING PIPE AND FITTINGS

A. General:
2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
3. Maintain six inches between pipes sharing a common trench. Do not stack pipes.
4. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20 foot length of pipe by pipe size are shown in the following table. All curvature results from the bending of pipe lengths. No deflection will be allowed at a pipe joint.
B. Mainline Pipe and Fittings:
1. Use only strap-type friction wrenches for threaded plastic pipe.
2. PVC Solvent Weld Pipe:
   a. Use primer and solvent cement. Join pipe in a manner recommended by the manufacturer and in accordance with accepted industry practices.
   b. Cure for 30 minutes before handling and 24 hours before allowing water in pipe.
   c. Snake pipe from side to side within the trench.
3. Fittings: The use of cross type fittings is not permitted.

C. Lateral Pipe and Fittings:
1. Use only strap-type friction wrenches for threaded plastic pipe.
2. PVC Solvent Weld Pipe:
   a. Use primer and solvent cement. Join pipe in the manner recommended by the manufacturer and in accordance with accepted industry practices.
   b. Cure for 30 minutes before handling and 24 hours before allowing water in the pipe.
   c. Snake pipe from side to side within the trench.
3. Dripline Pipe:
   a. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
   b. Hold in place with tubing stakes or landscape fabric staples spaced every four feet. Pipe is not to be compressed or crimped by the stake or staple or other construction activity.
4. Fittings: The use of cross type fittings is not permitted.

D. Specialized Pipe and Fittings:
1. Low Density Polyethylene Hose: Install per manufacturer’s recommendations.
2. No galvanized pipe will be allowed.
3. PVC Threaded Connections:
   a. Use only factory-formed threads. Field-cut threads are not permitted.
   b. Use only Teflon-type tape or Teflon based paste.
   c. When connection is plastic-to-metal, the plastic component shall have male threads and the metal component shall have female threads.
4. Make metal-to-metal, threaded connections with Teflon-type tape or pipe joint compound applied to the male threads only.

E. Thrust Blocks:
1. Use cast-in-place concrete bearing against undisturbed soil.
2. Size, orientation and placement shall be as shown on the installation details.
3. Wrap fitting with plastic to protect bolts, joint and fitting from concrete.
4. Install rebar with mastic coating as shown on the installation details.
F. Joint Restraint Harness: Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.

5.2.22 INSTALLATION OF MAINLINE COMPONENTS

A. Main System Shut Off Valve: Install where indicated on the drawings.
B. Winterization Assembly: Install where indicated on the drawings.
C. Master Valve Assembly: Install where indicated on the drawings.
D. Isolation Gate Valve Assembly:
   1. Install where indicated on the drawings.
   2. Locate at least 12-inches from and align with adjacent walls or edges of paved areas.
E. Quick Coupling Valve Assembly: Install where indicated on the drawings.

5.2.23 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals:
   1. Flush mainline before installation of RCV assembly.
   2. Install where indicated on the drawings. Wire connectors and waterproof sealant shall be used to connect control wires to remote control valve wires. Install connectors and sealant per the manufacturer’s recommendations.
   3. Install a ball valve in front of each valve. Locate valve box at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical. Arrange grouped valve boxes in rectangular patterns. Allow at least 12-inches between valve boxes.
   4. Adjust RCV to regulate the downstream operating pressure.
   5. Attach ID tag with controller station number to control wiring.
   6. Brand all valve box lids with an approved number in a sequence that corresponds to the controller layout.
B. Sprinkler Assembly:
   1. Flush lateral pipe before installing sprinkler assembly.
   2. Install per the installation details at locations shown on the drawings.
   3. Locate rotary sprinklers 6-inches from adjacent walls, fences or edges of paved areas.
   4. Locate spray sprinklers 3-inches from adjacent walls, fences or edges of paved areas.
   5. Install sprinklers perpendicular to the finish grade.
   6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
   7. Adjust the radius of throw of each sprinkler for best performance. Using nozzle set screw to adjust the radius is prohibited.

5.2.24 INSTALLATION OF DRIP IRRIGATION COMPONENTS

A. Remote Control Valve (RCV) Assembly for Drip Laterals:
   1. Flush mainline pipe before installing RCV assembly.
2. Locate as shown on the drawings. Wire connectors and waterproof sealant shall be used to connect control wires to remote control valve wires. Connectors and sealant shall be installed as per the manufacturer’s recommendations.

3. Install only one RCV to valve box. Locate at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical.


B. Zone Control Valve Assembly: Install at locations shown on the drawings.

C. Emitter Grid Layout:
   1. Locate as shown on the drawings and installation details.
   2. Flush lateral supply header pipe before installing emitter grid.
   3. Use tools and techniques recommended by the manufacturer.

D. Air/Vacuum Relief Valve Assembly: Install at the high point of each emitter grid layout as shown on the installation details.

E. Line Flushing Valve Assembly: Install at the end of each emitter grid layout as shown on the installation details.

5.2.25 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Irrigation Controller Unit:
   1. The location of the controller unit as depicted on the drawings is approximate; the Town’s Representative will determine the exact site location upon commencement of contract.
   2. Lightning protection: Provide grounding components such as ground rod or ground plate assembly, grounding wire, etc., in accordance with manufacturer’s recommendations. Drive 8-foot copper-clad grounding rod into the soil. If rock prevents driving, bury at least four feet deep. Use one ground rod assembly for each controller. Connect controller to grounding rod with AWG No. 6 solid conductor copper wire. Secure wire to grounding rod with approved Calweld Brand Connectors or approved equal.
   3. Install primary surge protection arrestors on incoming power lines.
   4. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with the identification number (see drawings) of the remote control valve to which the control wire is connected.
   5. Install combination switch / GFCI outlet inside the controller enclosure.
   6. Connect control wires to the corresponding controller terminal.

B. Control Wire:
   1. Bundle control wires where two or more are in the same trench. Bundle with pipe wrapping tape spaced at 10-foot intervals. Do not tape wire together where contained within sleeving or conduit.
   2. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90 degree change of direction, at both ends of sleeves and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 30-inch length of wire within each remote control valve box.
3. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted.

4. If a control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer's recommendations. Locate splice in a valve box which contains an irrigation valve assembly, or in a separate 10-inch round valve box. Use same procedure for connection to valves as for in-line splices.

5. Unless noted on plans, install wire parallel with and below PVC mainline pipe.

6. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill six inches about the wiring.

C. Power Wire:
   1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a junction box in accordance with local codes. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
   2. Green wire shall be used as the common ground wire from power source to all satellites.
   3. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
   4. Encase power wire in electrical conduit with a continuous run of warning tape placed in the backfill, 6-inches above the wiring.

5.2.26 INSTALLATION OF OTHER COMPONENTS

A. Tools and Spare Parts: Prior to the review at completion of construction, supply to the Owner operating keys, servicing tools, spare parts and any other items indicated in the General Notes on the drawings.

B. Other Materials: Install other materials or equipment shown on the drawings or installation details which are part of the irrigation system, even though such items may not have been referenced in these specifications.

5.2.27 PROJECT RECORD (AS-BUILT) DRAWINGS

A. The Contractor is responsible for documenting changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents (Record Drawings). Keep documents current. Do not permanently cover work until as-built information is recorded.

B. Record pipe and wiring network alterations. Record work which is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each controller or control unit, each sleeve end, each stub-out for future pipe or wiring connections and other irrigation components enclosed within a valve box.

C. Prior to acceptance, Record drawings shall be provided to the Town Engineer in electronic format including PDF, ACAD and GIS.
5.2.28 WINTERIZATION AND SPRING START-UP

Winterize the irrigation system in the fall and start-up the irrigation system in the spring of the first year following final approval of construction. Repair any damage caused by improper winterization at no additional cost to the Town. Coordinate the winterization and start-up with the landscape maintenance personnel.

5.2.29 MAINTENANCE

A. Upon completion of construction and review by the Town’s Representative, maintain irrigation system for a duration of 30 calendar days. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water.

B. Following completion of the Contractor’s maintenance period, the Town will be responsible for maintaining the system in working order during the remainder of the guarantee warranty period, for performing necessary minor maintenance, for trimming around sprinklers, for protecting against vandalism, and for preventing damage after the landscape maintenance operation.

5.2.30 CLEANUP

Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.
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SECTION 6.1

ENGINEERING SUBMITTAL REQUIREMENTS

6.1.1 MASTER PLAN COMPLIANCE

A. From time to time, the Town may adopt various master plans for water, sewer, drainage and roadway infrastructure. In addition to Municipal Code and Public Works Manual requirements, development applications must demonstrate compliance with pertinent master plans as identified by the Town. The Granby/SilverCreek Water & Wastewater Authority Water and Sewer Master Plans are examples applicable to areas within Granby Ranch. These plans will be updated as new development occurs. Granby Sanitation District may also have a master plan that will affect development. Developer should contact the Town as early as possible to define any master plan issues.

6.1.2 SKETCH PLAN

A. Sketch Plan should meet the requirements of Section 17.20.020 Sketch plan of the Town of Granby’s Municipal Code (GMC). Additional requirements include the following:

B. The Sketch Plan application shall include a map clearly representing and identifying the area in which the project is proposed, adjacent natural and man-made features and adjacent landowners.

C. The Sketch Plan shall be at a scale of not less than 1”=200’, and shall contain, at a minimum, the following information, represented graphically or as a map note:

1. Proposed name of the subdivision;
2. Location, boundaries and legal description of the project;
3. Names, addresses and phone numbers of the owner(s), applicant(s), planner(s) and engineer(s);
4. Date of sketch map preparation, map scale and a symbol designating true North;
5. Topography of the proposed subdivision showing, at a minimum, five (5) foot contours for terrain with an overall average slope of less than twenty percent (20%) and at a minimum ten foot (10’) contours for terrain with an overall average slope of over twenty percent (20%), contours developed by interpolation of U.S.G.S. quadrangle contours are acceptable;
6. General location and dimensions of all existing and proposed lots, streets, alleys, easements, road rights-of-way, irrigation ditches and water courses within and immediately adjacent to the proposed development;
7. Description of any natural or man-made features bordering on or within the development which may require buffering or screening, particularly the one hundred (100) year floodplain of any major drainages;
8. Vicinity map from a U.S.G.S. quadrangle at a scale of 1”=2000’ depicting the location of streets, highways and adjacent utility systems within a minimum of one-half (1/2) mile of the proposed subdivision and showing the natural drainage courses for streams flowing through the proposed subdivision with the limits of tributary areas shown where reasonable; and
9. Land use breakdown including:
a. Existing zoning and proposed zoning changes, if applicable;

b. Total development area;

c. Total number of lots proposed;

d. Total number of dwelling units proposed;

e. Total area of proposed non-residential floor space;

f. Total number of individual dwelling units proposed for each structure;

g. Total number of proposed off-street parking spaces; and

h. Total proposed density.

6.1.3 SKETCH PLAN SUPPLEMENTAL INFORMATION

A. In addition to the Sketch Plan map, the following supplemental information shall be submitted, in graphic and/or written form:

1. Source and amount of water supply;

2. Proposed type of sewage disposal;

3. U.S.D.A. Soil Conservation Service soil designations, with interpretation tables attached;

4. Statement assessing the impact of the proposed subdivision on the lakes, streams and topography of the site;

5. Statement assessing potential radiation hazards to the site;

6. Evidence that all lots and parcels created by the subdivision will have access to a public right-of-way, in conformance with the Colorado State Highway Access Code and applicable County Regulations; and

7. Anticipated source of electricity, natural gas, telephone and cable TV services; and

8. Compatibility/conformance with applicable water, sewer, drainage and roadway master plans.


6.1.4 PRELIMINARY PLAN

A. The Preliminary Plan shall meet the requirements of Section 17.20.030 Preliminary plat of the Town of Granby’s Municipal Code (GMC). Additional requirements include the following:

B. Soils, street, traffic reports as described in Division 4.

C. Drainage report and Master Plan for the entire project in conformance with this manual.

D. Water System Master Plan and Report in conformance with this manual and demonstrating that adequate supply, storage, system pressures and fire protection will exist throughout the project.

E. Sanitary Sewer Master Plan and Report in conformance with this manual and demonstrating that wastewater flows are properly handled on the project.

F. Engineering drawings, including the following:

1. Existing and proposed grading.

2. Roadway profiles.
3. Sewer system layout with elevations. (Profiles may be required in some instances).
4. Water system layout with elevations as required.
5. Drainage system layout with proposed elevations. (Profiles may be required in some instances).
7. Miscellaneous Utility Master Plan showing proposed electric, gas, and communications corridors and alignments allowing for adequate clearances from water, sewer and drainage infrastructure.
8. Proposed phasing plan. (Engineering concerns associated with phasing should also be discussed in the various engineering reports listed above).
6.1.5 STANDARD DRAWING NOTES

A. Engineered drawings shall include the following standard notes, at a minimum.

B. General Water Notes
   1. All water mains shall be installed with an 8 foot minimum depth of cover.
   2. All fittings (bends, crosses, plugs, valves, and tees) shall have megalugs and thrust blocks installed in accordance with the thrust block table shown on the detail sheet. For clarity’s sake, all thrust blocks may not have been shown on the plan view drawings.
   3. Follow all Colorado Department of Public Health & Environment (CDPHE) regulations for water and sewer line crossings.
   4. Contractor shall limit joint deflections to 1/2 the manufacturer’s recommendation.
   5. Contractor shall pothole all tie-ins and miscellaneous utilities that will cross or parallel the line prior to installing the line. If grade conflicts occur, contact Engineer so that grades can be adjusted.
   6. Minimum space between fittings shall be 3’.
   7. The Contractor shall ensure pipes are free of gravel and debris prior to being installed in the trench. If the pipe is dirty, has gravel or debris inside, or has sat unused for a long period of time, the pipe will require cleaning prior to installation.
   8. The Contractor shall notify the Town of Granby Public Works Department at least 48 hours prior to the start of construction.
   9. A chlorination/bacteriological and hydrostatic/leakage test are required on all new lines and systems before acceptance by the Public Works Department. These tests shall be performed as per applicable ANSI/AWWA Standards C600 and C651.
   10. The Contractor shall be responsible for restoring any disturbed areas in accordance with specifications.

C. General Sewer Notes
   1. Follow all Colorado Department of Public Health & Environment (CDPHE) regulations for water and sewer line crossings.
   2. Contractor shall pothole all tie-ins and miscellaneous utilities that will cross or parallel the line prior to installing the line. If grade conflicts occur, contact Engineer so that grades can be adjusted.
   3. The Contractor shall be responsible for restoring any disturbed areas in accordance with specifications.
   4. Mark ends of all sewer service lines with a T-post, 3-way swing ties, and depth to service.

D. General Road Notes
   1. Limits of construction shall be 5’ beyond grading limits, base of fill slopes or top of cut slopes, and 20’ either side of the centerline of utility installations. But not beyond fence line or right-of-way lines. Project limits shall also include any designated borrow areas,
excavation disposal areas, or material/topsoil stockpile areas. Respect all tree/vegetation preservation zones.

2. Traffic Control Requirements:
   a. Maintain access to other structures at all times. Temporary closure allowed for utility work – Provide for emergency access continuously.
   b. Provide safety cones, flaggers, vertical panels with beacons, signage and barricades to protect public and work site.
   c. Provide signage as required by owner and local government with jurisdiction over adjacent roads.

3. The Contractor shall certify that all aggregates used on the project are free from hazardous components in excess of the threshold concentrations as established by the EPA.

4. Prime coat not required unless indicated on drawings. Prepared base courses shall be primed at the Contractor's expense if the surface has deteriorated due to traffic, weather, or time lapse between surface preparation and placement of bituminous materials. Application rate shall be 0.3 gals/sq. yd.

5. All work shall be done in strict accordance with applicable sections of the site subsoil study. Contractor to note requirements for excavation, backfill, and support materials.

6. Throughout all phases of construction, until the final acceptance of the project, the Contractor shall keep the work site clean and free from rubbish and debris. The Contractor shall also abate dust nuisance as necessary by cleaning, sweeping, and sprinkling with water or other means as necessary. The Contractor shall have twenty-four (24) hours after the deposit of any earth, gravel, or other excavated material to remove such deposit.

6.1.6 FINAL PLAT

A. The Final Plat submittal shall meet the requirements of Section 17.20.040 Final plat of Town of Granby Municipal Code (GMC). Complete construction level engineering plans, descriptions and cost estimates for streets, drainage facilities, water and sewage disposal systems, bridges and other improvements shall be provided. If the Final Plat consists of a portion or a phase of an approved Preliminary Plan, the engineering plan shall demonstrate conformance with the previously approved master plans. Any master plan revisions shall be submitted with the Final Plat drawings as appropriate. Provide Phase III Drainage Report in general accordance with the Grand County Storm Drainage and Technical Criteria Manual modified for Town projects.
SECTION 6.2

CONSTRUCTION PROCESS/PROJECT ACCEPTANCE

6.2.1 INTRODUCTION

A. This Section defines the standard of care and documentation necessary to ensure the Town inherits a quality project. It is applicable to all projects that have received approval through the Town’s land use process and will be dedicating infrastructure to the Town.

B. The following subsections consist of the major steps involved with a detailed description of each. The construction process and associated checklists include the minimum standards to be followed. Some items may be viewed as guidelines or recommendations and every item may not be applicable on a particular project. Mandatory requirements for acceptance should be apparent. Any uncertainties can be clarified by contacting the Town Engineer.

C. Before the Town accepts the dedication of public infrastructure, project (Owners) representatives shall provide the required documentation discussed in this section necessary to ensure a satisfactory and complete project. This process is intended to enable the developer and their design engineer to control the process with minimal oversight from Town Staff and the Town Engineer. It is not meant to be burdensome. With the proper level of construction oversight, developers will find that these requirements can easily be met. Again, the intent here is QA/QC and to facilitate a timely project acceptance which benefits both the Town and the developer.

6.2.2 SUBDIVISION IMPROVEMENTS AGREEMENT (SIA) COMPLIANCE

A. The SIA lists general and project specific requirements and timeframes. This section discusses how the SIA will be integrated into the construction process.
1. Copies should be distributed to all affected parties at pre-construction meeting.
2. Follow procedure in SIA for Letter of Credit/Security reductions.
3. Review SIA at time of Initial/Preliminary Acceptance and at Final acceptance to verify all work in compliance with SIA.
4. Town has right to ask for a sample station.
5. Developers are required to turn any Water-Rights on project land over to the Town per GMC Chapter 13.05 WATER RIGHTS DEDICATION.
6. Note it is important to have Contractor/Owner warranty track with Town/Owner warranty.

6.2.3 PRE-BID MEETING

A. This section provides a checklist of the items that are necessary to discuss during a pre-bid meeting. A pre-bid meeting shall be held when any infrastructure will be dedicated to the Town of Granby. The Owner’s or Owner’s Engineer shall take and distribute notes of the key items discussed during the pre-bid meeting.

B. Agenda Checklist (use all that apply)
1. Introductions
2. Scope of project.
3. Potential revisions.
5. Special construction issues – supplied equipment.
   a. Specifications
   b. Plans
   c. Addenda dates and cutoff dates
   d. Public Works Manual
7. Schedule and sequencing issues.
8. Coordination with Town for meeting date/time, or notify 72 hours prior.
   a. Soil and groundwater issues
   b. Permits.
   c. Grading.
   d. Dewatering.
   e. Building.
   f. Other:
      i. Funding issues.
      ii. State funds.
      iii. Bonding.
      iv. Staging & disposal.
      v. Testing – who pays?
      vi. Personnel & roles for review, payment, approval & construction.
      vii. Documentation – Who, what?
      viii. Video
      ix. As-buils
t     x. Operation & maintenance
   a. On-site office for Town representative
   b. Weekly meetings
   c. Construction survey
      i. What by whom:
         Utilities to site – Contractor or Town/Owner
         Temporary utilities.
         Power
         Water
         Toilets Important to have Contractor/Owner warranty track with Town/Owner warranty.

6.2.4 PRE-CONSTRUCTION MEETING

A. This section provides a checklist of issues that should be discussed in a pre-construction meeting. A pre-construction meeting shall be held for any project that will involve the dedication of public infrastructure to the Town of Granby. The pre-construction meeting shall be held before any construction on public infrastructure starts and after a general contractor has been selected by the Owner. Representatives from the Town of Granby, Town’s Engineer, Owner’s Engineer, Owner, Contractor, major subcontractors, etc., as appropriate, shall be invited to the meeting. Either the Owner’s Engineer or another person appointed by the Owner shall coordinate, take notes and distribute notes from the meeting. The pre-construction meeting minutes shall be one of the documentation requirements
required from the Town before preliminary acceptance is granted. Agenda Checklist (use all that apply):
1. Introduction and sign-in.
2. Project personnel.
3. Lines of communication – resolution ladder.
4. Final construction drawings.
5. Determine keeper of updated drawings?
6. Tracking Changes
7. Construction surveying – request timelines.
8. Permits.
9. Testing requirements.
10. Observation requirements
11. Documentation requirements.
12. Shallow utility issues.
14. Discussion of work hours.
15. Progress payments.
16. Submittal requirements.
17. Periodic construction meetings.
18. Quality control requirements – Contractor/Owner.
19. Project closeout procedures.
20. Contractual insurance certificates.
21. Contractor license.
22. Construction schedule, sequence & phasing.
23. Approval of baseline schedule.
24. Attendees (as appropriate)
   a. Owner’s representatives
   b. Town representatives.
   c. Town Utility personnel.
   d. Street personnel.
   e. Owner’s Engineer.
   f. Utility company representatives.
   g. Review Agencies
25. Meeting minutes
   a. Note recording.
   b. Note distribution.

6.2.5 CONSTRUCTION DRAWINGS

A. This section provides requirements for construction level drawings. The requirements start when the final construction sets are issued at the startup of a project.
1. Have drawings received final approvals?
2. Have drawings been updated from Bid process?
3. Construction drawing sets shall be submitted to the Town and Town Engineer, as appropriate.
4. Construction drawings shall be stamped “FOR CONSTRUCTION” and each page shall have the stamp and signature of a professional engineer.
5. Cover sheet shall be signed by the Town Manager.
6. Town Engineer shall be notified in advance of construction if substantial design changes are required. This can be a Request-for-Information (RFI) for record keeping purposes.
7. Any design changes to the initial set of drawings shall be clearly delineated by showing the change and date in the revision block and by reflecting the change with a cloud mark.

8. Either the Owner’s Engineer or Contractor shall keep track of changes for record drawings.


6.2.6 SUBMITTAL REQUIREMENTS

A. Submittals are required for all major materials for public infrastructure dedicated to the Town. The checklists in this section shall be followed. The procedures for submittals and the submittal logs should be set up and discussed during the pre-construction meeting.

1. Owner’s Engineer shall keep submittal logs.

2. Copies of approved submittals and logs shall be sent to Town and Town’s Engineer for review and approval prior to construction.

3. Owner’s Engineer and Contractor shall both review and stamp acceptance on submittals.

4. Any submittal that includes design/build items, such as retaining walls, water tank structural drawings will require a P.E. stamp.

6.2.7 PERMITS

A. During the pre-construction meeting the required permits shall be discussed. One of the leading causes of construction and project delays is due to lack of adequate permits necessary for the project. Verify the following are in place, if needed:

1. CDPS Stormwater Construction Permit.

2. Army Corps of Engineers 404 Permit.


4. CDOT Access, Utility, Surveying Permits, etc.

5. Town Grading Permit

6. Building Permit

7. Street Cut Permit

8. Floodplain Development Permit

9. Approval letters from Town of Granby

10. Verify that all rights-of-way and easements have been obtained to start and complete construction.

11. Re-vegetation Bond security

12. Water Tap Permit

13. ROW permit

6.2.8 CONSTRUCTION OBSERVATION

A. This section discusses process that should be followed for Construction Observation, from who should be responsible for observation to the required documentation throughout construction. In order for projects to be accepted by the Town upon final completion, documentation of these procedures shall be required to demonstrate that project is complete and meets the quality standards of the Town.

B. Owner’s Engineer must regularly observe project and be able to write letter for security releases and at project completion certifying that construction was accomplished in “substantial compliance” with the approved drawings, and

1. Town’s Engineer to make periodic visits to observe construction, evaluate Contractor’s efforts, and ensure Owner’s Engineer is properly monitoring construction.

2. Utility department personnel to make periodic visits to observe utility installations.

3. Owner’s representatives, Engineer, Town Engineer and utility personnel to be present during pressure testing, etc. (as agreed upon in project meetings)

4. Owner’s representatives, Engineer, Town Engineer and utility personnel to be present during punch list walkthroughs.

5. Owner’s representatives to take job photos.

6. Owner’s Engineer to coordinate additional testing requirements.

7. Take minutes of meetings at the periodic construction meetings.

8. Minutes should include unresolved issues.

9. Owner’s Engineer to write substantial completion letter to Town and request Initial/Preliminary Acceptance.

10. Town Engineer will then perform comprehensive on-site observation to confirm Owner’s Engineer’s letter is necessary for preliminary and final acceptance.

11. Need to fill out Town of Granby Project Acceptance checklist.

**6.2.9 DOCUMENTATION REQUIRED**

A. At the beginning of the project, it is important that all parties involved in the construction process understand the documentation required for Town acceptance at the end of the project.

B. The Owner and Owner’s Engineer shall be responsible for furnishing the Town with a complete set of project records. Approved material submittals; should be transmitted prior to construction, meeting notes, inspection reports and test results should be furnished at regular intervals (weekly or bi-weekly as agreed upon). By the end of a project and before the Town accepts dedication of the infrastructure, all of the documentation discussed in this section should be provided to the Town in a neatly organized PDF document.

1. Bonding and insurance information.
2. Pre-bid meeting notes.
3. Pre-construction meeting notes.
4. Periodic meeting notes.
5. Site observation logs. (inspection reports).
6. Testing records.
7. Record drawings.
8. Approved material info.
11. Punch lists
12. Owner’s Engineer’s Initial/ Preliminary Acceptance letter.
13. Town Engineer’s Initial/ Preliminary Acceptance letter.
14. Town Council Preliminary Acceptance setting the two-year warranty period.
15. Owner’s request for Final Acceptance at 23 months.
16. Warranty item punch list.
17. Town Engineer’s Final acceptance letter
18. Town Council Final Acceptance.

6.2.10 UTILITY COORDINATION

A. Shallow and deep utility coordination is extremely important to the outcome of the construction process. The Town requires that the final utility design be incorporated into the approved construction drawings (rather than relying on separate drawings produced by the respective utility). Lack of utility coordination is a leading cause of construction budget and schedule overruns. The checklists below should be discussed during the pre-construction meeting.

1. Who shall be responsible for line locations?
2. Verification of existing facilities.
3. Required separations from other parallel and transverse utilities
4. Point of contact for fieldwork.
5. Coordination of utility supplied materials and work.
7. Disruption schedules (i.e., irrigation, water, water taps).

B. Colorado Revised Statutes (CRS) Section 9-1.5-102 through 106 requires that subsurface utility engineering (SUE) investigations meeting certain criteria be completed for “primarily horizontal construction” projects with excavation extents exceeding threshold levels (or involving boring/directional drilling) designed by Colorado licensed professional engineers. Projects involving horizontal utility construction must adhere to the requirements listed in these CRS sections.

C. Shallow utility construction is often the source of numerous punch list items and Town acceptance issues. The Owner is ultimately responsible for all work on the project, and appropriate coordination and inspection of shallow utility work is a must on every project.

6.2.11 PERIODIC RECURRING MEETINGS

A. Continual, recurring and open communication between all parties is essential to a successful construction process. Recurring meetings between the parties throughout the construction phase is necessary to discuss and resolve issues before they become problems. The resolution of these issues should occur as soon as possible when they first arise - not at the end of a project. This section provides a checklist of issues related to periodic recurring meetings. Weekly meetings on site at the same time during the length of construction are preferable. Notes should be taken by the Owner’s Engineer/representative and distributed to all parties.

1. Need to decide at pre-construction meeting where, who and how often construction meetings should occur.
2. Distribution of notes shall be decided at pre-construction meeting.
3. Discuss all design changes to construction documents.
4. Discuss all changed conditions to the construction contract.
5. Discuss project progress and schedule.
6. Discuss unresolved items.
7. Discuss all non-conforming work and the resolution to bring work into compliance.
6.2.12 TESTING REQUIREMENTS

A. The process of testing throughout the project for soils density testing, asphalt and concrete tests, etc., shall be set up before the project starts. Minimum requirements are listed in the Technical Specification and checklists contained in this manual. The pre-construction meeting and periodic recurring project meetings shall discuss the procedures, ongoing results and any corrective measures required as a result of the testing processes.

1. Who will be responsible for the soils/concrete/asphalt testing?
2. Discuss and agree upon the frequency of tests. (To be in accordance with approved plans, specifications and this Public Works Manual.)
3. Documentation and test results to be submitted to Town.
4. Contract for testing shall be between Contractor/Owner.
5. Engineer approval of stringline required prior to curb and gutter placement.
6. Proof roll subgrade.

6.2.13 PRE-PAVING/POUR MEETING

A. Both the paving and curb and gutter construction processes are extremely important to the longevity and functionality of public streets. Pre-paving/pour meetings shall be held with the paving or curb and gutter subcontractors to discuss procedures. This is particularly true of asphalt paving operations as it oftentimes occurs in the fall as cold weather sets in during conditions that may not be acceptable for Hot Bituminous Pavement quality control. The checklists in this section should be discussed during these meetings.

1. Schedule a pre-paving/pour meeting no later than one week before paving begins.
2. Paving/concrete subcontractor must attend.
3. Set up procedures for testing and quality control.
4. Must discuss weather issues, i.e., minimum/maximum temperatures, etc.
5. Discuss formwork/falsework inspection and rebar checks.
6. Must discuss subgrade and subbase testing procedures, i.e., geotechnical and proof rolling.
7. Must discuss road sections and maximum lift per course.
8. Stringline inspection for curb and gutter sections.

6.2.14 PROJECT INITIAL/PRELIMINARY ACCEPTANCE

A. Initial/Preliminary Acceptance can occur after Substantial Completion of the project. Substantial Completion is defined as the point when “The Work” (or a specified part thereof) has progressed to the point whereas, in the opinion of the Engineer, as evidenced by the Engineers definitive Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that “The Work” (or specified part) can be utilized for the purposes for which it is intended." Because Substantial Completion is a key concept in the acceptance of “The Work”, this section discusses the procedure that should be followed to establish Substantial Completion.

B. Must be initiated by contractor who notifies Owner’s Engineer that he is substantially complete.
C. Owner’s Engineer must confirm substantial completion; send letter and documentation listed below to Town recommending acceptance and requesting walkthrough with Town and other affected entities.
   1. Acceptance Request Letter
   2. Pre-final "As-built" Drawings
   3. Stamped certification letter from design engineer verifying all improvements were built to meet the requirements of the Town of Granby.
   4. Copies of all inspection reports, test results, construction docs. etc. shall be included if not previously transmitted.
   5. Support documentation (installation and operation manuals) of those facilities and equipment constructed/installed as part of project.
   6. Submittal detailing any and all-specific requirements as listed below) and actions taken to meet these requirements.
      a. Subdivision Improvement Regulations
      b. Zone District Regulations
      c. Commitments or Requirements made during Public Hearing
      d. Contractual Agreements
      e. Annexation Agreements
      f. Any/All Other
   7. Town and other representatives to perform site walkthrough and develop punch list items to be rectified prior to Initial/Preliminary Acceptance.
   8. Town Engineer to send letter to Town to recommend Initial/ Preliminary acceptance after satisfactory completion of all punch list items and receipt of all documentation.
   9. Town Council’s Initial/Preliminary acceptance triggers two-year warranty period.

6.2.15 PUNCH LIST PREPARATION

   A. This section provides the procedure to follow for the initial preparation and follow-through to completion of punch lists.
      1. Owner’s Engineer to prepare punch list.
      2. Must have items from utility companies, etc.
      3. Must have date initially added to list, date of completion for repairs, and date of signoff of originator of item.

6.2.16 WARRANTY PERIOD

   A. This section discusses the warranty period between the Town and the Owner (Owner) of the project and infrastructure being dedicated to the Town.
      1. Warranty period shall be two years.
      2. Triggered by date of Town Council’s Initial/Preliminary acceptance. (Note: satisfactory tests results and partial security releases do not initiate the warranty period.)
      3. SIA typically reserves 15% of project cost for security during warranty.
      4. Owner’s Engineer and reps shall keep track of scheduling a warranty period walkthrough at about 22 months. (Note: Security and warranty shall remain in effect if Owner fails to initiate walk-through and Final Acceptance procedures.)
      5. Important to have Contractor/Owner warranty track with Town/Owner warranty.
6.2.17 FINAL ACCEPTANCE

A. This section includes a checklist of items that are required prior to final acceptance by the Town. These items should be understood at the start of the project and kept current throughout the construction. Project Final Acceptance must include the following:

1. Letter from Owner’s Engineer.
2. Letter from districts and Town Engineer recommending acceptance.
3. Record drawings.
4. Updated plat.
5. AutoCAD files.
7. SIA Letter of Credit Reduction letters.
8. Project documentation.
9. Completion of punch list
10. Initial/ Preliminary Acceptance and establishment of warranty period.
11. Warranty work documentation and Owner’s request for Final Acceptance
12. Final walk-through and completion of punch list
13. Town Engineer’s recommendation of Final Acceptance
14. Town Board ruling of Final Acceptance

6.2.18 RECORD DRAWINGS

A. Record Drawings (commonly known as as-built drawings) are a requirement of Initial/Final Acceptance. C/O will be returned only after the town receives the as-built drawings. Use design drawings as base drawings. It is important to keep these drawings current throughout the project and not to wait until project completion to start them. This section provides a checklist of items to be included in the Record Drawings. Drawings to show the following:

1. Swing ties to end of water and sewer service lines.
2. Rim and invert elevations of sanitary and storm sewer manholes and inlets.
3. Location of all major utilities.
4. Elevation at end of sewer service lines.
5. Show all plat information, i.e., rights-of-way and easements.
6. Show all phone and cable pedestals, electric transformers, etc.
7. Show all shallow utilities.
8. Show CMP’s and all drainage features.
   a. Water infrastructure, including fire hydrants, curb valves, main line valves, bends, fittings, etc.
      i. Swing ties to water valves and curb stops.
      ii. Field/redline changes incorporated/annotated in electronic files.
   b. Secondary irrigation infrastructure.
   c. Stamp drawings as record drawings.
9. Provide AutoCAD drawing files and PDF copies of drawings to Town.
SECTION 6.3

CONSTRUCTION MATERIALS AND METHODS: STREETS

6.3.1 GENERAL

A. Curb, gutter, crosspans, sidewalk, ramps, driveway access, street surfacing and/or rejuvenation of asphaltic surface in public right-of-way under the jurisdiction of the Town, shall be installed in accordance with approved engineered plans, these Specifications and the General Conditions of the Public Works Manual of the Town of Granby.

B. The contractor shall obtain a street cut permit and notify the engineer in writing, twenty-four (24) hours before the planned construction is to commence or when work is to be resumed following a delay.

6.3.2 MATERIALS

A. Materials that are to be manufactured, processed, furnished and installed in street subgrades and finished surfaces shall conform to the minimum standards hereinafter referred to.

B. Specifications for materials as set forth by the American Society for Testing Materials (ASTM), the American Association of State Highway Testing Officials (AASHTO) and the Colorado Department of Transportation (CDOT) are made a part of these specifications. Referenced standards are considered to be the latest edition and revisions thereof.

6.3.3 CONCRETE

CDOT Class “B” concrete shall be used in the construction of curbs, gutters, sidewalks and cross pans.

6.3.4 BORROW

Loose friable soil reasonably free of refuse, stumps, roots and rocks. The maximum dimension of any rocks placed in fills shall not exceed two-thirds of the depth of lift being placed or twelve (12) inches, whichever is the lesser.

6.3.5 AGGREGATES FOR SUBBASE, BASE COURSE AND SURFACE COURSES

Aggregate and soil aggregate meeting the gradation hereinafter specified which have a plastic index not to exceed six (6), when tested in accordance with AASHTO T89 and T90 respectively, shall conform to the quality requirements of AASHTO M-147 except as modified below.

A. SELECT SUBBASE

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Characteristics</th>
</tr>
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<tbody>
<tr>
<td>% by weight passing 2/3 (depth of lift) 100</td>
<td>Retained on #10-LA abrasion-(not applicable)</td>
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<tr>
<td>Passing #4 – L.L. 30 max.</td>
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B. BASE COURSE

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>% by weight passing</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Class 5</td>
</tr>
<tr>
<td>2 ½”</td>
<td></td>
</tr>
<tr>
<td>2”</td>
<td></td>
</tr>
<tr>
<td>1 ½”</td>
<td>100</td>
</tr>
<tr>
<td>1”</td>
<td>95-100</td>
</tr>
<tr>
<td>¾”</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>30</td>
</tr>
<tr>
<td>*8</td>
<td>25</td>
</tr>
<tr>
<td>#200</td>
<td>3-15</td>
</tr>
<tr>
<td>L.A. Abrasion</td>
<td>50 max</td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>30 max</td>
</tr>
<tr>
<td>Plastic Index</td>
<td>6 max</td>
</tr>
</tbody>
</table>

Recycled concrete meeting the above requirements can be substituted.

C. HOT PLANT MIX; PAVEMENT AGGREGATE

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Surfacing</th>
<th>Overlay</th>
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<tbody>
<tr>
<td>1”</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>¾”</td>
<td>90-100</td>
<td></td>
</tr>
<tr>
<td>½”</td>
<td></td>
<td>90-100</td>
</tr>
<tr>
<td>3/8”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>(1)</td>
<td>(1)</td>
</tr>
<tr>
<td>#8</td>
<td>23-49</td>
<td>28-58</td>
</tr>
<tr>
<td>#3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>#200</td>
<td>2-8</td>
<td>2-10</td>
</tr>
</tbody>
</table>

1. 50% of the aggregate by weight retained on the #4 sieve shall have at least two (2) fractured faces when tested in accordance with Colorado Department of Transportation Procedure 45.

2. Aggregates shall have a percentage of wear, when tested in accordance with AASHTO T-96, of not more than forty-five (45).

6.3.6 CHIP SEAL COAT COVER AGGREGATES

A. Aggregates for cover coat material shall be 100% crushed stone, crushed slag, crushed gravel, or natural gravel conforming to the following requirements:

1. % of wear, Los Angeles Test (AASHTO T-96), not more than 35.

2. 100% of the gravel by weight retained on the No. 4 sieve shall have at least two (2) fractured faces.

3. When tested in accordance with AASHTO T-182, aggregate shall have a retained bituminous film above 95%.
4. Meet the following gradations:

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>Type II</th>
<th>Type III</th>
<th>lbs / sq. yd.</th>
</tr>
</thead>
<tbody>
<tr>
<td>½”</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>5/8”</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>0-15</td>
<td>0-30</td>
<td></td>
</tr>
<tr>
<td>#200</td>
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<td>0-1</td>
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</tbody>
</table>

6.3.7 BITUMINOUS MATERIALS

A. Asphaltic cements shall conform to the requirements of AASHTO M 320 and liquid asphalt materials shall conform to the requirements of AASHTO M-81, M-82 and ASTM D-2026 for the designated types and grades.

B. Emulsified asphalt shall conform to AASHTO M-140 and M-208 for the designated types and grade.

C. Asphalt rejuvenating agents shall be composed of a petroleum resin-oil base uniformly emulsified with water and shall conform to the quality requirements of the Colorado Department of Transportation.

D. Prime Coat shall be MC-70 bitumen applied at the rate of 0.25 – 0.25 gal/sq. yd. of surface area.

E. Cement shall be PG58-28, or as stated in the contract, incorporated with hot plant mix pavement aggregate at the rate determined by a Mix design prepared by a Professional Engineer meeting the requirements of Section 401 of the Colorado Department of Transportation Current Standard Specifications.

F. Tack Coat shall consist of one (1) part Grade CSS-1h emulsion conforming to AASHTO M-208 and one (1) part water, applied at the rate of not more than 0.1 gal/sq. yd. of surface area.

G. Seal Coat shall be a cationic rubberized or polymerized asphalt emulsion.

H. CRS-2P or HFRS-100S when applied at the rate of 0.30 – 0.35 gal/sq. yd. of surface area are considered as meeting this specification.

6.3.8 GEOTEXTILE FABRIC

Geotextile fabric to be in accordance with Section 712.08 of the latest revisions to the Colorado Division of Transportation Standard Specifications for Road and Bridge Construction.

6.3.9 CONSTRUCTION PRACTICES

A. All work in public rights-of-way shall be constructed to the lines and grades called for on Town approved plans. Stakes to control the work shall be set in the field by survey parties working under the supervision of a registered land surveyor. Town survey crews will establish the control for Town projects and controls established by developers are subject to checking by Town crews.
6.3.10 SITE PREPARATION, EXCAVATION, AND EMBANKMENT

(See Section 6.4 of this public works manual).

6.3.11 CURB, GUTTERS, SIDEWALKS AND CROSSPANS

A. All curbs, gutters, crosspans, sidewalks, walk ramps and driveways shall be cast in place to conform to the dimensions and contain the reinforcing called for by the Town of Granby Standard Detail Drawings. Preparation of subgrade shall be in accordance with the requirements of Section 6.4 of these Standard Specifications. Forming, concrete placing, finishing and cutting shall conform with the requirements set forth in Section 6.4.

B. Crosspans, curb return wings, driveways, walk ramps and sidewalks shall have a concrete thickness of not less than six (6) inches. Detached sidewalks that are not subjected to vehicular traffic shall have a minimum concrete thickness of four (4) inches. Crosspans and curb return wings shall be reinforced with #4 rebar at 2 foot centers in both directions as called for in the Standard Drawings.

C. Where curbs and gutters are adjacent to and constructed in conjunction with sidewalks, the concrete shall be placed simultaneously on a compacted subgrade. Monolithic concrete so placed, as in all slabs on grade, shall be divided into ten (10) foot sections by dummy joints formed with a jointing tool. Dummy joints shall extend into the concrete for a depth of not less than ¼ of the slab concrete depth and shall be approximately 1/8" in width.

D. Premolded expansion joint filler ¼" to ½" in thickness that extends for the full depth of the concrete shall be installed between all, concrete sidewalks, driveways, and any fixed structures or appurtenances such as manholes, utility poles, etc.

E. Back of curbs and edges of sidewalks shall be backfilled and shaped to drain after the forms have been removed. Areas between Property lines and back of sidewalk or curbs shall be shaped and uniformly graded.

6.3.12 AGGREGATE BASE COURSE

A. Base course shall be placed and compacted in four (4) inch to six (6) inch layers on a prepared subgrade surface in conformity with the lines, grades and typical cross sections shown on the plans.

B. Each layer shall be densified to ninety-five (95) percent of the Modified Proctor when tested in accordance with AASHTO T-180. Water shall be uniformly applied during compaction so as to achieve proper consolidation.
C. The prepared surface, ready to receive the surface course shall be uniformly graded to design elevation so when tested with a ten (10) foot straight edge the variation above or below the testing edge, between any two (2) contact points with the surface, shall not exceed \( \frac{1}{2} \)" for Class 1 or \( \frac{1}{4} \)" for Class 5 or Class 6 base course. Areas that do not conform with these tolerances shall be reworked.

6.3.13 ASPHALTIC CONCRETE JOB MIX FORMULA

A. The job mix formula developed in conformance with the Colorado Department of Transportation Standard Specifications on the aggregates to be incorporated in the asphaltic concrete surface must be submitted to the Town of Granby Public Works Director for approval prior to commencing the work.

B. Hot plant mix surfacing material using aggregates from sources that have not been tested, for the purpose of developing a job mix formula, within nine (9) months prior to the date of intended delivery will be rejected.

C. The job mix formula with allowable tolerances shall be within the master range specified in the material section of these specifications.

6.3.14 MANHOLE AND UTILITY BOX ADJUSTMENTS

A. Manholes, valve and survey range boxes shall be adjusted to \( \pm \frac{3}{8} \)" of finish grade after the surface course of asphalt is placed. The contractor shall remove all foreign matter found or introduced into them in the performance of his work, and it shall be his responsibility to insure proper compaction around same after they have been adjusted.

B. On streets that are being sealed, the contractor shall cover the manhole and valve covers with a roofing paper or other suitable material prior to sealing. The covering shall be left in place for a minimum of forty-eight (48) hours after which it shall be removed and disposed of. All covers shall be clean when work is complete.

C. On streets that are being overlaid with asphaltic concrete the contractor shall adjust the valve boxes and manhole lids by adding riser rings.

6.3.15 BITUMINOUS PRIME OR TACK COATING

A. Compacted subbase material, in place and shaped to subgrade elevation, shall be primed or tacked to the limits specified in the Special Conditions or at the rates stated in Guidelines for Design and use of Asphalt Pavements for Colorado Roadways.

B. Bituminous materials shall be applied to the width of the section to be coated by means of pressure distributions in a uniform and continuous spread. Care shall be taken that the application of bituminous material at any point, especially at the junction of spreads, is not in excess of the specified amount. Coatings shall not be applied when the surface is wet or when the temperature is below fifty (50) degrees Fahrenheit.

C. Coatings shall be applied in such a manner as to offer the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the bituminous material.
6.3.16 BLOTTING

If after the application of the prime coat or rejuvenating agent, the bituminous material fails to penetrate or if chip and seal applications bleed, approved blotter material shall be spread in the amounts required to absorb any excess bituminous material.

6.3.17 FLEXIBLE PAVEMENT

A. Hot plant mix asphaltic concrete shall be prepared and mixed to the proportions of the Colorado Department of Transportation job mix formula for the aggregate source, in accordance with Section 401.13 through 401.15 of the CDOT Standard Specifications.

B. Hot plant mix asphaltic concrete shall be placed only on properly prepared or constructed and accepted subgrades that are free of water, snow or ice. Contact surfaces of curbs, gutters, manholes and other structures shall be tack coated with a thin uniform coating of RC of SS-IH bituminous material prior to placing asphaltic concrete adjacent thereto.

C. Asphaltic concrete, to provide in place compacted thickness of four (4) inches or less, shall be placed and struck off by means of bituminous pavers. Use of spreader boxes to place the bituminous mixtures 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 ½) inches, may be uniformly spread using a patrol. In areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked and luted by hand tools. For such areas the mixture shall be dumped, spread and screeded to give the required compacted thickness.

D. Along the lip lines of gutters and crossspans sufficient bituminous material shall be deposited so that, after compacting, the wearing surface will remain not less than 1/4” nor more than 1/2” above the concrete when compacted to a catch curb. For median or spill curb wearing surface will be from 1/8” to 1/4” below concrete.

E. Longitudinal joints in the wearing surface layer shall be hand luted and provide a uniform transition, after compacting, between passes with the paving machine. They shall also be positioned such that they will overlay any sublayer longitudinal joint by six (6) inches. Longitudinal joints in the wearing surface shall be generally located as follows:
   1. For two lane roadways – at the center line of the pavement and at the outside edge of the traveled lanes.
   2. For roadways of more than two lanes – at the lane lines and at the outside edge of the travel lanes.

F. The bituminous mixtures shall be placed within the air temperatures limitation designated herein below and only with the weather conditions otherwise permit the pavement to be properly placed and finished.
PLACEMENT TEMPERATURE LIMITATIONS

<table>
<thead>
<tr>
<th>MINIMUM COMPACTED LAYER THICKNESS</th>
<th>WEARING SURFACE MINIMUM PLACEMENT AIR &amp; SURFACE TEMPERATURE</th>
<th>BLACK BASE MINIMUM PLACEMENT AIR &amp; SURFACE TEMPERATURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; or less</td>
<td>60 degrees Fahrenheit</td>
<td>50 degrees Fahrenheit</td>
</tr>
<tr>
<td>&gt;1&quot; to 3&quot;</td>
<td>50 degrees Fahrenheit</td>
<td>40 degrees Fahrenheit</td>
</tr>
<tr>
<td>&gt;3&quot;</td>
<td></td>
<td>30 degrees Fahrenheit</td>
</tr>
</tbody>
</table>

G. Asphalitic concrete shall be handled and placed on the prepared subgrade in such a manner as to minimize segregation. All segregated areas behind the pavers shall be removed immediately upon discovery and replaced at contractor’s expense, with specification material before the initial rolling. If more than fifty (50) square feet of segregated material is ordered removed and replaced in any 500 linear feet of paver width laydown, paving operations shall be discontinued until the source of the segregation has been found and corrected.

H. After the asphaltic concrete has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. Rolling of the surface shall begin as soon after spreading as rolling will not cause undue displacement cracking or shoving of the mixture. Rolling shall start at the sides and proceed longitudinally parallel with the street center line, 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 change to match CDOT specs for superpave mix designs of a laboratory specimen made in the proportions of the job mix formula has been obtained.

I. On lifts of asphaltic concrete three (3) inches or more in thickness breakdown rolling shall immediately follow the spreading sequence using rubber tired rollers, free of recapped tires, followed by steel wheel rolling. Field density determinations will be made in accordance with Colorado Procedure #44 and #81.

J. Contractor to verify surfaces are of uniform texture, conforming to required grades and cross sections.

K. Variation between any two (2) contacts with the surface shall not exceed 3/16” in ten (10) feet. Do not permit depressions where water may pool, testing by observation following rainfall event or use of water truck. All lumps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material as directed by the Town.

L. The Contractor will engage a testing agency to perform field testing to determine compliance of in-place asphaltic concrete paving materials and compaction. Testing Agency will test in-place pavement for density and thickness.

M. Asphalt density test shall be taken every 250 lineal feet per driving lane. Minimum acceptable density of in-place course materials is 95 percent of the recorded laboratory specimen density. Remove and replace all sections not in conformance density requirements.
N. Testing Agency will take not less than 4 inch diameter pavement specimens for each completed course from locations as directed by Town.

O. Repair holes from test specimens as specified for patching defective work.

P. Thickness: Variations from drawings
   1. Asphalt: ¼ inch
   2. Remove and replace paving less than minimum thickness.

Q. Inspection: The work of this section is subject to the inspection and approval of the Town. The following inspections are required:
   1. Protection of adjacent property
   2. Staking and establishment of elevations
   3. Establishment and compaction of subgrade
   4. Placement and compaction of bituminous base course and wearing surface
   5. Final inspection
   6. Obtain approval of each element of work listed above in sequence of its completion before proceeding with the next item

6.3.18 PARKING LOTS, TRAILS AND WALKWAYS

A. Subgrades for parking lots, bicycle trails and walkways shall have all vegetation removed, subgrade shaped, compacted and the soils then sterilized prior to installing base course and/or asphaltic concrete to prevent plant growth.

B. Asphaltic concrete Grading S or SX shall be placed and compacted to a minimum compacted thickness of four (4) inches for bicycle trails and walkways, and a density of match superpave mix requirements of a laboratory specimen made in proportion to the job mix formula. Compaction shall be uniform and accomplished by means of Town approved power rollers and/or hand tamping. Only in areas inaccessible to rollers will hand tamping be permitted. Asphalt thickness for parking lots shall be as called for in the plans.

6.3.19 STREET PATCHING

Areas in streets designated to be patched shall have the broken asphalt and subgrade materials removed to a minimum depth of six (6) inches and disposed of. Exposed subgrade shall be inspected by the Town prior to patching. Insufficient sub-base materials may require over-excavation and geotextile fabric installed prior to patching. A minimum 6" of Class 6 roadbase is required below any asphalt patching. The perimeter of the patch area shall be trued to vertical uniform line and then tack coated with a thin uniform coating of RC or SS-IH bituminous material prior to placing and compacting asphaltic concrete adjacent thereto and therein.

6.3.20 GEOGRID – SUBGRADE STABILIZATION

A. Subgrades to be geogrid stabilized shall be cleared of all vegetation or topsoil and then proof rolled to determine local soft spots, observe deflections, rutting and/or pumping. Areas so identified shall be excavated and the void thus created shall be refilled with approved granular material and again proof rolled and shaped, as directed in the field by the Town Representative.
B. Sections of specified geogrid shall then be rolled to cover the subgrade, cut and trimmed to clean manholes and valve boxes by one foot while providing a minimum roll overlap of one and one-half feet along the seams. On areas that cannot be covered and properly overlapped with two rolls of geogrid; installation shall commence along the perimeter edges and proceed towards the center of the area making sure the minimum overlap along seams is obtained. Seams between rolls shall be anchored or tied together with wire, polyethylene braid, or stakes driven through the apertures of overlap, on ten (10) foot centers.

C. Select granular fill materials shall then be end dumped adjacent to the exposed geogrid and then advanced to cover the geogrid in a minimum five (5) inch lift using a front end loader or dozer. At no time shall the equipment, advancing the fill cover, be in direct contact with the geogrid.

D. After the initial five (5") inch granular cover lift is placed, the entire lift shall be proof rolled. Rutted and settlements that develop shall be filled with additional select material. Proof rolling and adding of select materials shall continue until the entire geogrid is in tension, the area being stabilized is to the plan designated elevation of cover material, or as directed.

6.3.21 GEOTEXTILE FABRIC PAVEMENT SYSTEMS

A. Base course and soil subgrades shall be shaped and compacted to grade in preparation for placement of geotextile fabric. Previously asphalted surfaces shall have all hones and soft spots patched with Colorado Department of Transportation Grading C hot bituminous asphalt. Existing cracks narrower than 3/8 inch in width shall be filled with a liquid asphalt cement. Cracks larger than 3/8 inch shall be filled with an approved asphalt filler. After patching and filling the existing asphalt surface shall have all dirt, water and grease removed there from. When required, truing or leveling courses of asphalt shall be in place prior to installation of the fabric.

B. The approved surface to be overlayed shall then be given a tack coat of PG 58- 28 asphalt cement, applied at the rate of 0.20 to 0.25 gallons per square yard, and immediately covered thereafter with the geotextile fabric.

C. Laydown of the fabric shall be performed such that there are no wrinkles and the overlap between rolls is between two (2) and six (6) inches. Where wrinkles occur, the fabric shall be cut and laid flat. Corrected wrinkle areas and seams between rolls shall be retacked with asphalt cement to insure fabric saturation.

D. Fabric shall be installed to within zero (0) to six (6) inches of gutter lip lines or crossspans with a minimum of two inches (2") of asphalt. If pavement is not milled, fabric shall be installed to eighteen inches (18") within curb line. Around manholes, valve boxes, vaults, etc. the fabric shall be neat line trimmed and cut so as to clear the intrusion by one (1) foot.

E. Immediately after the fabric is in place, asphalt overlay paving shall commence. The minimum compacted thickness of asphalt overlay pavement, installed over a geotextile fabric, shall be 1 ½ inches. Use of fabric at locations where a potential for shoving exists, such as turning lanes and stopping intersections, is not recommended.
6.3.22 COLD MILLING, ASPHALT SURFACES

A. All valve boxes, manhole rings and covers within the area to be cold milled shall be lowered sufficiently to clear the milling operation, and then raised to within 3/8 inch of the resurfaced finished grade. Electric and phone vaults shall not be lowered, but shall be protected from damage during the performance of the work.

B. Cold milling shall be performed using mechanical equipment capable of uniformly routing materials while providing a uniform milled level or tapered surface, varying between 6 ½ to 8 feet wide and zero to 2 ½ inches in depth, per pass. Milled edges shall be vertical and true with the alignment of each pass of the equipment.

C. Electric and phone manholes and vaults are to be left with gradual asphalt tapered approaches in alignment with traffic flow, when resurfacing will not immediately follow the milling operation. Such approaches left to facilitate traffic adjacent to vaults, crosspans, utility manholes, structures, etc. shall be milled out or removed by other acceptable means, immediately preceding the resurfacing operation. Leaving of abrupt vertical edges that will impede traffic will not be allowed.

D. Where milling is required along and parallel with concrete gutters the router shall be set to provide a uniform tapered slope. The slope shall vary from two (2) inches below the gutter lip line to daylight with the existing asphalt surface, 6 ½ to 8 feet from and perpendicular to the gutter flow line.

E. Material recovered during the milling operation shall be disposed of by the contactor at his expense, unless otherwise directed.

F. Unless otherwise approved, milling and resurfacing shall be performed simultaneously such that both operations are completed during the same day.

6.3.23 OVERLAY SURFACE TREATMENT

A. Surfaces designated for asphaltic concrete overlay treatment shall have all soft areas removed and asphaltic concrete compacted in the void thus created. All cracks shall be sealed and low spots brought to grade with a leveling course of asphaltic concrete. The entire area shall be free of water and broom cleaned prior to commencing the leveling and/or overlay operation.

B. Cleaned areas to be leveled shall be tack coated, at the rate of 0.10 gallon per square yard with a 1:1 diluted CsS-1h emulsified asphalt. The tacked surface shall then be brought to grade by blade spreading or box laying and rolling therein, Colorado Department of Transportation Grading SX hot bituminous asphalt concrete.

C. Areas prepared for overlay shall be tack coated as specified above, for the leveling course. However, when a geotextile fabric is to be installed, the surface shall be tack coated with PG58-28 asphaltic concrete, applied at the rate recommended by the supplier.

D. Plant mix asphaltic concrete conforming to the Colorado Department of Transportation Grading SX shall be placed to an average compacted yield of 1 ½", or as directed over the tacked area. Plant mix asphaltic concrete shall be installed in
accordance with the requirement set forth herein for flexible pavement. Except the compacted finished grade of asphaltic concrete at gutter lip line may not exceed the lip line elevation by more than one inch.
SECTION 6.4

CONSTRUCTION MATERIALS AND METHODS: CONCRETE

6.4.1 GENERAL

A. All concrete and reinforcing placed in structures that are considered as capital improvements to the Town of Granby shall conform to approved engineered plans and these specifications.

B. Specifications of the American Society for Testing Materials (ASTM), detailed recommendations for acceptable practices set forth by the American Concrete Institute (ACI) and the Concrete Reinforcing Steel Institute (CRSI) are made a part of these specifications.

C. The contractor, through his fabricator, shall prepare and submit shop drawings showing all dimensions for fabrication and placing of the reinforcing steel, form work and accessories for review and approval before fabrication, when called for in the Special Conditions.

6.4.2 MATERIALS

Materials that are to be incorporated in the structure shall conform to the minimum standards hereinafter referred to, unless otherwise approved.

6.4.3 CEMENT

A. Portland Cement, conforming to the requirements of ASTM C-150 Type I or II.

B. Chemcomp, expansive shrinkage compensating cement, as manufactured by Texas Industries, Inc., or equal product licensed by and conforming to the requirements of the Chemical Prestressed Concrete Corp. (CPCC).

C. Air Entraining Agent conforming to the requirements of ASTM C-260, Protex R03300-3, or approved equal.

D. Water Reducing Agent conforming to the requirements of ASTM C-494, Master Builders Pozzolith, or approved equal. No accelerators or admixtures containing chlorides will be permitted.

E. Retarding Agent conforming to the requirements of ASTM C-494, Type B, Master Builders MB-HC, or approved equal. If Type D is used, adjust mixture of water reducing agent. Lignin type retarders will not be permitted.

F. Coloring Agent, when called for in the Special Conditions, shall conform to:
   1. Dry Shake Type, W.R. Grace & Co. Colorundum, or approved equal. Master Builders Colorcron will not be permitted.
G. Fibrous Concrete Reinforcement: 1.5 lbs/cy o 100% virgin polypropylene fibrillated fibers, as manufactured by Fibermesh Co., Chattanooga, Tennessee, or approved equal, shall be plant batched into the mix when called for in the Special Conditions.

H. Water – Potable, nonalkaline water devoid of salts and other injurious elements for concrete mixing shall be used.

6.4.4 AGGREGATES

A. General: All fine and course aggregates shall conform to the following specifications:

<table>
<thead>
<tr>
<th>Concrete Aggregate</th>
<th>ASTM C-33</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Weight of Aggregates</td>
<td>ASTM C-29</td>
</tr>
<tr>
<td>Organic Impurities Colormetric</td>
<td>ASTM C-40</td>
</tr>
<tr>
<td>Soundness of Aggregate by Sodium Sulfate</td>
<td>ASTM C-88</td>
</tr>
<tr>
<td>Sieve Analysis</td>
<td>ASTM C-29</td>
</tr>
</tbody>
</table>

B. Gradation: Fine and course aggregates are regarded as separate ingredients and each shall be well graded between the limits as shown in the following chart:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>#467</th>
<th>#57</th>
<th>#67</th>
<th>AASO-M6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ½&quot; to #4</td>
<td>1 1&quot; to #4</td>
<td>3&quot; to #4</td>
<td>#4 to #100</td>
<td></td>
</tr>
<tr>
<td>2&quot;</td>
<td>100</td>
<td>95-100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>1 ½&quot;</td>
<td>95-100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1&quot;</td>
<td>35-70</td>
<td>90-100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>¾&quot;</td>
<td>25-60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/8&quot;</td>
<td>10-30</td>
<td>20-55</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>0-5</td>
<td>0-10</td>
<td>0-10</td>
<td>95-100</td>
</tr>
<tr>
<td>#16</td>
<td>0-5</td>
<td>0-5</td>
<td>45-80</td>
<td></td>
</tr>
<tr>
<td>#50</td>
<td>10-30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#100</td>
<td>2-10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.4.5 REINFORCING STEEL

A. Bar Steel shall be round bars conforming to ASTM A-615, Grade 60, except #5 or smaller bars may be Grade 40 or 60 as shown on drawings, and deformed in accordance with the requirements of ASTM A-305.

B. Dowels for Slabs on Grade at joints where indicated shall be hot rolled merchant bars conforming to ASTM A-151, C-1020.

C. Miscellaneous Reinforcement not covered above must conform with the requirements of ACI-315 and ACI-318.

6.4.6 JOINT MATERIALS

A. Non-extruding and resilient non-bituminous type conforming to ASTM D1752 or resin-impregnated fiberboard having the Physical requirements of ASTM D-1752, in
widths shown or 3/8” where not shown, shall be used where joint sealers are indicated. Materials shall be Darasel-U fiberboard filler as manufactured by W.R. Grace & Co. or equal. Filler material containing asphalt or tar will not be allowed.

B. Non-extruding and resilient bituminous type conforming to ASTM D-1751 shall be used for concrete paving and structural construction where joint sealers are not called for.

C. Portland cement concrete pavement joints shall be sealed in accordance with the Colorado Department of Transportation (CDOT) specifications.

6.4.7 CURING COMPOUNDS

Curing Compounds where allowed shall conform to ASTM C-309.

6.4.8 PROPORTIONING INGREDIENTS

Concrete ingredients shall be proportioned so as to provide concrete which is workable and homogeneous, yet when hardened it will provide the required strength, durability, resistance to deterioration, abrasion, watertightness, appearance and other specified properties.

6.4.9 CDOT CLASS “B” CONCRETE

The end product shall have a minimum 28 day compressive strength of 4,500 psi when tested in accordance with ASTM C-31.

6.4.10 CLASS “C” CHEMCOMP CONCRETE

Concrete shall have a minimum of 6.0 sacks of expansive shrinkage compensating cement per cubic yard and a water reducing admixture, incorporated in strict conformance with the printed instruction of the cement manufacturers of the concrete, so as to produce a slump not to exceed six (6) inches and an end product having a minimum twenty-eight (28) day compressive strength of 4,300 psi, when tested in accordance with ASTM C-31.

6.4.11 CLASS “F” FLOW FILL CONCRETE

Concrete mix design for flow fill concrete, a substitute for Colorado Department of Transportation CL I & CL II Structural and Utility Trench Backfill shall be as follows:

<table>
<thead>
<tr>
<th>Mix Proportion</th>
<th>ASTM</th>
<th>Per CY of Concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement</td>
<td>C-150</td>
<td>42</td>
</tr>
<tr>
<td>Sand</td>
<td>C-33</td>
<td>1,845</td>
</tr>
<tr>
<td>Aggregate #57</td>
<td>C-33</td>
<td>1,700</td>
</tr>
<tr>
<td>AA</td>
<td>C-260</td>
<td>5</td>
</tr>
<tr>
<td>Water</td>
<td>C-94</td>
<td>325</td>
</tr>
<tr>
<td>Compressive Strength: 28 day = 60 psi MAX</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.4.12 CONSTRUCTION

Applications for the various combination of aggregate size, in combination with allowable air content and slump range, for the different classes of concrete shall adhere to CDOT Standards Specifications for Road and Bridge Construction Section 601, Standard Specifications for Structural Concrete.

6.4.13 MIX DESIGNS

A. Designs employing the same ingredients proposed for use and used successfully on a previous project under similar conditions to those anticipated on this project may be used. Provided the contractor requests and obtains Town approval on the following, all of which must be certified to by the supplier.

1. Concrete mix designs conforming to these specifications.
2. ID sets of 7 and 28 day concrete strength tests made during the last 6 months on concrete conforming to the design in (1) above.
3. Curve showing relationship of 7 and 28 day strengths in (2) above.
4. Reports of compliance tests of fine and course aggregates made during the last six (6) months.

OR

B. The contractor shall employ, at his expense an acceptable independent laboratory to design, proportion and select ingredients from the supplier’s sources that will produce a concrete mix conforming to the requirements of these specifications, while providing proper placability, durability, strength and other required physical properties for the proposed application.

6.4.14 FORM WORK

A. Provide all forms, shores, cores, molds and similar items in sufficient quantity and quality to properly execute the work.

B. Lumber or plywood contact surfaces must be free from knots, warps, breaks, or other defects likely to cause irregular surfaces. Metal forms must be free from irregularities, dents and sags and suitable for concrete exposed to view in finished areas.

C. Do not reuse forms if there is any evidence of surface wear or tear which would impair the quality of the finish. Thoroughly clean and relubricate forms for reuse.

6.4.15 TOLERANCES

Construct forms so as to insure that concrete surfaces will conform to tolerances of Section 203.1 ACI 347.

6.4.16 REPARATION OF FORM SURFACES

A. Make forms sufficiently tight to prevent leakage of grout or cement paste. Seal wood surfaces against absorption of moisture from the concrete with an acceptable oil, sealer, or factory applied nonabsorptive liner.
B. Coat forms to prevent bond with concrete prior to placing of the reinforcing steel. Do not allow coating material to stand in puddles in forms nor to come in contact with concrete against which fresh concrete will be placed.

6.4.17 REMOVAL OF FORMS

A. Form work that supports weight of concrete must remain in place until concrete has reached its specified 28 day strength, unless otherwise specified or permitted.

B. Form work not supporting weight of concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.

C. Whenever the form work is removed during the curing period, the exposed concrete shall be immediately cured by one of the methods herein specified.

6.4.18 FABRICATION TOLERANCE

A. Sheared length and bends, ± 1”.

B. Depth of truss bars, stirrups, ties and spirals, ±1/2”.

6.4.19 PLACEMENT TOLERANCE

A. Concrete cover to formed surface, minimum spacing between bars, top bars in slabs or beams and members to 8 inches deep, ±1/4”.

B. Members between 8” to 24” deep, ±1/2”.

C. Members more than 24” deep, ±1”.

D. Crosswise of members spaced evenly within 2”.

E. Lengthwise of members, ± 2”.

F. Movement of bars more than one diameter or in excess of above tolerances, to facilitate installation of embedded items, must be approved by the project engineer.

6.4.20 REINFORCEMENT PLACEMENT

A. Support and wire together all reinforcing bars to prevent displacement from external loading prior to and during concrete placement. On ground where necessary supporting concrete blocks may be used, otherwise use concrete, metal, plastic or other satisfactory bar chairs and spacers. Templates will be required for all column dowels.

B. At time of concrete placement all steel is to be free from loose, flaky rust, mud, oil or other coatings that may destroy or reduce bond.

C. Unless otherwise noted on the drawings, the steel shall be protected by concrete, after placement as follows:
   1. ¾” for interior slabs.
   2. 1” for interior walls and formed exterior slabs.
3. 1 ½" for beams, columns and concrete exposed to the weather or in contact with the ground.
4. 3" for concrete deposited against the ground.

D. Smooth dowels to join existing concrete to new concrete shall be epoxied into drilled holes and extend into the old concrete a distance of 24 diameters.

6.4.21 JOINTS

Provide joints only where shown unless otherwise specifically permitted by written authorization from the project engineer.

6.4.22 CONSTRUCTION JOINTS

A. Continue all reinforcing steel and welded wire fabric across joints, unless otherwise indicated. Provide keys and inclined dowels as shown or as directed. Provide longitudinal keys at least 1 ½" deep in all joints in walls and between walls and slabs.

B. Thoroughly clean surfaces and remove all laitance on the surface of joints before next placement.

C. When required or directed, obtain bond between hardened concrete and new concrete by:
   1. Use of an epoxy bond in accordance with the applicable provision of ACI Journal, Proceedings V59 #9, September 1962, p. 1121-1142.
   2. Use of an acceptable chemical retarder.
   3. By roughening surface of old concrete in an acceptable manner such as sandblasting.
   4. Provide a continuous water stop as specified.

6.4.23 EXPANSION JOINTS

Install filler in expansion joints ¾" thick by ½" less than slab thickness. For floors place a ¾" x ½" tapered wood strip over the joint filler, flush with the top of the slab and finish the edges with an edging tool. After the concrete has hardened remove the wood strip and seal the joint flush with the surface.

6.4.24 CONTROL JOINTS

A. Joints shall be formed by use of acceptable sheet metal forms, or by insertion of hard-pressed fiberboard strips into the plastic concrete, or by sawing with carborundum or diamond-tipped blade after concrete has set. Joints shall be ¼" wide and approximately ¼ of the slab thickness in depth, unless otherwise indicated or directed.

B. When concrete is dry, clean out sawed or fiberboard joints and fill to wearing surface with joint sealer.

6.4.25 EMBEDDED ITEMS
Items to be embedded include, but are not limited to, water stops, anchor bolts, inserts, sleeves, curb angles, dovetail anchor slots, frames, etc. and shall be placed prior to concrete placement.

6.4.26 PLACING EMBEDDED ITEMS

Position accurately and support against expansion joint material, water stop and embedded items. Fill temporarily with readily removable material to prevent the entry of concrete into the voids in sleeves, inserts and anchor bolts.

6.4.27 WATER STOPS

Provide water stops in construction and expansion joints in the maximum practical length possible. Forming necessary splices and intersections shall conform to manufacturer's recommendations and directions.

6.4.28 CONCRETE MIXING

A. Concrete shall be mixed and transported to the job site in accordance with the requirements of ASTM C-94.

B. Delivery tickets for each batch delivered shall show the date, mix by number or sack content with maximum size aggregate, admixtures and amounts used per cubic yard, air content, slump and time of loading.

6.4.29 AGITATING, MIX AND DISCHARGE

Concrete shall be continuously agitated from the time water is added and then mixed for 2 ½ minutes just prior to discharge. The mix shall be discharged from the truck within one (1) hour after cement is batched, unless longer time is specifically authorized.

6.4.30 WATER

Indiscriminate addition of water to increase slump is prohibited.

6.4.31 ADMIXTURES

A. Liquid admixtures shall be charged into the mixer by means of an approved metering device.

B. Powder admixtures shall be weighted or measured by volume in accordance with manufacturer's recommendation.

C. When two or more admixtures are to be incorporated in the mix, they shall be added separately during batching sequence.

6.4.32 RETEMPERING

A. Mix concrete only in quantities for immediate use. Retempering old concrete will not be allowed.
B. Concrete arriving at the project with slump below that suitable for placing may have water added only if neither:
   1. The maximum permissible water-cement ratio has not been exceeded.
   2. Maximum slump has not been exceeded.

C. Any addition of water above that permitted by limitation on water-cement ratio must be accompanied by a quantity of cement sufficient to maintain proper cement ratio and a mixing time of 1 ½ minutes. No such additions will be permitted unless specifically authorized in writing by a Town representative.

6.4.33 WEATHER

Perform work in conformance with detailed recommendations in ACI 306 for cold and ACI 305 for hot weather concrete placement.

6.4.34 BATCH TEMPERANCE

As mixed temperature of concrete shall be maintained above 55 degrees F and below 80 degrees F, even though the mean temperature falls below 40 degrees F.

6.4.35 PROTECTION

A. Provide adequate protection against rain, sleet, snow, cold and other weather conditions.

B. Protect exposed surfaces from rain water and from 40 degrees F and below temperatures with suitable covering, and equipment to maintain a minimum temperature of 50 degrees F for a period of 72 hours after the concrete has been placed.

6.4.36 PREPARATION OF SURFACES

Preparation for placing shall include, but is not limited to, form construction, setting of reinforcing steel and embedded items, securing and alignment of forms, cleaning thoroughly all surfaces that will be in contact with concrete and keeping them free of debris, ice, rust, scale, grease or other coatings during placement of the concrete.

6.4.37 EQUIPMENT AND LABOR

Assemble and provide sufficient labor and equipment for proper mixing, transporting, placement and protection of concrete until accepted by the Town.

6.4.38 CONVEYING

A. Truck mixers, agitators, and non-agitating units, including their manner of operation, must conform to the applicable requirements of ASTM C-94. Aluminum tubing or pipe for conveying concrete will not be allowed.

B. Concrete shall be conveyed to place of final deposit by methods which will prevent segregation or loss of ingredients and insure the required quality of the concrete is obtained. A hopper or tremie will be required at the end of metal chutes having a
slope greater than 1:2 or less than 1:3 vertical to horizontal; or chutes in excess of 20 feet in length.

C. Use of horizontal belt conveyors discharging into a hopper and pumping or pneumatic conveying equipment such that the loss in slump does not exceed 1 ½" shall be subject to approval.

6.4.39 DEPOSITING

A. Deposit concrete continuously, or in layers of such thickness that no concrete is deposited on concrete which is hardened sufficiently to cause formation of seams or planes of weakness within the section. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing.

B. Depositing of concrete in general shall conform with the applicable detailed recommendation of ACI 304.

6.4.40 CONSOLIDATION

A. Perform consolidation in conformance with applicable detailed recommendation of ACI 309.

B. Consolidate all concrete by internal and external vibrators, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, embedded items and into form corners, eliminating all air or stone pockets which may cause honeycombing, pitting or planes of weakness. Thoroughly consolidate concrete in slabs and floors with vibrating bridge screeds, roller pipe screeds or other acceptable means. Only mechanical vibrators having a minimum frequency 7000 RPM and operated by competent workmen shall be employed.

C. Over vibration and transporting concrete within the form by vibration will not be allowed.

6.4.41 UNDERWATER CONCRETING

A. Placing of concrete under water will not be allowed unless specifically approved method and authorization in writing has been obtained.

B. Where concrete is authorized to be placed under water, the cement content shall be increased 25% at contractor’s expense, to compensate for losses due to water.

6.4.42 TIE HOLES

Patch all tie holes, after being cleaned and thoroughly dampened, by filling solid with patching mortar immediately after form removal.

6.4.43 DEFECTIVE AREAS

A. Remove and repair all honeycombed and other defective concrete down to sound concrete.
B. Dampen area to be patched and area six (6) inches wide surrounding it. Brush into surface a bonding grout (1 part cement to 1 part sand passing a #30 sieve) mixed to a consistency of thick cream. Immediately after breaking in grout, patch the defective area with a mortar (1 part cement to 2 ½ parts sand by damp loose volume) using no more water than necessary for handling and placing.

6.4.44 SELECTION OF FINISHES

Unless otherwise shown or called for in the Special Conditions, the following finishes shall be provided.

<table>
<thead>
<tr>
<th>Type</th>
<th>Finish</th>
<th>Type of Surface Intended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scratch</td>
<td></td>
<td>To receive bonded applied cementitious application</td>
</tr>
<tr>
<td>Floated</td>
<td></td>
<td>To receive water proofing membranes or terrazzo</td>
</tr>
<tr>
<td>Trowled</td>
<td></td>
<td>Walking surfaces or for reception of floor covering</td>
</tr>
<tr>
<td>Broom or Belt</td>
<td></td>
<td>Sidewalks, garage floors and ramps</td>
</tr>
<tr>
<td>Non-slip</td>
<td></td>
<td>Exterior platforms, steps, athletic courts, landings and ramps</td>
</tr>
<tr>
<td>Board Form</td>
<td></td>
<td>Concrete platforms</td>
</tr>
<tr>
<td>Smooth Rubbed</td>
<td></td>
<td>Interior vertical and other exterior surfaces</td>
</tr>
<tr>
<td>Exposed Aggregate</td>
<td></td>
<td>Scrubbed, sandblast and tooled finishes as specified in the Special Conditions</td>
</tr>
</tbody>
</table>

6.4.45 TOLERANCES OF FINISH

<table>
<thead>
<tr>
<th>Finish Class</th>
<th>Application</th>
<th>Minimum Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>“A”</td>
<td>Roads</td>
<td>1/8” in 10 ft. using a 10 ft. straight edge</td>
</tr>
<tr>
<td></td>
<td>Slopes to Drains</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Floors</td>
<td></td>
</tr>
<tr>
<td>“B”</td>
<td>Ramps</td>
<td>¼” in 10 ft. using a 10 ft. straight edge</td>
</tr>
<tr>
<td></td>
<td>Sidewalks</td>
<td></td>
</tr>
<tr>
<td>“C”</td>
<td>Athletic Courts</td>
<td>¼” in 15 ft. using a 15 ft. straight edge</td>
</tr>
</tbody>
</table>

6.4.46 FLOATED FINISH SLABS

After concrete has been placed, struck off, consolidated, leveled and allowed to set to the point where water sheen has disappeared or where mix has stiffened sufficiently to permit proper working, being consolidation of the surface with power driven machines. Hand float with wood or cork-faced floats in locations inaccessible to power driven machines. Recheck trueness of surface at this state with applicable straight edge applied at not less than two different angles. Cut down all high spots and fill all low spots during this procedure to a Class “B” tolerance, then refloat the slab immediately to a uniform, smooth, granular texture.

6.4.47 TROWELED FINISH SLAB

A. Perform first power troweling immediately after power floating to produce a smooth surface which is relatively free of defects but which may still contain some trowel
marks. Perform additional troweling and consolidation of the surface by hand until a ringing sound is produced as the trowel is moved over the surfaces.

B. To resist slip the finish surface may show trowel marks which are uniform in texture and appearance, otherwise it shall be free of all trowel marks. In either case, the surface shall be to a Class “B” tolerance.

6.4.48 BROOM OR BELT FINISH

Sidewalk slabs and other slabs so specified shall have a coarse traverse sawed texture obtained by drawing a broom or burlap belt across the surface immediately after floating.

6.4.49 CURING

Freshly deposited concrete shall be protected from premature drying and excessively hot or cold temperatures and maintained with minimal moisture loss at a relatively constant temperature for the time required for hydration of cement and proper hardening of the concrete.

6.4.50 INITIAL CURING

A. Immediately following finishing the contractor shall provide methods to keep the concrete continuously moist at least overnight unless otherwise specified by:
   1. Ponding or continuous sprinkling
   2. Absorptive mat or fabric kept continuously wet
   3. Sand or other covering kept continuously wet
   4. Steam vapor mist bath at a temperature not to exceed 150 degrees F.
   5. Curing compounds conforming to ASTM C-309 applied according to manufacturer’s recommendations, providing the surface to be cured is not to be bonded to other cementitious materials.

6.4.51 DURATION OF CURING

Continue curing until the cumulative number of days, or fraction thereof, not necessarily consecutive, during which the air temperature in contact with the concrete is above 50 degrees F, has totaled seven (7) days.

6.4.52 COLD WEATHER CURING

Curing shall conform to all applicable detail recommendations in ACI-306. Temperature of concrete shall be maintained between 50 degrees - 70 degrees F for the required curing period when the mean daily atmospheric temperature is less than 40 degrees F. Sufficient equipment and materials required to comply with this specification shall be at the site prior to placing concrete.

6.4.53 HOT WEATHER CURING

Curing shall conform to all applicable detail recommendations, in ACI-305. As quickly as concrete hardening and finishing will allow, the contractor shall install such protective measures, such as, but not limited to, windbreaks, shading, fog spraying, sprinkling, ponding or wet covering as may be required.
6.4.54 PROTECTION FROM DAMAGE

Especially during the curing period and until the work is accepted, the contractor shall protect the concrete from damage by vehicular or mechanical equipment, foreign materials and by rain or by running water.

6.4.55 TESTING

Technical services performing routine preliminary testing of materials of proposed mix designs and resulting concrete for compliance with the specifications will be provided by the Town, at no expense to the contractor.

6.4.56 TESTS FOR CHANGES AND NON-COMPLIANCE

Testing required because of changes in materials or proportions of the mix requested by the contractor, as well as any extra testing of concrete, field cured cylinder, or materials occasioned by failure to meet specification requirements, shall be at the contractor’s expense.

6.4.57 TESTING PROVIDED BY THE TOWN

A. Test contractor’s proposed material for compliance.
B. Review and check test contractor’s proposed mix design.
C. Prepare and cure complete set of concrete cylinders, test and report results of 7 and 28 day compressive strength, in accordance with ASTM C-39, for each placement up to 50 cubic yards.
D. Determine slum range of concrete as delivered in accordance with ASTM C-143.
E. Determine air content of standard weight concrete with either ASTM method.
F. Check batching and mixing operations.

6.4.58 PRELIMINARY MATERIAL SAMPLES AND MIX DESIGN

Deliver to Town preliminary representative samples of all the materials, mix designs and other materials contractor proposed to use on the project which require testing, with request for acceptance.

6.4.59 CASUAL LABOR

Furnish such labor as is necessary to handle samples at the project or at the material source.

6.4.60 STORAGE FACILITIES

Provide and maintain adequate facilities on the site for safe storage and proper curing of concrete test cylinder for the first 24 hours, as required by ASTM C-31.
6.4.61 CERTIFICATES OF COMPLIANCE

A. Submit the following in duplicate for each shipment, with applicable ASTM Specifications:

6.4.62 DEFECTIVE CONCRETE

If concrete is found defective from testing, placing, curing or for other causes, and if the contractor is so directed, he must remove the concrete at no cost to the Town.
SECTION 6.5

CONSTRUCTION MATERIALS AND METHODS:

DEMOLITION, SITE PREPARATION, EXCAVATION AND EMBANKMENT

6.5.1 GENERAL

A. 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.

B. In public right-of-ways, wherein the Town 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.

6.5.2 LOCAL LAWS, ORDINANCES AND CODE

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

6.5.3 PROTECTION OF PUBLIC IMPROVEMENTS

A. 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 contract. 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 Town representative.

B. 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 the 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 Town representative to provide permanent access. Existing driveways shall be resurfaced with the then existing type of surfacing, whenever surfaces are destroyed.

C. Work shall include saw cutting or proper preparation of remaining materials, which are to be reconstructed. Materials left in place shall be protected from damage during construction. Contractor shall be responsible to maintain or repair materials left in place.
6.5.4 DISCONNECTION OF EXISTING UTILITIES

A. Before starting demolition of the 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 and marking shall be made in accordance with the regulations of the utility that controls the supply of service involved.

B. 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.

C. The county, district, or Town Public Works Department will provide a representative to be on site to observe and approve the contractors 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.

6.5.5 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.

6.5.6 PROTECTION OF SURVEY MONUMENTS

A. 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.

B. Non-pneumatic-tired equipment shall be allowed if the paved area in question is flagged off from public use for the duration of construction and will not be re-opened to public use until sufficient repair/replacement of paving surface is complete. Repair/replacement of paving surface shall be determined to the Town Engineer or Town Representative for the project.

6.5.7 DEMOLITION, CLEARING AND GRUBBING

The contractor shall remove from the site, or within the limits of construction, all obstructions specified in the special conditions or noted on the plans.
6.5.8 FENCES

Where existing fence or corner markers are to be removed, site corners shall be marked by ½” rebar, 18” long, firmly implanted at ground level by the contractor.

6.5.9 TREES AND SHRUBS

A. 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 an elevation of two (2) feet below existing or finished grade, whichever is lower. Downed trees, brush and rubble shall be removed from the site.

B. 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 Town at the contractor’s expense.

6.5.10 BURIED FUEL AND SEPTIC TANKS

A. Tanks that may exist on the site shall be completely removed and contaminated soils remediated. The void created shall be filled by the contractor to finished grade.

B. Underground motor fuel storage tanks shall be excavated and removed under the direction and in the presence of a representative from the Town of Granby. The contractor shall notify the fire district twenty-four-(24) hours in advance of the time he proposes to start excavation in the vicinity of the tanks.

6.5.11 WELLS

On site wells and well casings shall be sealed to prevent contamination of ground water aquifers in accordance with Section 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.

6.5.12 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.

6.5.13 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, cross pans, gutters, etc.
6.5.14 WALLS

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

6.5.15 SALVAGE

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

6.5.16 FILLING AND GRADING

A. 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 or asphalt be considered as approved fill material.

B. 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.

6.5.17 TOPSOIL

A. 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.

B. Topsoil shall be placed and spread at locations and to the thickness sown 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 fire spray by nozzles or spray bars in such a manner and extent that wash or eroding will not occur.

6.5.18 DISPOSAL

A. Unusable material may be disposed of outside the limits of view from the project with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners are to be furnished to the Town Engineer.

B. Where portions of structures are to be removed, the remaining portions shall be prepared to fit new construction. The work shall be done in accordance with the development drawings and in such manner that materials to be left in place shall be protected from damage; all damage to portions of structures to remain in place shall be repaired by the Developer at his expense. Reinforcing steel projecting from the
remaining structure shall be cleaned and aligned to provide bond with new extension.

6.5.19 EXCAVATION

A. 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.

B. 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 Town representative shall be disposed of by the contractor at his expense.

C. 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 project 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 materials with satisfactory material and thoroughly compact same at his own expense.

D. Whenever excavation below subgrade elevation to remove spongy material, vegetable matter, or other material 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 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.

E. The contractors 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 Town representative. When approved, disposal of surplus material on Town property shall be kept below the grade designated by the engineer.

6.5.20 EMBANKMENT

A. Areas to receive embankment and the top of cut areas shall first be stripped of all vegetation, organic material and materials unsuitable for use in embankments. Topsoil shall be stockpiled for reuse and unsuitable material disposed of.

B. Within the limits of the embankment and cut area the subgrade shall be scarified to a depth of six (6) inches and the moisture content increased or reduced as necessary to bring the moisture within ± 2% of optimum. This scarified 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 \( \geq 2\% \) of optimum moisture content and compacted to the relative compaction specified. Rollers shall be of a tamping type conforming to CDOT standards.

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

6.5.21 COMPACTION

A. Maximum dry densities of all soil types encountered or to be used will be determined in accordance with AASHO T-99 or T-180 Methods C-D. 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.

<table>
<thead>
<tr>
<th>Soil Classification (AASHO M-145)</th>
<th>AASHO T-99 Minimum Relative Compaction</th>
<th>AASHO T-180 Minimum Relative Compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>100</td>
<td>95</td>
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<tr>
<td>A-3</td>
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<tr>
<td>All Others</td>
<td>95</td>
<td>90</td>
</tr>
</tbody>
</table>

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

6.5.22 SUBGRADE FOR SLABS ON GRADE AND PAVING

A. Subgrade areas to be occupied by curbs, gutters and sidewalks base course or asphaltic concrete shall be excavated, backfilled and compacted to establish grade. This work shall be done with particular care in accordance with all requirements herein.

B. Proof rolling may be required to determine whether certain areas of subgrade meet compaction requirements. Proof roll designated areas with heavy rubber-tired roller having a minimum weight of 50 tons, or single axle water truck loaded to provide equivalent wheel loading. Areas found to be weak or fail the test shall be ripped, scarified, wetted if necessary, and re-compacted to requirements for density and moisture at contractor’s expense.

C. Surface of ground between curb or sidewalk line and property line shall be sloped as staked or as directed by the project engineer and rounded into existing lawn or ground surface.

6.5.23 WETTING AND COMPACTING

A. 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 project engineer shall be used.

B. Concurrently with the rolling or tamping operations, the materials shall be wetted by uniformly sprinkling each layer or course of material being placed, to \( \geq 2\% \) of optimum. 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.

C. 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) psi at the tamper. Successive blows with the tamper shall overlap at least one-fourth the width of the tamper foot.

6.5.24 SURPLUS EXCAVATION

A. 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 emission shall be furnished to the project engineer. The Town relinquishes all right and title to the surplus material unless otherwise specified in the Special Conditions.

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

6.5.25 CONCRETE CURB, GUTTER AND VALLEY PANS

The contractor shall replace in like kind all curb and gutter and valley pans that are damaged during construction. The replacement shall be of equal or better quality than found.

6.5.26 REPAIR OF TREE DAMAGE

Any trees along the alignment of the conduit 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 treatment shall be done in accordance with the forestry regulations of the authority having jurisdiction and at contractor’s expense.

6.5.27 SURFACE RESTORATION

A. The contractor will secure all street cut and ROW permits required for the prosecution of the work. The contractor shall assume full responsibility for the consequences of such cutting or damaging and shall comply with all requirements contained therein.
B. The replacement of excavated base course, permanent paving and damaged curb and gutter shall be done in accordance with the Public Works Manual and requirements contained in the permits.

C. 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.

D. 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 replace in cultivated and agricultural areas; and any excess earth shall be removed from the ROW at no additional expense to the Town. All grassed areas shall be reseeded or re-sodded, and the contractor shall be responsible for caring for the grass until its growth is established.

E. 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 coarse 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 project 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.

F. 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.

G. In the event of the contractor’s failure to perform the above work, the Work may be performed by the Town at the expense of the contractor.

6.5.28 ASPHALT CUT

A. Any excavation, cut, trench or opening in or under any paved street shall be repaired with asphalt substantially similar to that used in the original pavement of the street. The asphalt and dirt shall have a compaction of ninety percent (90%), tested and approved by a certified person at Permittee’s expense. A copy of the testing results must be provided to the Town of Granby.

B. In any excavation work on or under any paved street, the pavement must be cut with an asphalt spade or cutting wheels. The use of a backhoe in cutting the pavement is expressly prohibited. The width of all cuts in the pavement shall be sufficient so that all excavation in or under any paved street can be accomplished without disturbing or lifting the surrounding pavement.
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CONSTRUCTION STANDARD DETAILS & SPECIFICATIONS FOR PUBLIC INFRASTRUCTURE

TOWN OF GRANBY

GRANBY
COLORADO
1905

PREPARED BY:

SGM
118 W. 6TH STREET, SUITE 200
GLENWOOD SPRINGS, CO 81601
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TYP. ROAD CROSS-SECTION
SCALE: 3/8" = 1'-0"

NOTE: ASPHALT AND BASE DEPTHS IDENTIFIED ARE MINIMUMS. PROVIDE DEPTHS AS DETERMINED BY SOILS REPORT AND ENGINEERS DESIGN BASED UPON PROJECTED TRAFFIC CONDITIONS (INCLUDING CONSTRUCTION TRAFFIC), LOADING AND SOIL STRENGTHS.

EXISTING ROAD CROSS-SECTION
NOT TO SCALE

NOTE: LOT OWNERS ARE PROHIBITED FROM PLACING FILL OR GRADING WITHIN TOWN RIGHT OF WAY WITHOUT WRITTEN PERMISSION. EXISTING DRAINAGE PATTERNS MUST BE MAINTAINED AS DIRECTED BY PUBLIC WORKS.
MIN. THICKNESS OF NEW ASPHALT TO BE 4" OR MATCH EXISTING DEPTH, WHICHEVER IS GREATER (3" MAX. LIFT). MINIMUM THICKNESS OF NEW BASE IS TO BE 8" OR MATCH EXISTING DEPTH, WHICHEVER IS GREATER.

NOTES:

1. WHERE EXIST. PAVEMENT IS A MACHINE PLACED HOT MIXED ASPHALTIC CONCRETE, A PREMIXED HOT APPLIED CONCRETE WILL BE USED.

2. ALL REPLACEMENT MATERIAL SHALL BE COMPACTED TO A DENSITY OF 95% OPTIMUM DENSITY.

3. TEMPORARY A.C. REPAIR TO BE PLACED THE SAME DAY AS COMPLETION OF BACKFILL. CONTRACTOR WILL MAINTAIN TEMPORARY REPAIR UNTIL PERMANENT REPAIR HAS BEEN COMPLETED.

4. PROVIDE FLOWABLE FILL BACKFILL WHERE DIRECTED BY TOWN.

ASPHALTIC PAVEMENT REPLACEMENT
NOT TO SCALE
LOCATE STORM SEWER MANHOLES IN CENTER OF TRAFFIC LANE

LOCATE SANITARY SEWER MANHOLES IN CENTER OF STREET.

STUB-OUT FOR FUTURE EXTENSIONS SHALL EXTEND BEYOND THE INTERSECTION RADIUS OR 40' MINIMUM FROM VALVE.

FIRE HYDRANT WITH VALVE AND BOX

EDGE OF ASPHALT

EDGE OF ASPHALT

PIPE PLUG & THRUST BLOCK

SANITARY SEWER @ CL

STORM SEWER

VALVE AND BOX
(ALT. LOC.)

6' MIN.

10' MIN.

40' MIN.

10' MIN.

6' MIN.

R.O.W.

8'
CONCRETE FOR FLATWORK AND CURB/GUTTER

1. EXPANSION JOINTS: 100’ ON CENTER AND AT DRIVEWAYS.

2. DUMMY JOINTS: 1” DEEP BY 1/8”–1/4” WIDTH AT INTERVALS EQUAL TO SIDEWALK WIDTH.

3. USE 1/4” RADIUS ON ALL EDGES.

4. USE 6” DEPTH OF CONCRETE ON ALL DRIVEWAYS.

5. CURE FOR 72 HOURS USING CURING COMPOUND, PLASTIC COVERING OR MOISTURE.

6. USE 3750 PSI CONCRETE WITH FIBERMESH ADDITIVE AT 1–1/2 LBS./C.Y. MAXIMUM SLUMP 4”.

7. CONCRETE REQUIREMENTS:
   - 4000 PSI (28 DAY COMpressive STRENGTH)
   - AIR – 4% TO 8%
   - SLUMP – 4” MAXIMUM
   - CEMENT – TYPE II
   - REINFORCEMENT – FIBERMESH, 1 1/2 POUNDS/CU.YD.
   - AGGREGATE – MAXIMUM 1” (NO. 6, TABLE 703.03)
   - FINISH – BROOM
   - JOINTING – MAXIMUM 15’ OR AS SHOWN; SAW CUT TO 25% PAVEMENT THICKNESS
   - JOINT SEALER – DOW 888 WITH BACKER OR EQUAL (TRAFFIC GRADE SILICONE SEALER).
18" CURB & GUTTER

SCALE: 1 1/2" = 1'-0"

MINIMUM 2" LEVELING AGGREGATE BASE COURSE CLASS 6

SHAPE SUBGRADE PARALLEL TO STREET CROSS SLOPE

INVERTED 18" CURB & GUTTER

SCALE: 1 1/2" = 1'-0"

MINIMUM 2" LEVELING AGGREGATE BASE COURSE CLASS 6

SHAPE SUBGRADE PARALLEL TO STREET CROSS SLOPE
This mold is built with 1/4" per foot slope on top of curb (same as monolithic mold 66–2633M).

Curb joint: contraction = 8'–0"
Intervals: expansion = 100'–0"

Mountable Curb & Gutter
Scale: 1" = 1'–0"

Minimum 2" leveling aggregate base course Class 6

Shape subgrade parallel to street cross slope

This mold is built with 1/4" per foot slope on top of curb (same as monolithic mold 66–2633M).

Curb joint: contraction = 8'–0"
Intervals: expansion = 100'–0"

Mountable Curb & Gutter Inverted
Scale: 1" = 1'–0"
STANDARD CURB & GUTTER

SCALE: 1 1/2" = 1'-0"

MINIMUM 2" LEVELING AGGREGATE BASE COURSE CLASS 6
SHAPE SUBGRADE PARALLEL TO STREET CROSS SLOPE

INVERTED CURB & GUTTER

SCALE: 1 1/2" = 1'-0"

MINIMUM 2" LEVELING AGGREGATE BASE COURSE CLASS 6
SHAPE SUBGRADE PARALLEL TO STREET CROSS SLOPE
PROVIDE FIBERMESH REINFORCEMENT IN CONCRETE MIX AT 1 1/2 # PER CU.YD.

WIDTH PER PLAN AS APPROVED BY TOWN

SLOPE 1/4"/FT.

SHAPE SUBGRADE PARALLEL TO STREET CROSS SLOPE

2" MIN. AGGREGATE BASE COURSE CLASS 6

CURB JOINT: CONTRACTION = 10'-0"
INTERVALS: EXPANSION = 100'-0"

MOUNTABLE CURB & GUTTER W/SIDEWALK
N.T.S.
NOTES:

1. EXPANSION JOINTS: NO MORE THAN 100’ ON CENTER AND AT DRIVEWAYS.
2. DUMMY JOINTS: 1” DEEP BY 1/8” – 1/4” WIDTH AT INTERVALS EQUAL TO SIDEWALK WIDTH.
3. USE 1/4” RADIUS ON ALL EDGES.
4. USE 6” DEPTH OF CONCRETE ON ALL DRIVEWAYS.
5. CURE FOR 72 HOURS USING CURING COMPOUND, PLASTIC COVERING OR MOISTURE.
6. USE 4000 PSI CONCRETE WITH FIBERMESH ADDITIVE AT 1–1/2 LBS./C.Y. MAXIMUM SLUMP 4”.

CONCRETE SIDEWALK

SCALE: 1”= 1’–0”

TYP. SIDEWALK W/ THICKENED EDGE

SCALE: 1”= 1’–0”
CURB DETAIL
SCALE: 1 1/2" = 1'-0"

CONCRETE TRENCH DETAIL
SCALE: 1 1/2" = 1'-0"

NOTE: TRENCH WIDTH AND TRENCH FRAME AND COVER TO BE DETERMINED BASED UPON A DRAINAGE STUDY.
CURB/GUTTER
OR VALLEY PAN

RAISE ASPHALT 3/8" MINIMUM ABOVE
ALL CONCRETE EDGES, PROVIDE CLEAN,
SMOOTH FINISHED EDGE OF ASPHALT.

NOTE:
ON INVERTED CURB/GUTTER,
ASPHALT TO BE FLUSH
WITH GUTTER.

TYP. ASPHALT/CONCRETE CONNECTION

SCALE: 1" = 1'-0
VALLEY PAN DETAIL

SCALE: 1" = 1'-0"

NOTE: LOCATION OF CONTRACTION JOINTS TO BE AS DETAILED OR AS DETERMINED IN FIELD WITH AND APPROVED BY TOWN.

STANDARD CONTRACTION JOINT

N.T.S.

NOTE: EXPANSION JOINTS TO BE LOCATED ADJACENT TO ANY EXISTING CONCRETE OR FIXED STRUCTURE.

STANDARD EXPANSION JOINT

N.T.S.

Valley Pan Detail & Expansion and Contraction Joint Details

Town of Granby

Detail C9  RD-VPan&JT.dwg
FLOWLINE TO BE ON UNIFORM GRADE BETWEEN TANGENT POINTS

DOWELS

RADIUS VARIES

REFER TO VALLEY PAN DETAIL C9

REINFORCE VALLEY GUTTER AND APRONS FIBERMESH AT 1 1/2# PER CU.YD.

PLAN VIEW
N.T.S.

CURB/GUTTER SECTION

SMOOTH DOWELS THROUGH EXPANSION JOINT
(3 #6 DOWELS, EQUALLY SPACED)

EXPANSION JOINT PER DETAIL 7

SECTION
N.T.S.

Valley Gutter at Intersection
Town of Granby
Detail C10
RD-VGutter.dwg
NOTES:

1. DIMENSIONS MAY BE ALTERED TO AVOID OBSTRUCTIONS WITH ENGINEER'S APPROVAL.

2. SURFACE OF RAMP TO HAVE COARSE BROOM FINISH.

SHAPE SUBGRADE PARALLEL TO STREET CROSS SLOPE

DETECTABLE WARNING PAVERS START 6 IN. FROM THE FLOW LINE & 24" IN WIDTH

NOTE: HANDICAP RAMS SHALL BE 6" THICK CONCRETE ALL OTHER CONCRETE FLATWORK SHALL BE 4" THICK. AGGREGATE BASE FOR 4" CONCRETE FLATWORK SHALL BE 2" MIN. COMPACTED CLASS B AGGREGATE

SECTION A—A
N.T.S.

PLATE SET SO THAT THE TOP OF DOME IS FLUSH WITH ADJACENT CONCRETE RAMP

ADA TRUNCATED DOME PLATE DETAIL
SCALE: N.T.S.

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NOTES:
1. DIMENSIONS MAY BE ALTERED TO AVOID OBSTRUCTIONS WITH ENGINEER’S APPROVAL.
2. SURFACE OF RAMP TO HAVE COARSE BROOM FINISH.

SECTION A-A
N.T.S.

ADA TRUNCATED DOME PLATE DETAIL
SCALE: N.T.S.
SECTION D–D

NOTES:

1. TRANSITION TO SPILLWAY/CHANNEL AS PER APPROVED PLANS.

2. A CENTER WALL SHALL BE INSTALLED IN SCUPPERS WIDER THAN 4' OR IF MORE THAN 1 SCUPPER IS BUILT IN SERIES.

3. EXPANSION JOINT FILLER SHALL BE 1/2" BITUMINOUS TYPE PREFORMED EXPANSION JOINT FILLER, A.S.T.M. D–1751.

Concrete Scupper
Town of Granby

Detail C14  RD-Scupp2.dwg
NOTES: (DETAIL SHOWN IS FOR 30" CURB AND GUTTER)

1. FRAME, GRATE & CURB INLET TO BE NEENAHL OR CASTINGS, INC. R-3501-R FOR MOUNTABLE CURB AND Gutter installations. PROVIDE NEENAH R-3228-BD CURB INLET FRAME, DIAGONAL GRATE AND CURB BOX FOR VERTICAL CURB INSTALLATIONS, OR APPROVED EQUAL. SEE BELOW.

2. DOUBLE INLET FRAME, GRATE & CURB INLET TO BE NEENAH R-3504-F OR APPROVED EQUIV. (ABUTTING SIDE FLANGES TO BE OMITTED TO FORM DOUBLE). THE CONCRETE BASIN FOR THE DOUBLE INLET SHALL BE THE SAME AS SHOWN, EXCEPT THAT THE OVERALL WIDTH OF SECTION A-A SHALL BE 6'-10" RATHER THAN 3'-8".

3. FRAME & GRATE SHALL BE ASPHALT PAINT-DIPPED BY MANUFACTURER.

4. PRECAST CONCRETE ADJUSTMENT RINGS (IF REQUIRED) SHALL BE GROUTED IN PLACE.

5. SET GRATE W/ CONC. LEVELING COURSE TO MATCH LONGITUDINAL SLOPE OF THE ROAD.

6. CAST IN PLACE INLET BOXES ARE AN ACCEPTABLE ALTERNATIVE TO PRE-CAST GIVEN WRITTEN APPROVAL FROM TOWN.

7. ALTERNATE CDT TYPE INLETS AND GRATES AS APPROVED BY TOWN.

SECTION A-A

SECTION B-B

TYPE 1 DRAIN INLET DETAIL

NOT TO SCALE
SLOPE CONCRETE
1/2" TO MATCH ELEVATION OF GRATE

REFERENCE POINT ON PLAN VIEWS, CENTERLINE AT BACK CURB, WITH STA./OFFSET

TOP BACK OF CURB

B

LIP OF GUTTER

SLOTTED GRATE SEE NOTE #2

PROVIDE DIAGONAL GRATE INSTALLATION FOR AREAS SUBJECT TO BICYCLE TRAFFIC

FLOWLINE

A

PLAN

NOTES: (DETAIL SHOWN IS FOR 30" CURB AND GUTTER)

1. FRAME, GRATE & CURB INLET TO BE NEENAH OR CASTINGS, INC. R-3501-R FOR MOUNTABLE CURB INSTALLATIONS PROVIDE NEENAH R-3228-BD CURB INLET FRAME, DIAGONAL GRATE AND CURB BOX FOR VERTICAL CURB INSTALLATIONS, OR APPROVED EQUAL.

2. DOUBLE INLET FRAME, GRATE & CURB INLET TO BE NEENAH R3504-F OR APPROVED EQUAL. (ABUTTING SIDE FLANGES TO BE OMITTED TO FORM DOUBLE). THE CONCRETE BASIN FOR THE DOUBLE INLET SHALL BE THE SAME AS SHOWN, EXCEPT THAT THE OVERALL WIDTH OF SECTION A-A SHALL BE 6'-10" RATHER THAN 3'-8".

3. FRAME & GRATE SHALL BE ASPHALT PAINT-DIPPED BY MANUFACTURER.

4. PRECAST CONCRETE ADJUSTMENT RINGS (IF REQUIRED) SHALL BE GROUTED IN PLACE.

5. SET GRATE W/ CONC. LEVELING COURSE TO MATCH LONGITUDINAL SLOPE OF THE ROAD.

6. ALTERNATE COOT TYPE INLETS AND GRATES AS APPROVED BY TOWN.

SECTION A-A

SECTION B-B

TYPE II DRAIN INLET

N.T.S.

FLOWLINE

TOP OF CURB

1 1/2"

2'-6"

3'-2"

4"

MIN. B/B WELDED WIRE MESH

DEPRESS GRATE 1/2" BELOW FLOW LINE ELEV. LISTED

PRECAST CONC. BASIN

RIM/FLOWLINE ELEVATION AT CENTERLINE OF GRATE AS SHOWN ON PLANS

REFERENCE LINE

RIM/FLOWLINE ELEVATION AS SHOWN ON PLANS

RECEIVED

GROUT PIPE IN PLACE

PIPE SIZES, LOCATION & INVERT ELEVATION AS SHOWN ON PLANS

TOP OF BOX

TOP OF CURB

6" TYP

6"

1'-11"

2'-7"

4"
NOTE: FOR DEPTHS EXCEEDING 5', PROVIDE ENGINEERED DESIGN FOR TOWN APPROVAL OF BARREL SECTION.

6" THICK X 12" WIDE CONCRETE COLLAR TO BE INSTALLED IN UNPAVED AREAS ONLY.

PRECAST MANHOLE BARREL PIPE LENGTH AS REQUIRED

CONCRETE BASE CAST IN PLACE

NOT TO EXCEED 5'

PLACE BASE ON UNDISTURBED GROUND OR 1-1/2" COMPACTED WASHED ROCK FOR STABILIZATION

FLOWLINE

D = PIPE DIAMETER

PROVIDE A "FORMED" INVERT IN MANHOLE

NOTES:

1. PRECAST RINGS OR METAL RISER RING COURSE SHALL BE UTILIZED WHERE REQUIRED WITH 2 COURSES MINIMUM AND 6 COURSES MAXIMUM (1" MINIMUM, 6" MAXIMUM HEIGHT).

2. WHERE AVAILABLE FROM PIPE MANUFACTURER, USE EXPANDABLE WATER STOP OR SPECIAL SLEEVE AS PER MANUFACTURER’S SPECIFICATIONS.

3. ALL BASES SHALL BE CAST IN PLACE OR PRECAST CONCRETE; USE #4 REBAR ON 12" C-C BOTH WAYS IN Poured BASES.

4. SET EACH RING IN A FULL BED OF MORTAR AND GROUT ALL INSIDE JOINTS.

5. SET RIM 1/2" BELOW PAVEMENT SURFACE ON GRADE MATCHING PAVEMENT LONGITUDINAL AND CROSS SLOPE. SET RIM 6" BELOW GRADE ON GRAVEL ROADS.

STORM DRAIN MANHOLE DETAIL

N.T.S.

Granby Colorado

Storm Drain Manhole
Town of Granby

Detail D3

DR-MH.dwg
1. All bases shall be cast in place or precast concrete; use #4 rebar on 12" C-C both ways in poured bases.
2. Joint to be located on each side of all manholes, maximum of 24" from inside face.
3. Where available from pipe manufacturer, use expandable water stop or special sleeve as per manufacturer's specifications.
4. Stops to be located on side of bench or over upstream pipe.
5. Use Rub-R-Nek preformed gasket (2 layers) or grout in place between all bottom section, barrel sections, concrete grade rings, and top castings.
6. Backfill within 24" of manhole: Class 6 aggregate or native materials with less than 3" size.
7. Precast rings or metal riser ring course shall be utilized where required with 2 courses minimum and 12 courses maximum (2 minimum, 12" maximum height).
8. Grade adjustment as follows: greater than, or equal to, 1 foot, concrete barrel sections; less than 1 foot, concrete or metal grade rings.
9. Finish grade as follows: asphalt or concrete pavements min. 3/4" below grade; base course road surface 6" below grade, open field 6" above grade.
10. Set rim to match longitudinal grade and cross slope of pavement.

SECTION ELEVATION

SECTIONS B - B

6" thick x 12" wide concrete collar to be installed in unpaved areas only.

PRECAST ECCENTRIC CONE, 3" HIGH

REINFORCED CONCRETE OR POLYETHYLENE GRATE RINGS FOR FINE GRADING AS REQUIRED (6" WALL)

VERTICAL SIDE

SECTION A - A

PRECAST OR CONCRETE BASE CAST IN PLACE

RUBBER O-RING OR FLEXIBLE MANHOLE SEAL.
SEAL NOT ALLOWED.

NOT TO SCALE

Standard Manhole Detail
Town of Granby
Detail S1
MH.dwg
NOTES:

1. ALL BASES SHALL BE CAST IN PLACE OR PRECAST CONCRETE; USE #4 REBAR ON 12" C--C BOTH WAYS IN Poured BASES.
2. JOINT TO BE LOCATED ON EACH SIDE OF ALL MANHOLES, MAXIMUM OF 24" FROM INSIDE FACE.
3. WHERE AVAILABLE FROM PIPE MANUFACTURER, USE EXPANDABLE WATER STOP OR SPECIAL SLEEVE AS PER MANUFACTURER'S SPECIFICATIONS.
4. STOPS TO BE LOCATED ON SIDE OF BENCH OR OVER UPSTREAM PIPE.
5. USE RUB-R-NEK PREFORMED GASKET (2 LAYERS) OR GROUT IN PLACE BETWEEN ALL BOTTOM SECTION, BARREL SECTIONS, CONCRETE GRADE RINGS, AND TOP CASTINGS.
6. BACKFILL WITHIN 24" OF MANHOLE: CLASS 6 AGGREGATE OR NATIVE MATERIALS WITH LESS THAN 3" SIZE.
7. PRECAST RINGS OR METAL RISER RING COURSE SHALL BE UTILIZED WHERE REQUIRED WITH 2 COURSES MINIMUM AND 12 COURSES MAXIMUM (2 MINIMUM, 12" MAXIMUM HEIGHT).
8. GRADE ADJUSTMENT AS FOLLOWS: GREATER THAN, OR EQUAL TO, 1 FOOT, CONCRETE BARREL SECTIONS; LESS THAN 1 FOOT, CONCRETE OR METAL GRADE RINGS.
9. FINISH GRADE AS FOLLOWS: ASPHALT OR CONCRETE PAVEMENTS MIN. 3/4" BELOW GRADE; BASE COURSE ROAD SURFACE 6" BELOW GRADE, OPEN FIELD 6" ABOVE GRADE.
10. SET RIM TO MATCH LONGITUDINAL GRADE AND CROSS SLOPE OF PAVEMENT.

SECTION A -- A

SECTION ELEVATION

SHALLOW MANHOLE DETAIL

NOT TO SCALE

SHALLOW MANHOLE DETAIL

NOT TO SCALE
DROP CONNECTION TO STANDARD MANHOLE

NOT TO SCALE
1) PAVEMENT REPLACEMENT SHALL MEET EXISTING THICKNESS AND KIND WITH THE FOLLOWING MINIMUMS: ASPHALT SURFACING = 3" MIN., AGGREGATE BASE COURSE = 8" MIN.

2) BASE COURSE REPLACEMENT SHALL MEET EXISTING THICKNESS WITH THE FOLLOWING MINIMUMS: AGGREGATE BASE COURSE = 12" MIN.

3) DIRT / TOPSOIL PLACEMENT SHALL MEET EXISTING THICKNESS AND KIND WITH THE FOLLOWING MINIMUMS: 4" TOPSOIL.

4) SELECT MATERIAL AS FOLLOWS: 6" MAXIMUM SIZE IN TOP 12" OF BACKFILL
   12" MAXIMUM SIZE IN REMAINDER OF BACKFILL

5) INSULATE SEWERLINE IN SAME MANNER AS SHown FOR WATERLINE IN DETAIL W6 AT DITCH CROSSINGS ETC WHERE LOCAL COVER IS <7".

SEWER TRENCH CROSS SECTION
SCALE: 3/4" = 1'-0"
SERVICE STUB-OUT BEDDING

NOT TO SCALE

PIPE SUBGRADE

SDR 35
SERVICE LINE

UNDISTURBED
SOIL

12" (MIN)
BEDDING ZONE

6" STEEL
FENCE POST,
TOP 12"
PAINTED GREEN

PROPERTY
LINE

2'

4'

6" SCREENED
ROCK

TRENCH
BACKFILL

SEWER SERVICE
FROM BUILDING

GRADE 1/8"
PER FOOT MIN.

INSTALL WATER
TIGHT PLUG/CAP
OR CONNECT TO
BUILDING SEWER

WYE SADDLE, WYE FITTING
OR EQUIVALENT

45' BEND

STAINLESS STEEL
STRAPS (2 EACH
SADDLE)

PROFILE

STANDARD SEWER SERVICE CONNECTION DETAIL

NOT TO SCALE

SEWER SERVICE LINE NOTES:

1. IN-LINE WYE FOR ALL NEW MAINS
2. WYE SADDLE FOR NEW SERVICES ON EXIST. MAINS
3. BACKFILL UNDER WYE TO BE CLASS 6 AGGREGATE, 95% COMPACTION DENSITY PER ASTM D-698.
4. MINIMUM COVER - 7 FEET.
5. TAP ON MAIN MUST BE DONE WITH RIGID PLASTIC SADDLE.
6. SADDLE BANDS MUST BE STAINLESS STEEL
7. MUST BE SDR 35 SEWER PIPE.
8. SCHEDULE 40 PIPE IS TO BE USED UNDER FOUNDATION WALL.
9. ALL FITTINGS MUST BE GLUE OR GASKET TYPE.
10. 45° MAX. BEND FITTINGS.
11. MUST HAVE DOUBLE, OPPOSING CLEANOUTS.
12. MINIMUM BURY DEPTH OF 7'.
13. BEDDING MATERIAL MUST BE COMPACTED CLASS 6 AGGREGATE.
14. MINIMUM BEDDING DEPTH 6" BELOW, 12" ABOVE SERVICE LINE.

Standard Sewer Service
Connection Detail
Town of Granby

Detail S5
Sew-Ser.dwg
DOUBLE SEWER CLEAN-OUT DETAIL
NOT TO SCALE

SEWER CLEAN-OUT NOTES:

1. BACKFILL UNDER WYE TO BE CLASS 6 AGGREGATE, 95% COMPACTION DENSITY PER ASTM D-698.
2. MINIMUM COVER – 7 FEET.
3. MUST BE SDR 35 SEWER PIPE.
4. SCHEDULE 40 PIPE IS TO BE USED UNDER FOUNDATION WALL.
5. ALL FITTINGS MUST BE GLUE OR GASKET TYPE.
6. 45° MAX. BEND FITTINGS.
7. MUST HAVE DOUBLE, OPPOSING CLEANOUTS LOCATED EVERY 90 FEET.
8. MINIMUM BURY DEPTH OF 7'.
9. BEDDING MATERIAL MUST BE COMPACTED CLASS 6 AGGREGATE.
10. MINIMUM BEDDING DEPTH 6" BELOW, 12" ABOVE SERVICE LINE.
11. SERVICE LINE TO HAVE 2% MINIMUM SLOPE TO MAIN.
SECTION B-B

CONCRETE SKID

MANHOLE LID

SECTION A-A

SEWER AIR RELEASE MANHOLE

NOT TO SCALE

GRADE RING AS REQ'D

48" DIA.

6" MIN. TYP.

PVC

8" 3/4" SCREENED ROCK

LINE SIZE PVC BALL VALVE

CONCRETE SUPPORT

OPEN BOTTOM MANHOLE SECTION

CONCRETE SKID

SEWAGE AIR RELEASE VALVE
CRISPIN UNIVERSAL MODEL US-20
2" INLET X 2" OUTLET
WITH 1/4" ORIFICE

VALVE SUPPORT TO
MANHOLE WALLS
(2 @ 90°)

2" PVC BALL VALVE

WYE W/1" BALL VALVE
& F. HOSE CONNECTION
TYP., SEE DETAIL 1

FROST PROOF MANHOLE LID, NEENAH
R-1758-E OR EQUAL. SET RIM TO
MATCH LONGITUDINAL GRADE AND
CROSS SLOPE OF PAVEMENT.

SECTION A-A

SEWER AIR RELEASE MANHOLE

NOT TO SCALE
NOTES:

1. ALL JOINTS FROM MAIN TO HYDRANT SHALL BE RESTRAINED MECHANICAL JOINTS.

2. HYDRANT, VALVE AND FITTINGS TO BE 250 P.S.I. RATED (MIN.).

3. POLYETHYLENE WRAP SHALL COVER D.I.P. ASSEMBLY FROM HYDRANT BASE TO WATER MAIN.

4. ALL HYDRANT LEAD PIPING TO BE 6" CLASS 52 DIP

5. CENTERLINE OF HYDRANT TO BE 4’-0” FROM BACK OF CURB UNLESS OTHERWISE NOTED.

6. HYDRANTS TO BE MOUNTAIN SPEC MUELLER SUPER CENTURION A–423.

FIRE HYDRANT ASSEMBLY INSTALLATION DETAIL

NOT TO SCALE
1. IN LINE VALVES TO BE MJ x MJ WITH MEGALUG RETAINER GLANDS OR EQUAL.

2. DESIGN LOCATIONS OF VALVES ARE OUTSIDE OF CONCRETE, CURB/GUTTER AND VALLEY PANS. INSTALLED VALVES WHICH CONFLICT WITH CONCRETE AREAS SHALL BE RELOCATED AT THE CONTRACTOR'S EXPENSE.

3. THIS DETAIL DOES NOT APPLY TO HYDRANT ASSEMBLY VALVES.

4. OPERATING NUT EXTENSION SHALL BE PROVIDED PER TOWN REQUIREMENTS AS PART OF THE VALVE ASSEMBLY.

5. ALL PACKING BOLTS AND VALVE BONNET BOLTS SHALL BE STAINLESS STEEL.

6. ALL BOLTS FOR MJ'S SHALL BE COR-BLUE OF EQUAL.

7. RIM TO BE SET 3/4" BELOW PAVEMENT. RIM TO BE SET 6" BELOW GRAVEL ROAD.

**NOT TO SCALE**

**TYPICAL GATE VALVE**

**GRANBY COLORADO 1903**

**SGM**

118 West Sixth Street, Suite 200
Glenwood Springs, CO 81601
970.945.1004  www.sgm-inc.com

Typical Gate Valve
Town of Granby
Detail W2  WatValve.dwg
**SERVICE STUB-OUT BEDDING**

*NOT TO SCALE*

**WATER SERVICE LINE NOTES:**

1. **TAP ON THE MAIN MUST BE DONE WITH A DOUBLE STRAP SADDLE; MUELLER DR25 OR SIMILAR.**
2. **MUST BE TYPE K COPPER, ONE SOLID PIECE PREFERRED.**
3. **ALL FITTINGS MUST BE COMPRESSION TYPE.**
4. **ALL FITTINGS/CONNECTIONS MUST BE AT LEAST 10' AWAY FROM BUILDING FOUNDATION.**
5. **MINIMUM BURY DEPTH OF 8'.**
6. **BEDDING MATERIAL MUST BE CDOT CLASS 6 BASE COURSE AGGREGATE.**
7. **MINIMUM BEDDING DEPTH 6" BELOW, 12" ABOVE SERVICE LINE.**
8. **AIR PRESSURE TEST OF 100 PSI REQUIRED AT TIME OF INSPECTION.**
9. **CURB STOP TO BE LOCATED AT THE PROPERTY LINE OR AT THE EDGE OF EASEMENT—WHICHEVER IS CLOSER TO THE MAIN.**

**TYP. WATER SERVICE DETAIL**

*NOT TO SCALE*
These details are provided for standardization purposes only. This detail represents minimum design standards which may require upgrading for specific applications. Refer to water and sanitary sewer system construction standards and minimum design criteria for the Granby/Silvercreek water and wastewater authority for specific material and installation requirements.

Service stub-out bedding

Not to scale

Owner's service pipe & responsibility for repairs

60' max. P.L. to meter

Cover for stop box shall be installed & maintained level w/ the adjacent ground

Ball valve

Traffic rated valve box

Riser key

Curb stop

3' max. (note 1)

Place "3M" locating disk

Service pipe to be type K copper

Compacted class 6 aggregate base course, compaction density of 95% per ASTM D698 within town R.O.W.

Copper service line

Undisturbed soil

Pipe subgrade

12" (min)

Trench backfill

6" (min)

Bedding zone

Service line, stop box & inside meter installation

Not to scale

Water service line notes:

1. Placement of stop box is to be a minimum of 3 feet inside the property line (unless otherwise approved).
2. Owner's responsibility for repairs extends to and includes the corporation stop.
3. The district or other public entities are not responsible for any damage that may occur due to a leak on a service line. This is the responsibility of the owner of the property to which the service line is connected.
4. If the depth of cover is less, use insulation per drain w/ the "goose neck" at the corporation stop may have less cover and may require insulation even if the rest of the service line does not.
5. Compression type fittings only.
DEAD END

THRUST BLOCK NOTES:

1. ALL FITTINGS TO BE WRAPPED WITH 8 MIL POLYETHYLENE.

2. PIPE INSTALLED UNDER CONDITIONS DIFFERENT FROM THOSE NORMALLY ENCOUNTERED SHALL REQUIRE THRUST BLOCKS DESIGNED FOR THOSE PARTICULAR CONDITIONS.

3. THRUST BLOCKS ON PIPE LARGER THAN 12 INCHES DIAMETER SHALL BE DESIGNED FOR CONDITIONS EXISTING AT THE INSTALLATION SITE.

4. ALL THRUST BLOCKS TO BE READY MIXED 3000 P.S.I. CONCRETE.

5. MEGALIC RETAINER GLANDS OR EQUAL TO BE INSTALLED ON FITTINGS AND TEES.

AREAS GIVEN IN TABLE ARE BASED UPON AN INTERNAL STATIC PRESSURE OF 100 P.S.I. AND A SOIL BEARING CAPACITY OF 1000 LBS. PER SQ. FT. BEARING AREAS FOR ANY PRESSURE AND SOIL BEARING CAPACITY MAY BE OBTAINED BY MULTIPLYING THE TABULATED VALUES BY A CORRECTION FACTOR "F".

\[
F = \frac{\text{ACTUAL SPECIFIED TEST PRESSURE IN HUNDREDS OF LBS.}}{1.5} \cdot \frac{\text{ACTUAL SOIL BEARING CAPACITY IN THOUSANDS OF LBS. PER SQ. FT.}}{1000}
\]

INSTALLATION OF THRUST BLOCKS ARE NOT ALLOWED FOR CONDITIONS OUTSIDE OF THOSE LISTED UNTIL SUBMITTAL OF CALCULATIONS FOR THE CORRECTION FACTOR ARE SUBMITTED TO AND REVIEWED BY THE ENGINEER AND WRITTEN APPROVAL BY THE ENGINEER IS GIVEN.

TYP. CONCRETE THRUST BLOCK DETAILS

NOT TO SCALE

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<th>SIZE (INCHES)</th>
<th>90° (SQ. FT.)</th>
<th>45° (SQ. FT.)</th>
<th>22.5° (SQ. FT.)</th>
<th>11.25° (SQ. FT.)</th>
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NOTES:
1. PAVEMENT REPLACEMENT SHALL MEET EXISTING THICKNESS AND KIND WITH THE FOLLOWING MINIMUMS: ASPHALT SURFACING = 3" MIN., AGGREGATE BASE COURSE = 8" MIN. 2)
2. BASE COURSE REPLACEMENT SHALL MEET EXISTING THICKNESS WITH THE FOLLOWING MINIMUMS: AGGREGATE BASE COURSE = 12" MIN.
3. DIRT/TOPSOIL PLACEMENT SHALL MEET EXISTING THICKNESS AND KIND WITH THE FOLLOWING MINIMUMS: 4" TOPSOIL.
4. SELECT MATERIAL AS FOLLOWS: 6" MAXIMUM SIZE IN TOP 12" OF BACKFILL 12" MAXIMUM SIZE IN REMAINDER OF BACKFILL.
5. INSULATE WATERLINE PER DETAIL W6 AT DITCH CROSSINGS, ETC. WHERE LOCAL COVER IS <8'.
6. USE OF 3/4" SCREENED ROCK MAY BE USED AS PIPE BEDDING ONLY WITH APPROVAL BY TOWN AND MAY REQUIRE INSTALLATION OF CLAY DAMS WITHIN THE TRENCH EVERY 100'.

WATER TRENCH CROSS SECTION

SCALE: 3/4" = 1'-0"
ELEVATION WATERLINE/CULVERT CROSSING
NOT TO SCALE

4" OF POLYSTYRENE INSULATION
(LOCATED ALONG SIDES AND ON TOP OF PIPE)

CLASS 6 PER "TRENCH CROSS SECTION"

WATERLINE

INSULATION SECTION
NOT TO SCALE

CONTRACTOR TO DEFLECT JOINTS AS REQUIRED TO MAINTAIN 18" MIN. SEPARATION W/ NO ADDITIONAL HIGH POINTS OR LOW POINTS CREATED

STORM DRAIN

NEW WATERLINE

INSULATION FOR WATERLINE (SEE INSULATION SECTION BELOW)

ROADBASE

ASPHALT

4'-6" MIN.

4' MIN.

4' MIN.
CONDITION #1: NEW WATER MAIN BELOW EXIST. SEWER MAIN

CONDITION #2: NEW WATER MAIN LESS THAN 18" ABOVE EXIST. SEWER MAIN

NOTE: SEWER LINE TO BE CONSTRUCTED OF ONE FULL PIPE LENGTH (20' MINIMUM) OF C-900 PVC, OR 18" PIPE, CENTERED ON WATER LINE FOR PERPENDICULAR CROSSING. FOR SKEW CROSSINGS, USE C-900 PIPE UNTIL HORIZONTAL SEPARATION EXCEEDS 10'.

WATER/SEWER CROSSING DETAIL
NOT TO SCALE
Concrete Cut-Off Detail
Town of Granby
Detail W8
Cut-Off.dwg
SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01 SUMMARY.

A. Requirements. The Contractor shall submit to the Engineer for approval all submittals required by the Contract Documents. Submittal shall be submitted on form 01300-A.

B. Form 01300-A includes an area for the contractor to check that he has verified that the material or equipment meets the specification requirements or deviates from the specification for the reasons listed. A line also exists for the contractor to sign the submittal. If the areas are not checked or the submittal is unsigned, it will be returned disapproved.

C. The contractor shall review and approve all shop and layout drawings, product data, samples, materials, manuals and plans required to be submitted by the contract documents. Approval by the contractor dictates that he has verified all materials, field measurements with those shown on the drawings, and similar items. Approval also indicates that the contractor has coordinated information contained in the submittal with work requirements of all trades and with the contract documents. The contractor’s submissions to the Engineer shall be timely so as to not delay the work.

D. The contractor is required to submit three (3) hard copies or one (1) electronic copy of each submittal or re-submittal for approval. The Engineer will return two copies to the contractor. The Engineer may request up to an additional five copies of Manuals by notifying the contractor in writing and such copies will be at no extra cost.

1.02 SUBMITTAL CONTENT.

A. The submittal number shall be arranged as follows:
   1. The first character shall be a letter identifying “D” as a shop or layout drawing, “5” as a sample, “M” as a manual or miscellaneous, or “P” as a plan or schedule.
   2. The next 5 digits of the submittal number shall be the specification Section number.
   3. The next 3 digits shall be the numbers 001 through 999 to sequentially number each separate package submitted under each specific specification Section number.
   4. The last character shall be a letter A through Z indicating whether the submittal is the first submission (A) or a resubmission (B through Z). The letter “B” indicates a second submission, “C” a third submission, etc. An example of a submittal number would be D-03300-008-B, which indicates a shop drawing submittal pertaining to the concrete section that is the eighth submittal under this section and is the second submission of this particular shop drawing.

B. Submittals will be returned to the contractor marked either “NET’ which means that No Exceptions Taken, or the submission is approved, “MCN” which indicates Make Corrections Noted, and that the submittal is approved subject to incorporation of the comments shown on the submittal, “A&R” which is Amend and Resubmit, and “R” which is Rejected, or the submittal is disapproved for the reasons shown or listed and shall be resubmitted. One other notation may be shown as “N” which is Noted, for a submittal that does not require Engineer approval but will be placed in the project files.
C. Reviewed submittals will be returned to the contractor with the Engineer’s comments, if any. The Engineer’s review is for general conformance with the contract documents only and all work is still subject to the detailed requirements of the contract documents. The Engineer’s review is to help the contractor find or discover errors and omissions. The Engineer’s review does not relieve the contractor of the obligation and responsibility to coordinate and plan the details of the work and fulfill the intent and purpose of the contract. The Engineer’s review shall not relieve the contractor of the responsibility for accuracy, proper fit or proper functioning and performance of the work. The Engineer reserves the right to require written conformation from the contractor that the comments placed on submittals stamped “MCN” were actually or will be implemented. The Engineer will make every reasonable effort to process and return each submittal within 15 days after receipt in the Engineer’s office, but with the following qualifications:

1. Large or multiple submittals may require additional time.
2. Contractor may prioritize submittals and Engineer will review and return them in the order of highest priority.
3. If requested by the contractor, individual drawings from large submittals with numerous drawings may be returned as they are reviewed rather than waiting for the entire review to be completed.
4. The need for re-submissions or delays in obtaining the Engineer’s review or approval shall not entitle the contractor to a time extension for contract completion.

D. The contractor shall make all corrections and changes to submittals as required by the Engineer and resubmit until approved. The contractor shall review submittals returned by the Engineer and shall determine if changes requested by the Engineer result in extra cost. He shall notify the Engineer in writing within 5 days of receiving a returned submittal if the contractor believes extra costs will be incurred along with the reasons for such belief. Failure of the contractor to notify the Engineer of the extra costs, or if the contractor proceeds with the work, ordering materials, products or equipment or delivery to the site, waives the contractor claim for compensation.

E. Only the contractor shall make submissions to the Engineer. All data and correspondence prepared by subcontractor and suppliers shall be submitted through the contractor. The contractor shall prepare submittals with sufficient information, and in such a manner, that no more than two submittals are necessary to obtain the Engineer’s approval. If more than two submittals are required, the Owner reserves the right to deduct the cost of the Engineer’s time to review all additional re-submittals (after re-submittal number two) from moneys due the contractor.

F. The contract drawings are diagrammatic and show the general arrangement of the complete construction work. The contractor shall review the drawings and specifications and shall include any and all work required to provide a complete and operable facility. The contractor shall be responsible for preparing and submitting to the Engineer for review, all general arrangement drawings showing the interrelationships between civil construction and all mechanical, electrical and instrumentation equipment to be installed. Should there be a need to deviate from the contract drawings and specifications, the contractor shall submit written details, comparisons with the contract requirements, reasons for all changes, an explanations as to why the proposed change is equal or better than the contract requirement and any reduction or increase in cost for the change to the Engineer for approval before making such changes. All extra costs to make the changes to structures, electrical, mechanical, piping and other items associated with a change shall be borne by the contractor. In the event of varying interpretations of the contract documents, the Engineer’s interpretation shall govern.
1.03 REQUIRED SUBMITTALS

A. Submittal Schedule. The contractor shall submit to the Owner for approval a detailed schedule listing all submittals to the Owner. This schedule shall include, but is not limited to, shop drawings and related data; layout drawings; materials, equipment, and fixture lists; certificates of compliance; spare parts data; sample materials and equipment manuals; test procedure plan and test results. The schedule shall indicate the type of item, contract requirement reference; the contractor’s scheduled dates for submitting the above items and projected procurement dates. The contractor shall revise and resubmit schedules as necessary to the Owner for monitoring.

B. Shop Drawings. See Section 01340 – Shop Drawings.

C. Project Record Documents. See Section 01700 - Contract Closeout.

D. Schedule of Values. Refer to General Conditions for requirements. On bid items to be paid as lump sum that may extend beyond a single pay estimate, a schedule of values shall be submitted to OWNER a minimum of 10 days prior to work on that item. Adequate detail shall be given to allow a value to be placed on work completed during any given pay estimate. Where payment is to be based on unit bid prices, correlate schedule of values with Divisions and Sections of Specifications, unless otherwise approved by the Engineer. If separate payment is to be requested for materials suitably stored but not installed, paid invoices for the item shall be submitted.

E. Construction Schedule. See Section 01310 – Construction Schedule.

F. Progress Reports. During the performance of the work, the contractor shall submit to the Owner a written monthly progress report on or before the fifth of each month covering the previous month. Such progress reports shall include:
   1. A copy of the construction schedule outlining progress to date for the previous major items of work.
   2. A narrative summary indicating the status of work performed and other pertinent activities indicating the actual percentage of work completed and an estimate of the percentage of work to be completed in the succeeding month; problem areas and recommended solutions, and manpower hours used by trade. If the work has fallen behind schedule, the contractor shall state how the time is to be made up to remain on schedule. Include construction photographs.
   3. The progress report shall include a procurement and delivery schedule, listing items approved, ordered, delivered and installed, for equipment, products and materials.
   4. If a progress report is not submitted, the Owner reserves the right to withhold payment until delivered.

G. Traffic Control Plan. See Section 01570 - Traffic Control.


I. Certificates of Compliance. Certificates required for demonstrating proof of compliance with specification requirements, including mill certificates, shall be provided by the contractor. It shall be the contractor’s responsibility to review and approve all certificates before submissions are made to ensure compliance with the contract requirements. Each certificate shall be signed by an official authorized to certify on behalf of the manufacturing company and shall contain the name and address of the contractor, the project name and location and
the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the contractor from furnishing satisfactory material, if, the material is later found not to meet the specific requirements.

J. Manufacturer’s Certified Reports. Where the Contract Documents require an equipment manufacturer or his authorized representative to be present at installation and startup, such manufacturer shall submit a notarized written report with respect to his equipment certifying that 1) the equipment has been properly installed and lubricated under his supervision, 2) the equipment is in accurate alignment, 3) he was present when the equipment was placed in operation, 4) he has checked, inspected and adjusted the equipment as necessary, 5) the equipment is free from any undue stress imposed by connecting piping or anchor bolts, 6) has been operated under full load conditions and operated satisfactorily, 7) he has inspected the equipment during the operational demonstrations and system validation testing to the extent specified and 8) is fully covered under the terms of the guarantee.

K. Samples. After award of the contract, the contractor furnish for approval. Samples required by the specifications. The contractor shall prepay all shipping charges of samples. Materials, products or equipment for which samples are required shall not be used in the work until approved in writing. Each sample shall have a label or tag indicating:

- Name of project building or facility, project title and address.
- Name of contractor and, if appropriate, name of subcontractor.
- Identification of material, product or equipment with specification section.
- Place of origin.
- Name of producer and brand.
- Samples of finish materials shall have additional markings that will identify them in regard to installed location.

1. Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any contract requirement. Substitutions will not be permitted unless they are approved in writing.

2. Approved samples in good condition will be marked for identification and may be used in the work. Materials, products and equipment incorporated in the work shall match the approved samples. Other samples not destroyed or damaged in testing or not approved, will be returned to the contractor at his expense if so requested at time of submission.

3. Failure of any material to pass the specified tests will be sufficient cause for refusal to consider, under this contract agreement, any further samples of the same brand or make of that material. The Owner reserves the right to disapprove any material, product or equipment which has previously has proven unsatisfactory in service.

4. Samples of various materials, products or equipment delivered on the site or in place may be taken by the Owner for testing. Samples failing to meet contract requirements will automatically void previous approvals of the items tested. The contractor shall replace such materials, products or equipment found to have not met contract requirements, or there shall be proper adjustment of the contract price as determined by the Owner.

L. Miscellaneous Submissions.

1. Accident Reports shall be submitted in 3 copies as soon after the accident as possible.
2. The contractor shall submit an organization chart of his construction team for approval not later than 14 days after the beginning of mobilization or prior to any construction activity on the site. It shall show executive, administrative, and construction supervision broken into trades and crews shall include subcontractors and shall:
   a. Include all personnel from Ownership through Project Manager to foreman level and designate the extent of authority and responsibility and those who can receive field orders, sign documents, etc.
   b. Describe personnel duties.
   c. Provide qualifications and experience of those not included in prequalification documents.
   d. Contractor shall update the organization chart whenever key people are changed. The Engineer may interview any of the contractor's proposed staff prior to approval.

3. Insurance Certificates. Refer to General Conditions and Supplemental General Conditions for submittal requirements. Submit updated certificates as necessary to verify current coverage.

   END OF SECTION
01300-A SUBMITTAL TRANSMITTAL FORM
(This form to be enclosed with ALL Submittals)

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<td>CONTRACTOR:</td>
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We are sending you:  
- _____ Attached
- _____ Under separate cover via ____________________________
- _____ Submittals for review and comment
- _____ Product data for information only

Remarks:

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(1) **Note:** NET=No exceptions taken; MCN=Make corrections noted; A&R=Amend & resubmit; R=Rejected, Develop Replacement

Attach additional sheets if necessary.

**Contractor**

Certify either A or B:

- _____ A  We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).
- _____ B  We have verified that the material or equipment contained in this submittal meets all the requirements specified, except for the attached revisions.

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Certified by: _____________________________ Date: ____________________

Contractor's Signature
PART 1 GENERAL

1.01 SUMMARY.

A. Within ten (10) days after EFFECTIVE DATE OF AGREEMENT or by the pre-construction conference, the Contractor shall submit a Critical Path Project Schedule covering the duration of the project, beginning with the Notice to Proceed and indicating Substantial Completion and “Contract Completion”. The purpose of the Project Schedule shall be to:
   1. Assure adequate planning, scheduling and reporting during the execution of the Work by the Contractor.
   2. Assure coordination of the Work of the Contractor and various Subcontractors at all tiers.
   3. Establish a critical path for the completion of the Work to assist the Contractor, Owner, and Engineer in monitoring the progress of the Work and evaluating proposed changes to the Contract Duration and the Project Schedules resulting from changes in the Work and/or potential weather delays.
   4. Assist in the coordination of construction activities so as to complete the Work within the Contract Time.

B. The Project Schedule shall be based upon the Critical Path Method (CPM) for planning, scheduling and progress reporting of the Work.

C. The Project Schedule shall include a graphic network prepared by the Contractor. The Contractor shall transmit all schedule submissions to the Owner or his representative as both a printed or plotted pure logic diagram and a bar chart with an accompanying computer disk of the schedule. The computer disk shall be in a file format published by Primavera Project Planner (Windows versions), Primavera Suretrack, or Microsoft Project.

D. The Contractor shall provide a Network, which shall be a reasonable representation of how the Work is planned to be performed and shall be used to monitor the progress of the work of the Contract. All costs associated with the development and maintenance of the schedule shall be borne by the Contractor.

1.02 SCHEDULING.

The Contractor shall submit a preliminary Project Schedule as stated above. The Owner or his representative shall review the preliminary Project Schedule and return comments to the Contractor within ten (10) working days after receipt. The Contractor then shall have five (5) working days to review the schedule and return it to the Owner or his representative for review. The five (5) working day review and review cycles shall continue until an acceptable schedule is received by the Owner. The owner's review of the project schedule is for compliance with this article and other contractor requirements. Acceptance by the owner of the contractor's project schedules does not relieve the contractor of any of his responsibility whatsoever for the accuracy or feasibility of the project schedule, or of the contractor's ability to meet the contract completion date, nor does such acceptance expressly or impliedly warrant, acknowledge or admit the reasonableness of the activities, logic, duration or, when
Section 01310 – Construction Schedules

An approved schedule shall be required prior to submission of the first progress payment in accordance with the Contract Documents. The following guidelines must be met:

1. The Project Schedule shall contain a sufficient number of activities to allow effective monitoring of the progress of the work.
2. Each activity shall contain only the work of a single trade or subcontractor.
3. Each activity shall be less than fifteen (15) working days in duration. Procurement and material delivery, surveying and shop drawing approvals may exceed fifteen (15) working days in duration. Activities exceeding fifteen (15) working days in duration shall be separated into two or more individual activities of less than sixteen (16) working days by area, type of work, etc. to allow for effective monitoring of the Work.
4. Each activity shall include a description of the work, original duration, contractor or subcontractor performing the work, the equipment and manpower required to do the work, all specific area, phasing or milestone classifications and the activity’s relationship to other activities (contained in the Methods Statement).
5. The Project Schedule shall begin with the Notice to Proceed and end with Contract completion activities. A critical path (zero float path) through Contract completion must be generated.
6. Normally anticipated weather conditions shall be included in the Project Schedule.
7. Anticipated utility relocation activities must be shown in the schedule as they affect the contractor’s activities.
8. Failure by the Contractor to include any element of work required for performance of the Contract shall not excuse the Contractor from completing all work within the Contract Time.
9. Work times shall be included showing number of days per week, shifts per day and hours per shift.
10. The Project Schedule shall contain activities for the anticipated submittal cycle of equipment or materials that could affect timely completion of the project.
11. The schedule shall include activities for anticipated procurement and delivery of material or equipment with lead times greater than three (3) weeks.
12. The progress schedule shall include all activities for all work on the project, including subcontracted work, delivery dates for critical material, submittal and review periods, milestone requirements and no work periods. Where the project has specific phases, each phase shall be described separately for each salient feature.

1.03 METHODS STATEMENT.

A. A Methods Statement shall be included for all work items that fall on the critical path of the construction schedule. This Methods Statement shall be a detailed narrative describing each feature and all work necessary to complete the feature. The Methods Statement shall be submitted with the Construction Schedule. The following format is required.
1. Feature: name of the feature.
2. Responsibility: Contractor, subcontractor, supplier, utility, etc. responsible of the feature.
3. Procedures: procedures to be used to complete the work. The procedure to be used shall include general information regarding methods such as forming, excavation, placing, heating, curing, backfill and embankment, trenching, protecting the work, etc. When separate or different procedures are to be employed by the Contractor due to seasonal or project phasing requirements, such differing procedures shall be described in the procedure statement.
4. Production Rates: the planned quantity of work per day for each feature.
5. Labor Force: the labor force planned to do the work.
6. Equipment: the number, types, and capacities of equipment planned to do the work.

7. Work Times: the planned time for the work to include:
   a. Number of work days per week.
   b. Number of shifts per day.
   c. Number of hours per shift.

B. At the Owner’s request, the Contractor shall update the Methods Statement, or any part thereof, and submit it with the next monthly schedule update.

1.04 PROJECT SCHEDULE UPDATES.

A. The Project Schedule updating shall be done on a monthly basis. The revision shall indicate actual progress to date, changes resulting from change orders, and planned changes necessary to complete the Work in accordance with the Contract Documents.

B. Should the Project Schedule update indicate that the project is more than ten (10) days behind schedule it shall be revised to indicate the means which the Contractor shall use to regain the Contract Completion Date.

C. Updating the Project Schedule to reflect actual progress made up to the date of a schedule update shall not be considered revisions to the Project Schedule.

D. Failure by the Contractor to update the schedule shall result in a material breach of contract and will also result in the withholding of progress payments until an acceptable update is submitted by the Contractor and accepted by the Owner.

1.05 TIME IMPACT ANALYSIS FOR CHANGE ORDERS, DELAYS & CONTRACTOR REQUESTS.

A. When Change Orders are initiated or delays are experienced a Time Impact Analysis shall be completed to determine the effect on the Contract Completion Date. The durations of effected activities shall be altered as mutually agreed upon and the schedule recalculated. The Contract Completion Date will not be extended unless the schedule recalculation indicates a completion date beyond the current Contract Completion Date. A delay must impact the critical path of the Project Schedule as a condition to extending the Contract Completion Date.

B. Delays caused by weather shall be reviewed at the monthly update meetings. Seasonal weather conditions shall be considered and included in the planning and scheduling of all work influenced by high or low ambient temperatures, wind, and/or precipitation to ensure completion of all work within the Contract Time. Seasonal weather conditions shall be determined by an assessment of average historical climatic conditions.

C. Float is not for the exclusive use or benefit of either the Owner or the Contractor. Extension of the Contract Time will be granted only to the extent the equitable time adjustments to the activity or activities affected by the Change Order or delay exceeds the total (positive or zero) float of a critical activity (or path) and extends the Contract Time as set forth in the Contract.
1.06 SUBMITTALS

A. The number of opaque reproductions required by the CONTRACTOR plus four (4) copies which will be retained or distributed by the OWNER/ENGINEER.
   1. Do not submit fewer than five (5) copies.

B. Distribution.
   1. After review, ENGINEER will distribute copies of schedules to:
      a. Two (2) copies to OWNER.
      b. One (1) copy to Resident Project Representative.
      c. One (1) copy to be retained in ENGINEER's file.
      d. One (1) copy to CONTRACTOR to be kept on file at CONTRACTOR's field office.
      e. Remainder to CONTRACTOR for his distribution following modifications if required.

C. Schedule recipients will report promptly to ENGINEER and CONTRACTOR, in writing, any problems anticipated by the projections shown on the schedules.

END OF SECTION
SECTION 01320

PRODUCT DELIVERY, STORAGE AND HANDLING

PART 1 GENERAL

1.01 RELATED REQUIREMENTS
   A. General and Supplementary Conditions

1.02 PRODUCTS
   A. Products include material, equipment and systems.
   B. Comply with Specifications and referenced standards as minimum requirements.

1.03 TRANSPORTATION AND HANDLING
   A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer’s unopened containers or packaging, dry.
   B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.
   C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

1.04 STORAGE AND PROTECTION
   A. Store products in accordance with manufacturer’s instructions, with seals and labels intact and legible. Store sensitive products in weathertight enclosures; maintain within temperature and humidity ranges required by manufacturer’s instructions.
   B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
   C. Store loose granular materials on solid surfaces in a well drained area; prevent mixing with foreign matter.
   D. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.

END OF SECTION
SECTION 01340
SHOP DRAWINGS

PART 1    GENERAL

1.01 REQUIREMENTS INCLUDED

The CONTRACTOR shall submit to the ENGINEER for approval all shop drawings required by the specification sections.

1.02 SHOP DRAWINGS

A. Shop drawings shall be prepared by a qualified detailer for CONTRACTOR, subcontractor, supplier, or manufacturer, and shall illustrate some portion of the work, showing fabrication, layout, setting, or erection details.

B. Identify details by reference to sheet and detail numbers shown on Contract Drawings. Use same symbols used on Contract Drawings to identify shop drawing details wherever practicable.

1.03 PRODUCT DATA

A. Submit manufacturer's standard schematic drawings:
   1. Modify drawings to delete information that is not applicable to the project.
   2. Supplement standard information to provide additional information applicable to project.

B. Submit manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other standard descriptive data.
   1. Clearly mark each copy to identify pertinent materials, products or models.
   2. Show dimensions and clearances required, performance characteristics and capabilities, wiring diagrams and controls, and any other pertinent data applicable to the project.

C. Submit manufacturer's certificate of compliance certifying to compliance with specification requirements, applicable reference standards and test data requirements. Include reference to the specification section and paragraph with which the product or materials is intended to comply.

1.04 CONTRACTOR RESPONSIBILITIES

A. CONTRACTOR shall submit a minimum of five (5) copies of each shop drawing required. Certain materials and equipment may require more than the minimum of five (5) sets of shop drawings, contact ENGINEER for applicable sections.

B. Submittals shall be made by CONTRACTOR to the ENGINEER with a transmittal form or letter and not by subcontractors, suppliers or manufacturers. CONTRACTOR shall review, stamp with his approval, and submit in orderly sequence all submittals required by the specifications. By approving and submitting items, CONTRACTOR represents that he has
verified all field measurements, field construction criteria, materials, catalog numbers, and similar data, and has coordinated each shop drawing with requirements of the project.

C. The CONTRACTOR shall not begin work that requires submittals until the ENGINEER reviews and approves submittals. The ENGINEER will return an approved copy of the submittal to the CONTRACTOR.

D. CONTRACTOR's responsibility for errors and omissions in submittals, or for deviations in submittals from requirements of the Contract Documents, shall not be relieved by review of submittals unless ENGINEER gives written acceptance of specific deviations. The CONTRACTOR shall notify ENGINEER in writing at time of submission of deviations in submittals from requirements of the Contract Documents.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

This work shall consist of furnishing, installing, moving, maintaining and removing temporary traffic signs, advance warning signs, barricades, channelizing devices, delineators, and flagmen as required by the latest revision of the “Manual on Uniform Traffic Control Devices for Streets and Highways” and the latest revisions of the Colorado Supplement thereto, in accordance with the Drawings and these Specifications.

1.02 REFERENCE STANDARDS.

A. Federal Highway Administration; Manual on Uniform Traffic Control Devices.

B. Colorado Department of Transportation, Standard Specifications for Road and Bridge Construction, current version; Subsection 107.10 and Section 630.


1.03 SUBMITTALS

A. Review, by Engineer or Owner, of the Contractor’s Traffic Control Plan (TCP) and Methods of Handling Traffic (MHT’s) in no way limits or removes from the Contractor the full responsibility for the safe and effective handling of traffic both vehicular and pedestrian through or around the project.

B. Traffic Control Plan. Traffic control, both vehicular and pedestrian, through the construction area is the responsibility of the Contractor. The Contractor shall prepare a Traffic Control Plan (TCP) to be submitted with the return of the signed agreement. The TCP shall include a schedule of traffic control devices to be used on the project, general layout of devices, situations that may require use of flaggers and/or pilot cars, and methods of notifying public of impending traffic changes. The Engineer or Owner will review the TCP for general coordination of the project.

C. Methods of Handling Traffic (MHT). The Contractor shall control traffic in accordance with the Traffic Control Plan (TCP). To implement the TCP, the Contractor shall develop and submit a method for handling traffic (MHT) for each different phase of construction, which shows the Contractor’s proposed construction phasing and proposed traffic control devices consistent with the TCP. If at any time the Contractor desires to change the MHT, it shall be considered a different phase requiring a new MHT.

D. Each MHT shall be submitted to the Engineer/Owner before the corresponding phase of construction will be allowed to begin. The initial MHT shall be submitted a minimum of 10 days prior to the start of work on the project. All successive MHT’s shall be submitted to allow reasonable time for review. MHT’s for work in CDOT rights-of-ways shall be submitted a minimum of thirty (30) days prior to commencement of related work.
E. The proposed MHT shall include detailed information as contained in Section 630.09 of the CDOT Standard Specifications.

F. The Contractor shall continually review their methods of handling traffic. If revisions are needed for the safe movement of traffic through or around the work areas, the Contractor shall implement the revisions immediately. The Contractor shall notify the Engineer/Owner of all changes made.

PART 2 PRODUCTS

2.01 GENERAL

All materials shall conform to the applicable portions of the Reference Standards.

2.02 BARRICADES

Minimum 8' wide on movable skids.

2.03 DETOURS

As required by the project.

2.04 ROAD RESTRICTIONS

As required by the project.

2.05 FLAGMEN

Certified flaggers only. Provide as needed, as directed by Engineer or as stated on Drawings to control traffic encroaching in construction zone.

2.06 BARRICADES, CHANNELIZING DEVICES, FLASHING WARNING LIGHTS

Provide for all work areas, open trenches, lane closures, equipment and material storage, etc., and as called for on the Drawings and located within limits of construction. Protection to be in place 24 hours per day and device inspection shall be seven days per week.

2.07 TRAFFIC CONTROL MANAGEMENT

Provided by a certified traffic control supervisor on a 24-hours-per-day basis. An after hours contact shall be provided for every calendar day from the first placement of traffic control devices until all devices are removed. Any changes to this contact shall be submitted to the Engineer and to Dispatch Services.

END OF SECTION
SECTION 01700

PRODUCT ACCEPTANCE

PART 1    GENERAL

1.01   SCOPE

   A. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to provide all documents, information and items as specified herein.

1.02   PROJECT RECORD DOCUMENTS.

   A. Job site documents: Maintain at the job site one record copy of the following:

       1. Drawings
       2. Specifications
       3. Addenda
       4. Reviewed Shop Drawings
       5. Change Orders
       6. Other Modifications to Contract
       7. Field Test Records

       Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.

   B. Record Information: Label each document "Record Document". Mark all information with contrasting color using ink. Keep each record current. Do not permanently conceal any work until required information is recorded.

       Record following information on Drawings:

       1. Depth of foundation elements.
       2. Horizontal and vertical location of underground utilities.
       3. Location of internal utilities and appurtenances concealed in construction.
       4. Field changes of dimension and detail.
       5. Changes by Change Order or field order.
       6. Details not on original Contract Drawings.

       Record following information on Specifications:

       1. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed.
       2. Changes by change order or field order.
       3. Other matters not originally specified.

       Maintain Shop Drawings as record documents recording changes made after review as specified for Drawings above.
Submittal: At completion of project, deliver record documents to Engineer with transmittal letter containing date, project title and number, contractor's name and address, title and number of each record document, and certification that each document is complete and accurate. Submittal shall be signed by Contractor or his authorized representative.

1.03 CLOSEOUT PROCEDURES

The following project closeout procedure defines the responsibilities of the Contractor, Owner and Engineer in closing the project:

Step 1: Contractor advises Engineer in writing that he has reached "Substantial Completion" and provides a list of items to be completed or corrected. Closeout may be conducted by areas or portions of the work if requested by Owner.

Step 2: Engineer inspects the work to determine if it is substantially complete, and issues a Certification of Substantial Completion plus a "punch list" of items to be completed or corrected.

Step 3: Contractor completes and/or corrects all punch list items and notifies in writing that his work is ready for final inspection. At this time, a final application for payment is submitted to the Engineer.

Step 4: Engineer makes final inspection. When the Work is found to be acceptable under the Contract Documents, and the contract fully performed, Engineer will issue a final Certificate of Payment.

1.04 RE-INSPECTION FEES

Should the Contractor fail to complete and/or correct all punch list items such that additional inspections are required by the Engineer, the Contractor will be billed at the Engineer's current rate for additional services. If the Contractor has any question with regard to any items on the punch list, he is to request clarification before final inspection.

1.05 FINAL PAPERWORK

Prior to release of final payment, the General Contractor shall deliver the following items to the Engineer:

1. Inspection Certificates, as applicable.
3. Equipment and material guarantees.
4. General Contractor's two-year guarantee of materials and workmanship.
5. Maintenance Manuals and Parts Lists, as specified.
6. All other guarantees, warranties and submittals, as specified.
7. Receipts for extra materials delivered to the Owner.
8. Miscellaneous keys, switches, etc.
10. Consent of surety to final payment.
12. Project record drawings.
13. Contractor acknowledgement of Date of Substantial Completion.
14. All documentation as required for federally funded projects or as contained herein.

The above items are described in following articles or applicable sections of the Specifications.

1.06 Inspection Certificates. Each subcontractor shall, upon completion of the Work, secure in triplicate from any state or local governing bodies having jurisdiction in dictating that the Work is in strict accordance with the applicable codes and deliver same to the General Contractor for transmittal to the Owner.

1.07 Certificates of Compliance. Provide certificates of compliance for materials and products incorporated into the project. Each certificate shall include:

1. The Engineer’s project number
2. A complete description of the material.
3. The manufacturer’s name.
4. The name of the product or assembly.
5. The model, catalog, of stock number if applicable.
6. A lot, heat, or batch number that identifies the material delivered.
7. A statement that the product or assembly to be incorporated into the project was fabricated in accordance with and meets the applicable specifications.

1.08 Warranties. The General Contractor and each subcontractor shall remedy any defects due to faulty materials or workmanship and pay for any damage to other Work resulting therefrom, which shall appear in his Work within a period of two-year from the date of Notice of Acceptance and in accordance with the terms of any special warranties provided in the Contract. The Owner shall give notice of observed defects with reasonable promptness. A complete warranty inspection will be scheduled at approximately one (1) year, eleven (11) months.

Upon completion of his Work, the General Contractor shall deliver to the Engineer in duplicate, a written warranty based on the provision of the Article properly signed and notarized. Warranty shall be address to the Owner. Provide separate written warranties from mechanical and electrical contractors.

1.09 Miscellaneous Keys and Wrenches. At the completion of the project, all adjustment wrenches and keys of electric switches, electrical panels, etc., shall be accounted for and turned over to the General Contractor for transmittal to the Owner.

END OF SECTION
SECTION 02101
REMOVAL OF STRUCTURES AND OBSTRUCTIONS

PART 1 GENERAL

1.01 SUMMARY

A. This Work shall consist of furnishing all labor, equipment, materials and miscellaneous items for the removal and satisfactory disposal or abandonment in place of all fences, signs, structures, old pavements, roads, sidewalks, retaining walls and any other obstructions. It shall also include salvaging of designated materials and backfilling the resulting trenches, holes, and pits.

B. This Work shall include sawing concrete and asphalt in reasonably close conformity with the dimensions of these Specifications to create lines of weakness in order to facilitate controlled breaking for removal.

1.02 SUBMITTALS

A. Copies of written agreements for disposal areas will be given to the Engineer before work begins.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 GENERAL

A. Contractor shall meet with Owner to determine which items are to be removed and which are to be salvaged. The Contractor shall remove and dispose of all signs, structures, fences, old pavements, abandoned pipelines, and other obstructions. All salvageable materials noted shall be removed, without unnecessary damage, in sections or pieces that may be easily transported and stored.

3.02 DISPOSAL

A. It is the contractor's responsibility to dispose of all materials that are not deemed salvageable.

B. Where portions of structures are to be removed, the remaining portions shall be prepared to fit new construction. The work shall be done in accordance with Drawings, and in such manner that materials to be left in place shall be protected from damage; all damage to portions of structures to remain in place shall be repaired by the Contractor at his expense. Reinforcing steel projecting from the remaining structure shall be cleaned and aligned to provide bond with new extension.
3.03 SALVAGE

A. Salvage all items shown on the Drawings. During demolition, Owner or his representatives may designate additional materials to be salvaged rather than disposed. All salvage materials shall be removed from the job site by the Contractor and stored at a site to be designated by the Owner.

3.04 PIPE TO BE LEFT IN PLACE

A. All metal pipe and metal culverts directed to be left in place shall have the ends crushed and crimped back where possible. The ends of all masonry and plastic pipe products shall be completely back-filled with concrete or grout a minimum of 18" or one pipe diameter, whichever is greater. All headwalls and appurtenances shall be removed. Where shown on the Drawings, pipe shall be backfilled their full length.

3.05 SAWING OF CONCRETE

A. The sawing of concrete shall be done carefully, and all damages to concrete remaining in place, due to Contractor's operations, shall be repaired by the Contractor at his expense and as directed by Project Engineer. An effective dust control method must be utilized throughout concrete sawing operations. The minimum depth of saw cut in concrete shall be two (2) inches or to the depth of the reinforced steel, whichever occurs first, unless otherwise designated.

3.06 SAFETY

A. Operations that may damage or constitute a hazard to the traveling public will not be permitted. Contract shall abide by OSHA standards.

3.07 REMOVAL OF CULVERTS AND OTHER DRAINAGE STRUCTURES

A. Culverts and other drainage structures in areas under traffic use shall not be removed until satisfactory arrangements have been made to accommodate traffic.

B. Where portions of existing structures lie wholly or in part within the limits of a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

3.08 REMOVAL OF PIPE

A. Pipes indicated on the Drawings to be removed for salvage and reuse shall be carefully removed, cleaned and every precaution taken to avoid damage to the pipe. Removal of pipe shall include all appurtenances. Pipe to be salvaged shall be taken to the Owner's designated storage yard; pipe to be re-laid shall be stored by the Contractor so that no damage to pipe will occur. The Contractor shall replace, at his expense, all pipe lost or damaged due to negligence, improper storage or improper construction techniques.
3.09 REMOVAL OF PAVEMENT, SIDEWALKS, CURBS, ETC.

A. All concrete pavement, sidewalks, curbs, gutters, etc., designated for removal, shall be broken into pieces, the size of which shall not exceed approximately 400 pounds or 3 square yards of surface area, and shall be disposed of off site by Contractor or otherwise directed by Project Engineer.

B. Where old concrete construction abuts new concrete construction, edges of pavement sidewalks, curbs, etc., to be left in place shall be sawn to a true line with a vertical face (see sawing of concrete).

C. Asphalt and bituminous pavements to be cut to the full depth of pavement with a vertical face in a straight line parallel to the limit of excavation. Cuts shall be made with flat bladed air hammer or saw, or as approved in writing by Engineer, so as to provide a straight, true cut. Concrete pavements, including curbs, gutters and sidewalks, to be saw cut to the full depth of pavement with a vertical face in a straight line parallel to the limit of excavation. An effective method of dust control shall be utilized throughout concrete sawing operations.

D. Feathering of new asphalt pavements onto old pavements will not be permitted under this Contract.

3.10 ABANDONMENT OF MANHOLES, CATCH BASINS, INLETS, ETC.

A. Remove all portions of structure to 12 inches below finish grade. Fill all voids with concrete or Class 1 Structure Backfill (95% Standard Proctor density). Backfill to surface with concrete, Class 6 aggregate and/or bituminous asphalt or topsoil to match final surface treatment.

END OF SECTION
SECTION 02140
DEWATERING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Design and installation of a dewatering system to protect excavation from subsurface water and to allow construction of foundations and damp-proofing of new construction in dry conditions.

2. Information pertinent to determining the possible extent of construction dewatering is shown on civil drawings and described in soils reports and letters. Discharge of groundwater is subject to conformance with the approved Stormwater Discharge Permit issued by CDPHE.

3. The Contractor is responsible for obtaining and maintaining a Construction Dewatering and Stormwater Discharge permit from the State.

1.02 SYSTEM DESCRIPTION

A. Design Criteria: Dewatering Contractor shall be solely responsible for design and installation of a dewatering system capable of allowing construction of all work located inside the excavation support system in dry conditions.

1. Dewatering system shall consist of a series of well points or dry wells located outside the excavation support system. Use of other systems and methods may be used with prior written approval by the Engineer in consideration of prevailing site conditions.

2. Comply with requirements of soil and foundation investigation.

3. Dewatering system must be compatible with construction procedures and acceptable to the Engineer, Geotechnical Engineer and Owner.

4. Dewatering system to comply with Construction Dewatering and Stormwater Discharge Permit.

B. Maintenance: After installation, the dewatering system shall be continuously maintained by the Contractor until completion of foundation backfill.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Contractor shall obtain and pay for all required permits.

1.05 PROJECT CONDITIONS
A. Test Holes: A test hole was made for Owner by a separate geotechnical consultant. Log and report are believed to be accurate; however, neither Owner nor Engineer guarantees information contained therein nor do they prevail at other locations on site. Contractor may at his own expense, conduct additional geotechnical investigations. For access to the site, contact the Owner.

B. Existing Utilities: Locate all existing utilities prior to drilling. Contractor shall pay for any damage to utilities caused by dewatering.

PART 2 PRODUCTS

2.01 MATERIALS

A. Dewatering System: Provide all necessary materials for installation and complete operation of dewatering system. Provide spare pumps, hoses, etc. as required. All pumps shall be new and in good working condition at the time of installation.

PART 3 EXECUTION

3.01 Examination

A. Existing Conditions: Examine existing conditions to determine dewatering requirements.

3.02 Protection

A. Take all necessary precautions and make provisions to protect adjacent existing improvements from damage from dewatering operations.

3.03 Installation

A. Design and install systems as required. Furnish stand-by equipment of sufficient size and capacity to insure continuous operation of the system. Remove all pumps and piping upon completion of foundation backfill. Fill all well casings with gravel and cut off casing below level of final grading.

3.04 Field Quality Control

A. Make periodic inspections and verify that the system is maintaining a dry excavation.

3.05 Damage to foundations

A. Any damage or settlement to the installed foundations or other work by the failure or operation of the dewatering system shall be repaired by the Contractor at no cost to the Owner.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all clearing and grubbing, excavation, backfilling, compacting, testing and related work not specified elsewhere, as shown on the Drawings and required by the Specifications.

B. All work within the rights-of-way of the Federal Government, the Colorado Division of Highways, County Governments or Municipal Governments shall be completed in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor’s responsibility to secure all required permits and pay all costs thereof to complete work in accordance with specifications.

1.02 REFERENCE STANDARDS


1.03 SUBMITTALS

A. The Contractor shall prepare and submit information for all imported fill material.

1.04 FIELD CONDITIONS

A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate, only, and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction limits.

1. Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.

2. In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.

3. The Contractor shall make arrangements for and pay all costs for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation. The Owner shall pay the costs for such relocation.
B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged as a result of this work shall be restored to original condition or better, as determined by the Engineer.

1. Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater that will be encountered within the limits of construction.

1.05 PROTECTION OF WORK

A. Safety. All excavations shall be protected by barricades, lights, signs, etc. as required by governing federal, state and local safety codes and regulations.

B. Sheeting, shoring and bracing. Except where banks are cut back on a stable slope, provide and maintain sheeting, shoring and bracing systems necessary to protect adjoining grades and structures from caving, sliding, erosion or other damage, and suitable forms of protection against bodily injury, all in accordance with applicable codes and governing authorities.

1. Remove sheeting and shoring systems as excavations are backfilled in a manner to protect the construction or other structures, utilities or property. Do not remove any sheeting after backfilling.

2. Sheet and shoring systems shall be structurally designed and sufficiently braced to provide necessary restraining of retained backfill. Prior to installation of such systems, methods of installation and materials proposed shall be discussed with and approved by Engineer. All systems shall be in strict compliance with local, state and federal safety regulations. Contractor is solely liable for non-compliance.

C. Site Drainage. Excavation to be protected from surface water drainage at all times. At no time shall excavated area be allowed to fill with storm water runoff. Contractor shall provide proper, temporary drainage structures at his cost to detour runoff from excavated areas.

1.06 BLASTING

A. No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris.

B. Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by Engineer prior to any blasting. All
damage as the result of blasting shall be repaired, at the Contractor’s expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

1.07 CONSTRUCTION IN STREETS

A. When construction operations are located within streets, make provisions at cross streets and walks for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval. Pedestrian routing plans shall be shown on Traffic Control Plans.

PART 2 PRODUCTS

A. All materials for construction fills and backfills shall meet specified requirements for gradation and other factors defining suitability for the intended use. All classes of suitable material shall be free from perishable matter, debris, frozen material and stones and/or cemented pieces larger than permitted by the specified gradation. Classification of materials shall be as follows:

2.01 EXCAVATION

A. Excavation shall consist of the excavation of all materials of whatever character required for the Work, obtained within the right-of-way, including surface boulders and excavation for ditches and channels not being removed under some other item.

2.02 MATERIALS FOR EMBANKMENT

A. Embankment material shall consist of approved material acquired from excavations, hauled and placed in embankments in reasonably close conformity with the line, grades, thicknesses and typical cross sections shown on the plans or as designated.

B. When source of embankment material is not designated on the plans, approval of the source will be contingent on the material having a resistance value of at least that shown on the plans, when tested by the Hveem Stabilometer, and a maximum dry density of not less than 90 pounds per cubic foot.

C. Contractor may incorporate cobbles or rock fragments < 24" into non-structural fill areas as approved by Town. Adequate care shall be taken to achieve proper compaction and avoid nesting and associated voids.

2.03 TOPSOIL

A. Topsoil shall consist of selectively excavated, loose, friable loam reasonably free of admixtures of sub-soil, refuse, stumps, roots, rocks, brush, weeds or other material which would be detrimental to the proper development of vegetative growth; topsoil to be free of any stone or rock greater than 3" in size.
PART 3 EXECUTION

3.01 CLEARING AND GRUBBING

A. Preservation of Existing Conditions:
The Engineer will establish right-of-way lines and construction lines and Owner shall designate all trees, shrubs, plants and other things to remain. The Contractor shall preserve all things designated to remain. Paint required for cut or scarred surfaces of trees or shrubs selected for retention shall be an approved asphaltum base paint prepared especially for tree surgery.

B. Clearing and Grubbing:
Clear and/or grub all surface objects and all trees, stumps, roots and other protruding obstructions, not designated to remain, including existing pavement, as required, except undisturbed stumps and roots and non-perishable solid objects which will be a minimum of two feet below subgrade or slope embankment. Outside cut or fill limits, but within construction limits, stumps may be left at finish grade if allowed by Engineer.

1. Except in areas to be excavated, backfill stump holes and other holes from which obstructions are removed, with embankment material and compacted in accordance with Section 3.05.

C. Disposal:
If perishable material is burned, burn under the constant care of competent watchmen at such times and in such a manner that the surrounding vegetation, the other adjacent property or anything designated to remain within the right-of-way, will not be jeopardized. Burning shall be done in accordance with the obtained burn permit and applicable laws and ordinances.

1. When permitted, materials and debris which cannot be burned and perishable materials may be removed from the site and disposed of at approved locations off the project. The Contractor shall make all necessary arrangements with property owners for obtaining suitable disposal locations and the cost involved shall be included in the unit price bid.

2. All merchantable timber in the clearing area, which has not been removed from the right-of-way prior to the beginning of construction, shall become the property of the Contractor, unless otherwise specified.

D. Scalping:
Scalp areas where excavation or embankment is to be made. Scalping shall include the removal of material such as brush, roots, sod, grass, residue or agricultural crops, sawdust, and other vegetable matter from the surface of the ground.

E. Hedges:
Hedges shall be pulled or grubbed in such a manner as to assure complete and permanent removal. Scattered hedge or shrubs not classified as hedge shall be removed as specified for hedge.
F. Topsoil:
Strip topsoil from all areas to be disturbed by construction. Topsoil to be stockpiled separately from excavated materials.

3.02 CONSTRUCTION REQUIREMENTS

A. The excavation and embankments required shall be finished to smooth and uniform surfaces. Materials shall not be wasted without permission of the Engineer. The Engineer reserves the right to change grade lines, cut slopes or fill lines during the progress of the Work.

3.03 EXCAVATION

A. Material outside of the limits of excavation will not be disturbed. Prior to beginning excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these Specifications. The Contractor shall not excavate beyond the dimensions and elevations established. Common excavation shall include all materials of whatever nature encountered in the work for construction of excavations to the lines and grades called for on the Drawings. Structure excavation shall include all earthwork required for the construction of structures to the lines and grades called for on the Drawings. If any areas are inadvertently over-excavated, fill such over-excavation with embankment material and compact in accordance with Section 3.05.

1. Tolerances. In those areas upon which a subbase material is required, upon which finished landscaping improvements, including sod or lawn seeding, or upon which a structure is to be constructed directly, deviation of not more than 1 inch shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 1 inch at any point.

   a. In those areas upon which a base course material is required, deviation of not more than 0.04 foot shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 0.04 foot at any point.

   b. In those areas where no additional construction, other than topsoil addition and native seeding will occur, the finished surface shall be smooth and shall not deviate from grade by more than 0.5 foot at any point.

2. Groundwater Control. Contractor to maintain facilities on site to remove all groundwater from excavated area and keep water below the bottom of the excavation to a point such that a firm base for equipment or concrete installation exists. Facilities shall be maintained until all backfilling is in place at least 24 inches above anticipated water levels before groundwater removal. All water removal shall be subject to approval by the Engineer.

   a. Removal of water by well point, sump or trench diversions, intermittent pumping, or sump with submersible pumps is
3. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters.

   a. Backfill material to be segregated from stock piled topsoil and unusable backfill materials.

4. Over-excavation. Whenever the site is over-excavated more than 0.1' to eliminate point bearing by rocks or stones beneath proposed structures, unsuitable materials or when grade tolerances are exceeded, the Contractor is to re-establish grade using Class 1 Backfill (CDOT Section 703.08 - Class 1). Compaction shall be to 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.

5. Unstable Materials. Materials which are not capable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, then a contract price for Unstable Soil Excavation shall be negotiated between Owner & Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.

   a. Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.

6. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards or solid or fractured rock, which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor had in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for Rock Excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.

   a. Rock shall be removed to a 4" depth below grade. In addition, all rock loosened during jacking, blasting, etc. shall be removed and
stored on site. For payment purposes, maximum depth to be paid for shall be 12" below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, D. Inclusion of a bid item for Rock Excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavation; no payment shall be made for excavation prior to notification.

7. Disposal of Excess Excavation. Contractor to dispose of excess excavation off-site or on-site as approved by Town. Disposal in any case shall be the sole responsibility of the Contractor.

3.04 EMBANKMENT AND BACKFILLING

A. Do not begin embankments until construction below grade has been approved, underground utility systems have been inspected, tested and approved and trash and debris have been cleaned from the excavation.

B. Place approved excavated material in successive uniform maximum loose layers not exceeding 8 inches for the full width of the cross-section in all accessible areas. Place material in successive uniform loose layers not exceeding 4 inches in areas not accessible or permitted for the use of self propelled rollers or vibrators. Do not place fill on muddy or frozen subgrade, or until subgrade is approved by the Engineer.

C. Plow, step, or bench sloped surfaces steeper than 4:1 on which fill or backfill is to be placed in such a manner that fill material will adequately bond with existing surfaces. Scarify all surfaces to receive backfill to a depth of 6" before filling.

D. Construct fills and embankments to the lines and grades indicated on the Drawings within tolerances stated in Section 3.03, A, above.

E. Use suitable materials removed from the excavation prior to obtaining material from borrow areas.

F. Where otherwise suitable material is too wet, aerate, dry or blend to provide the moisture content specified for compaction.

3.05 COMPACTION

A. During placing and/or compacting operations of earth or earth-and-rock mixtures, the moisture content of materials in the layers being compacted shall be near optimum and uniform throughout the layer. In general, maintain the moisture content of the material being placed and compacted within 2% of optimum condition as determined as ASTM Standard D698.

1. Compaction Equipment. Perform all compaction with approved equipment well suited to location and material being compacted. Use heavy vibratory rollers or sheepsfoot rollers where heavy equipment is authorized. Do not operate heavy equipment closer to structures than a horizontal distance equal to height of backfill above bottom of structure foundation. Compact remaining area with hand tampers suitable for
material being compacted. Place and compact backfill around pipes with care to avoid damage.

Compact fill materials to following densities at optimum moisture content based on ASTM D698 or AASHTO T99:

a. Structure fill under or within 5’ horizontally of all concrete structures: 95%.
b. Backfill beneath or within 5’ horizontally or within the area defined by a line extended at an angle of 1:1 of existing or proposed pavements, roadways, sidewalks, curbs, utility lines, retaining wall bases, or other improvements: 95%
c. Backfill within lagoon berm: 95%
d. Backfill within public or designated rights-of-way: 95% or as shown on the Drawings.
e. Backfill within undeveloped, green or undesignated area: 85%.
f. Backfill for any fill for overcut grading in areas of lot/home construction: 95%.

2. Jetting. Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. Techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be at the direction of the Engineer. No jetting will be allowed on materials with a 200-minus gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and compaction testing and any retesting or re-compaction required. No jetting shall be done prior to written approval and direction of the Engineer.

3. Maintenance. Contractor to maintain all embankment in satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.

3.06 PROOF ROLLING

A. Proof rolling with a heavy rubber-tired roller will be required for all paved and graveled travel ways. Proof rolling shall be done after specified compaction has been obtained. Areas found to deflect excessively and those areas which failed shall be ripped, scarified, wetted if necessary and re-compacted to the requirements for density and moisture at the Contractor's expense. Equipment to be used for proof rolling may also be fully loaded, tandem axle dump truck or water truck or rubber-tired roller with equivalent loading characteristics.

3.07 SURFACE RESTORATION

A. All existing surface improvements and site conditions disturbed or damaged during construction are to be restored to a condition equal to pre-construction condition. All restoration costs are considered incidental to excavation and
backfill.

1. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Engineer and all affected property owners.

2. Final Grading. The Contractor is to re-establish existing final grade or finish to final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.

3. Roadways. All roadways to be restored to original condition with material types removed. Materials and methods to conform to Section 02222 - Embedment and Base Course Aggregate; and Section 02612 - Hot Bituminous Pavement. Additional requirements are:
   a. Minimum base course material on gravel roadways or minimum depth gravel beneath hard surface roadways to be 8", unless shown otherwise on Drawings.
   b. Minimum asphalt pavement surfacing to be 4", unless shown otherwise on the Drawings.
   c. Minimum concrete pavement surfacing to be 6", unless shown otherwise on Drawings.

4. Green Areas. Place excavated topsoil from the roadway (or from pits) directly upon constructed cut and fill slopes without the use of stockpiles whenever conditions and the progress of construction will permit.
   a. Do not place topsoil until the areas to be covered have been properly prepared and grading operations in the area have been completed.
   b. Place and spread topsoil at locations shown on the plans. Use a 4" minimum thickness or as indicated on plans. Key to the underlying material by the use of harrows, rollers or other equipment suitable for the purpose.
   c. Apply water to the topsoil at the locations and in the amounts designated. Apply in a fine spray by nozzles or spray bars in such manner that it will not wash or erode the topsoil areas.
   d. All loose exposed rock larger than three inches shall be removed from slopes that are to receive topsoil.
   e. See Sections 02821, 02822, 02830.

3.08 INSPECTION AND TESTING

A. Inspection and testing to be performed at the direction of the Engineer and by a Geotechnical Engineering Firm, respectively. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing. Contractor to backfill all test excavations in accordance with these Specifications.

3.09 DENSITY TESTING AND CONTROL

A. Reference Standards. Density/moisture relationships to be developed for all soil
types encountered according to ASTM D698 or AASHTO T99.

B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.

C. Frequency of Testing. Frequency of testing to be done at the direction of the Engineer.

D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by Geotechnical firm approved by the Engineer.

3.10 PAYMENT FOR TESTING

A. Owner responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

END OF SECTION
PART 1  GENERAL

1.01  SUMMARY

A. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all clearing and grubbing, excavation, backfilling, compacting, testing and related work not specified elsewhere, as shown on the Drawings and required by the Specifications.

B. All work within the rights-of-way of the Federal Government, the Colorado Division of Highways, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor’s responsibility to secure all required excavation permits and pay all costs thereof.

1.02  REFERENCE STANDARDS


1.03  SUBMITTALS

A. The Contractor shall prepare and submit information for all imported backfill material.

1.04  FIELD CONDITIONS

A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction limits.
   1. Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.
   2. In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.
   3. The Contractor shall make arrangements for and pay all costs for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation. The Owner shall pay the costs for such relocation.

B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged as a
result of this work shall be restored to original condition or better, as determined by the Engineer.

1. Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater that will be encountered within the limits of construction.

1.05 PROTECTION OF WORK

A. Safety. All excavations shall be protected by barricades, lights, signs, etc. as required by governing federal, state and local safety codes and regulations.

B. Sheeting, shoring and bracing. Except where banks are cut back on a stable slope, provide and maintain sheeting, shoring and bracing systems necessary to protect adjoining grades and structures from caving, sliding, erosion or other damage, and suitable forms of protection against bodily injury, all in accordance with applicable codes and governing authorities.

1. Remove sheeting and shoring systems as excavations are backfilled in a manner to protect the construction or other structures, utilities or property. Do not remove any sheeting after backfilling.

2. Sheetin and shoring systems shall be structurally designed and sufficiently braced to provide necessary restraining of retained backfill. Prior to installation of such systems, methods of installation and materials proposed shall be discussed with and approved by Engineer. All systems shall be in strict compliance with local, state and federal safety regulations. Contractor is solely liable for non-compliance.

C. Site Drainage. Excavation to be protected from surface water drainage at all times.

1.06 BLASTING

A. No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority (ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris.

B. Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by Engineer prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

1.07 CONSTRUCTION IN STREETS

A. When construction operations are located within streets, make provisions at cross streets and walks for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval.
PART 2 PRODUCTS

2.01 All materials for construction fills and backfills shall meet specified requirements for gradation and other factors defining suitability for the intended use. All classes of suitable material shall be free from perishable matter, debris, frozen material and stones and/or cemented pieces larger than permitted by the specified gradation. Classification of materials shall be as follows:

2.02 MATERIALS FOR STRUCTURE BACKFILL

A. Structure backfill shall be composed of materials designated as Class 1, Class 2, Class 3 or Class 4.

1. Class 1 Backfill (CDOT Section 703.08 - Class 1). Class 1 backfill shall be composed of materials from excavations, borrow areas, or other sources. This material shall conform to the following requirements when tested with laboratory sieves:

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>% by Weight Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>30-100</td>
</tr>
<tr>
<td>No. 50</td>
<td>10-60</td>
</tr>
<tr>
<td>No. 200</td>
<td>5-20</td>
</tr>
</tbody>
</table>

In addition, this material shall have a liquid limit not exceeding 35 and a plasticity index of not over 6 when determined in conformity with AASHTO T89 and T90.

2. Class 2 Structure Backfill (CDOT Section 703.08 - Class 2). Class 2 structure backfill shall be composed of suitable materials developed from excavation, borrow areas or other sources. If the material contains rock fragments which, in the opinion of the Engineer, will be injurious to the structure, the material will not be used for backfilling. In addition, no rock larger than 4" shall be placed within the structure backfill zones shown in CDOT M-Standards M-206-1 and M-206-2.

3. Class 3 Backfill (CDOT Section 703.03 - Class 6). Class 3 backfill shall consist of crushed stone, crushed slag, crushed gravel, or natural gravel conforming to the following requirements when tested with laboratory sieves.

<table>
<thead>
<tr>
<th>Sieve Designation</th>
<th>% by Weight Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4 inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 4</td>
<td>30-65</td>
</tr>
<tr>
<td>No. 8</td>
<td>25-55</td>
</tr>
<tr>
<td>No. 200</td>
<td>3-12</td>
</tr>
</tbody>
</table>

In addition, this material shall have a liquid limit not exceeding 30 and a plasticity index of not over 6 when determined in conformity with AASHTO T89 and T 90.

4. Class 4 Backfill (CDOT Section 703.03 - Class 2). Class 4 backfill shall be composed of suitable materials developed from excavation, borrow areas, or other sources. If the material contains rock fragments that in the opinion of the Engineer will be injurious to the structure, the native material will not be used for backfilling and the Contractor will be required to furnish Class 1 backfill material at a unit price mutually agreed upon between Contractor and Owner.
2.03 TOPSOIL

A. Topsoil shall consist of selectively excavated, loose, friable loam reasonably free of admixtures of sub-soil, refuse, stumps, roots, rocks, brush, weeds or other material which would be detrimental to the proper development of vegetative growth.

PART 3 EXECUTION

3.01 SITE PREPARATION

A. Clearing. Remove all vegetation, stumps, roots, organic matter, debris and other miscellaneous structures and materials from work site. Dispose of off-site.

B. Topsoil Removal. Strip existing topsoil from all areas to be distributed by construction. Topsoil to be stockpiled separately from excavated materials.


D. Preservation of Trees. Refer to plans for designation of all trees, shrubs, plants and other vegetation within the project site to remain. Do not remove trees outside of excavated or filled areas, unless their removal is authorized by the Engineer. Protect trees left standing from permanent damage by construction operations.

3.02 CONSTRUCTION REQUIREMENTS

A. The excavation and embankments required shall be finished to smooth and uniform surfaces. Materials shall not be wasted without permission of the Engineer. The Engineer reserves the right to change grade lines, cut slopes or fill lines during the progress of the work.

3.03 STRUCTURE EXCAVATION

A. Material outside of the limits of excavation will not be disturbed. Prior to beginning excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these Specifications. The Contractor shall not excavate beyond the dimensions and elevations established.

B. Structure excavation shall include all earthwork required for the construction of structures to the lines and grades called for on the Drawings.

C. If any areas are inadvertently over-excavated, fill such over-excavation with Class 1 or Class 3 backfill.

1. Tolerances. In those areas upon which a sub base or base course material is required, or upon which a structure is to be constructed directly, deviation of not more than 1 inch shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 1 inch at any point.
   a. In those areas where no additional construction, other than topsoil addition, will occur, the finished surface shall be smooth and shall not deviate from grade by more than 0.5 foot at any point.

2. Groundwater Control. Contractor to maintain facilities on site to remove all groundwater from excavated area and keep water below the bottom of the
excavation to a point such that a firm base for equipment or concrete installation exists. Facilities shall be maintained until all backfilling is in place at least 24 inches above anticipated water levels before dewatering equipment removal. All water removal shall be in accordance with the CDPHE dewatering permit and is also subject to approval by the Engineer.

a. Removal of water by bucketing, sump or trench diversions, intermittent pumping, or sump or submersible pumps is considered incidental to excavation work. Inclusion of a bid item for dewatering indicates dewatering by continuous pumping, well-point type systems is expected. If such dewatering system is required, in the opinion of the Engineer, this work to be paid for as indicated in the bid schedule, or if not included in the bid schedule to be considered extra work paid for at a price negotiated between Contractor and Owner prior to the start of dewatering.

3. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing monitoring wells, fire hydrants and water valves
   a. Maintain natural drainage courses and street gutters.
   b. Backfill material to be segregated from stock piled topsoil and unusable backfill materials.

4. Over-excavation. Whenever the site is over-excavated more than 0.1' to eliminate point bearing by rocks or stones beneath proposed structures or when grade tolerances are exceeded, the Contractor is to re-establish grade using Class 1 backfill. Compaction shall be to 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.

5. Unstable Materials. Materials which are not capable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, then a contract price for Unstable Soil Excavation shall be negotiated between Owner & Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.
   a. Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.

6. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards or solid or fractured rock, which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor had in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for Rock Excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.
Section 02201 – Excavation and Backfill for Structures

a. Rock shall be removed to a 4" depth below grade. In addition, all rock loosened during jacking, blasting, etc. shall be removed from the site. For payment purposes, maximum depth to be paid for shall be 12" below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, D.

b. Inclusion of a bid item for Rock Excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavation; no payment shall be made for excavation prior to notification.

3.04 BACKFILLING

A. Do not begin backfilling until construction below grade has been approved, underground utility systems have been inspected, tested and approved and trash and debris have been cleaned from the excavation.

B. Place approved excavated material in successive uniform maximum loose layers in the same order as removed; not exceeding 8 inches for the full width of the cross-section in all accessible areas. Place material in successive uniform loose layers not exceeding 4 inches in areas not accessible or permitted for the use of self-propelled rollers or vibrators. Do not place fill on muddy or frozen subgrade, or until subgrade is approved by the Engineer.

C. Construct fills to the lines and grades indicated on the Drawings within tolerances stated in Section 3.03, A above. Use suitable materials removed from the excavation prior to obtaining material from borrow areas. Where otherwise suitable material is too wet, aerate, dry or blend to provide the moisture content specified for compaction.

3.05 COMPACTION

A. During placing and/or compacting operations with earth or earth-and-rock mixtures, the moisture content of materials in the layers being compacted shall be near optimum and uniform throughout the layer. In general, maintain the moisture content of the material being placed and compacted within 2% of optimum condition as determined as ASTM Standard D698.

1. Compaction Equipment. Perform all compaction with approved equipment well suited to location and material being compacted. Use heavy vibratory rollers or sheepfoot rollers where heavy equipment is authorized by Engineer. Do not operate heavy equipment closer to structures than a horizontal distance equal to height of backfill above bottom of structure foundation. Compact remaining area with hand tampers suitable for material being compacted. Place and compact backfill around pipes with care to avoid damage.

Compact fill materials to following densities at optimum moisture content based on ASTM D698 or AASHTO T99 as shown on the Drawings or as follows:

a. Structure fill under or within 5’ horizontally of all concrete structures: 95%

b. pavements, roadways, sidewalks, curbs, utility lines or other improvements: 95%

c. Backfill within public or designated rights-of-way: 90% or as shown on the Drawings.

d. Backfill within undeveloped, green or undesignated area: 85%.
e. Backfill for any fill for overcut grading in areas of lot/home construction: 95%.

2. Jetting. Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. Techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be at the direction of the Engineer. No jetting will be allowed on materials with a 200-minus gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and compaction testing and any retesting or recompaction required. No jetting shall be done prior to written approval and direction of the Engineer.

3. Maintenance. Contractor to maintain all backfill in satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.

3.06 SURFACE RESTORATION

A. All existing surface improvements and site conditions disturbed or damaged during construction are to be restored to a condition equal to pre-construction condition. All restoration costs are considered incidental to excavation and backfill.

1. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Engineer and all affected property owners.

2. Final Grading. The Contractor is to re-establish existing final grade or finish to final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.

3. Roadways. All roadways are to be restored to original condition with material types removed. Additional requirements are:
   a. Minimum base course material on gravel roadways or minimum depth gravel beneath hard surface roadways to be 8", unless shown otherwise on the Drawings.
   b. Minimum asphalt pavement surfacing to be 3", unless shown otherwise on the Drawings.
   c. Minimum concrete pavement surfacing to be 6", unless shown otherwise on the Drawings.

4. Green Areas. Restore all green areas as specified in Section 02480 – TREES, PLANTS, SEEDING, EROSION CONTROL

3.07 INSPECTION AND TESTING

A. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance with these Specifications.
3.08 DENSITY TESTING AND CONTROL

A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99.

B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.

C. Frequency of Testing. Frequency of testing to be done at the direction of the Engineer.

D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

3.09 PAYMENT FOR TESTING

A. Owner responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all excavation, backfilling and compaction of underground pipelines, conduits, cables and appurtenances shown on the Drawings and specified herein.

B. All work within the rights-of-way of the Federal Government of the Colorado Division of Highways, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor’s responsibility to secure all required excavation permits and pay all costs thereof. Contractor will be required to obtain necessary road cut permits.

1.02 SUBMITTALS

A. Bedding Material
   1. Submit sieve analysis

B. Select Fill
   1. Submit sieve analysis

1.03 FIELD CONDITIONS

A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction area.

1. Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.

2. In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.

3. The Contractor shall make arrangements for and pay all costs for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation. The Owner shall pay the costs for such relocation.
B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged, as a result of this work shall be restored to original condition or better, as determined by the Engineer.

1. Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater that will be encountered within the limits of construction.

1.04 PROTECTION OF WORK

A. Safety. All excavation shall be protected by barricades, lights, signs, etc., as required by governing federal, state and local safety codes and regulations.

B. Sheeting, Shoring and Bracing. Where trench walls are not excavated at a stable slope, the Contractor shall provide and maintain support sufficient to prevent caving, sliding or failure and property or bodily damage. Any damage due to inadequate support shall be repaired at the sole expense of the Contractor.

1. Under normal construction conditions, support shall be removed as work progresses. Support shall remain installed if directed by the Engineer or if pipe does not have sufficient strength to support backfill based on trench width as defined by the sheeting. Sheeting shall not be removed after the start of backfilling.

2. Use of a movable trench shield or coffin box will not be allowed where pipe strength is insufficient to support backfill as defined by the trench width after the trench shield is removed.

3. The Contractor shall be held solely responsible for any violation of applicable safety standards. Particular attention is called to minimum requirements of OSHA and COSH (Colorado Occupational Safety and Health).

C. Site Drainage. Excavation to be protected from surface water at all times. At no time shall excavated area be allowed to fill with storm water runoff. Contractor shall provide proper, temporary drainage structures at their cost to detour runoff from excavated areas.

1.05 BLASTING

A. No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any
property or persons will occur due to either the blast or debris. Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by Engineer prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor’s expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

1.06 CONSTRUCTION IN STEETS

A. When construction operations are located within streets make provisions at cross streets and walks for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval.

PART 2 PRODUCTS

2.01 EMBEDMENT MATERIAL

A. Pipeline embedment material shall comply with the appropriate classes as listed below and as illustrated in the Construction Drawings:

1. Class A - Use where improper trenching or unexpected trench conditions require its use as determined by the Engineer.
   a) Characteristics - Concrete cradle foundation with densely compacted Class 6 aggregate base backfill to 12” above top of pipe, or densely compacted Class 6 aggregate granular foundation with concrete arch cover to 6” above top of pipe.

2. Class B - Use for all PVC, DIP, CMP and concrete pipe under normal construction conditions.
   a) Characteristics - Densely compacted Class 6 aggregate granular foundation of depth shown on Typical Details with densely compacted Class 6 aggregate 12” above top of pipe.

2.02 SELECT MATERIAL

A. Subject to approval by the Engineer, select material shall be allowed in place of the embedment material for Class B when excavation and soil conditions allow, but only if approved by Engineer. Contractors shall bid project based upon Class B. If Class A or select material is used, price adjustments shall be made.

1. Characteristics - Soil materials free from rocks, clods, and organic material.

2.03 CONCRETE FOR EMBEDMENT

A. Shall be 2000 psi concrete (28-day compressive strength).
2.04 BACKFILL MATERIAL

A. Characteristics - Native materials free from debris, organic matter and frozen material. Uniformly graded sufficient to allow proper compaction.

B. Gradation - No boulders greater than 6-inch diameter in top 12 inches of backfill.

1. Generally no boulders greater than 12-inch diameter in remainder of trench. Limited number of boulders not exceeding 24-inch diameter to be allowed at discretion of Engineer provided boulders can be uniformly dispersed and will not interfere in compactive effort.

PART 3 EXECUTION

3.01 SITE PREPARATION

A. Clearing. Remove all vegetation, stumps, roots, organic matter, debris and other miscellaneous structures and materials from project site. Dispose of off site.

B. Topsoil Removal. Strip existing topsoil from all areas to be disturbed by construction. Topsoil to be stockpiled separately from excavated materials.


3.02 TRENCH EXCAVATION

A. Limits of Excavation. Trenches to be excavated along lines and grades shown on the Drawings, or as modified in the field by the Engineer. Trench widths for pipe loading to be measured 12 inches above top of pipe.

1. Minimum trench width to be the outside diameter of the pipe or conduit plus 16 inches.

2. Maximum trench width to be the outside diameter of the pipe or conduit plus 24 inches for all pipes or conduits with outside diameter of 24 inches or less, and plus 30 inches for all pipes or conduits with outside diameters greater than 24 inches.

3. If maximum trench width is exceeded, Contractor will provide at his expense, higher strength pipe or special bedding including concrete at the direction of the Engineer.

4. Trench excavation not to be completed more than 100 feet in advance of pipe installation. Backfill to be completed within 100 feet of pipe installation.

B. Groundwater Control. Contractor to maintain facilities on-site to remove all groundwater from trench and keep water at least 12 inches below the trench bottom to a point such that a firm base for pipe or conduit installation exists. Facilities shall be maintained until all concrete is cured and backfilling is in place.
at least 24 inches above anticipated water levels before water removal is discontinued; all water removal shall be subject to approval by the Engineer.

C. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters.

1. Backfill material to be segregated from stockpiled topsoil and unusable backfill materials.

D. Excavation for Appurtenances. Excavation to be done in accordance with these Specifications and as shown on the Drawings. Adequate working clearances to be maintained around appurtenances. Provisions for base and bottom preparations shall apply to all appurtenances. Precautions to be taken to maintain trench widths in the vicinity of adjacent pipelines and conduits.

3.03 BOTTOM PREPARATION

A. Undisturbed Foundation. Where soils are suitable and have adequate strength, bottom to be graded and hand-shaped such that pipe barrel rests uniformly on undisturbed soil. All rocks or stones, which may result in a point bearing on the pipe, shall be removed.

1. Undisturbed grades shall be within 0.1 feet ± tolerance. Soils for final pipe grade placed within these limits shall be fine granular (100% passing No. 4 sieve) or may be native materials, hand compacted to 95% maximum density.

B. Bell Holes. Material to be removed to allow installation of all fitting and joint projections without affecting placement of pipe.

C. Over-excavation. Whenever trench is over-excavated to eliminate point bearing by rocks or stones or when undisturbed grade tolerances of 0.1’ are exceeded, the Contractor is to re-establish grade using Class 6 aggregate bedding material. Compaction shall be 95% maximum density. All work to re-establish grade shall be at the Contractor’s expense.

D. Unstable Materials. Materials incapable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, then a contract price for Unstable Soil Excavation shall be negotiated between Owner and Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.

E. Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil
excavation; no payment shall be made for excavation prior to authorization of Engineer.

F. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards of solid or fractured rock, which makes hand shaping of the bottom impossible and which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in trench excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor has in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above, and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for rock excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.

1. Rock shall be removed to a 4” depth below grade. Additionally, all rock loosened during jacking, blasting, etc., shall be removed from the trench. For payment purposes, maximum trench width to be paid for shall be as defined in Subsection 3.02, A. Maximum depth to be paid for shall be 12” below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, C.

2. Inclusion of a bid item for rock excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavating; no payment shall be made for excavation performed prior to notification.

3.04 BACKFILLING

A. Tamping Equipment. Except immediately next to the pipe, mechanical or air operated tamping equipment to be used. Hand equipment, such as T-bar, to be used to pipe if necessary. Care to be taken when compacting under, along side and immediately above pipe to prevent crushing, fracturing or shifting of the pipe. The Contractor is to note densities required for materials being backfilled and shall use appropriate approved equipment to obtain those densities.

1. Wheel rolling is not considered to be an adequate compaction technique to meet these Specifications and will not be allowed. Where 85% compaction is required, wheel rolling may be considered. Before acceptance, the Contractor shall backfill a portion of the trench and pay for density testing to verify adequacy of the proposed backfill techniques.

2. A hydro hammer may be allowed to obtain the specified density up to 4’ in depth. The Contractor will be required to re-excavate those areas that have been tamped so that density tests can be taken to insure that the specified intensity is being obtained full depth.

B. Moisture Control. Generally maintain moisture of backfill material with ± 2% of optimum moisture content as determined by ASTM D698. Maintain closer
tolerances as needed to obtain densities required.

C. Compaction. Maximum density (100%) based on ASTM D698 or AASHTO T99.

1. Bedding Material, including material used for over-excavation of any kind: 95%.

2. Select Material: 95%.

3. Backfill beneath existing or proposed pavement, roadways, sidewalks, curbs, utility lines and other improvements or within 5' horizontally of such improvements: 95%.

4. Backfill within public or designated right-of-way: 90% or as shown on the Drawings.

5. Backfill within undeveloped, green or undesignated area: 85%.

6. Backfill for any fill over over-cut grading in areas of lot/home construction: 95%.

D. Placing Backfill. The maximum loose lifts of backfill material to be placed in the reverse order as removed and as follows: use smaller lifts where necessary to obtain required densities:

1. Bedding and select material: 6" (or see Section 3.03A).

2. Backfill Material: 12" where 95% compaction required; 24" where less than 95% compaction required.

E. Backfilling Appurtenances. Backfilling to be done generally at the same time as adjacent pipelines. Backfilling procedure to conform to this section. Use special techniques or materials as shown on drawings.

F. Disposal of Excess Excavation. Contractor to dispose of excess excavation off site. Disposal in any case shall be the sole responsibility of the Contractor.

G. Jetting. Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. Techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be at the direction of the Engineer. No jetting will be allowed on materials with a 200 minus gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and a retesting or recompaaction required. No jetting shall be done prior to written approval and direction of the Engineer.

H. Maintenance of Backfill. Contractor to maintain all backfill in a satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement
shall be the responsibility of the Contractor.

I. Clay Barrier Water Stops. Because of the presence of ground water, a clay barrier may be required to be installed full depth in trench in place of all bedding material and backfill. This barrier shall be full depth and two feet thick and installed every 500 lineal feet of trench. Clay barrier installation shall be considered incidental to the pipe installation and not paid for separately.

3.05 SURFACE RESTORATION

A. All existing surface improvements and site conditions disturbed or damaged during construction to be restored to a condition equal to pre-construction condition. All restoration costs are considered incidental to excavation and backfill.

1. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until Engineer and all affected property owners accepts restoration. Improvements include, by example, other utilities, culverts, structures, curb and gutter, mailboxes, signs, sprinkler systems, etc.

2. Final Grading. The Contractor is to re-establish existing final grade or finish final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.

3. Roadways. All roadways to be restored to original condition with material types removed. Materials and methods to conform to Section 02222, Embedment and Base Course Aggregate; and Section 02612, Hot Bituminous Pavement. Additional requirements are:

   a) Minimum base course material on gravel roadways or minimum depth gravel on hard surface roadways to be 8", unless shown otherwise on Drawings.

   b) Minimum bituminous surfacing to be 3" unless shown otherwise on Drawings.

   c) Minimum concrete pavement surfacing to be 6", unless shown otherwise on Drawings.

3.06 COMPACTION

A. It should be fully understood that it will be the sole responsibility of the Contractor to achieve the specified densities for all embedment and backfill material placed. Contractor will be responsible for ensuring that correct methods are being used for the placement and compaction of said materials. Correct backfill methods include, but are not limited to:

1. Use of proper equipment for existing soil condition encountered.
2. Moisture content of existing soils; determination if water should be added or if soil should be air dried to reduce moisture content.

3. Thickness of backfill lift.

B. Contractor may, at his own expense, have an approved geotechnical engineer monitor the methods of backfill and compaction used to ensure that the desired densities are being obtained.

C. Inspection and testing will be performed as directed by the Engineer. Testing will be conducted as a quality control check to verify the Contractor's compliance with the standards indicated in the Specifications.

3.07 INSPECTION AND TESTING

A. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing. Contractor to backfill all test excavations in accordance with these Specifications. Any areas that require a specified density, including fill, backfill, trenches, embankments, road base, hot bituminous pavement, backfill for structures, shall be tested.

3.08 DENSITY TESTING AND CONTROL

A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99.

B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.

C. Frequency of Testing. Minimum of one (1) test every 250' trench per lift or as directed by Engineer. Contractor to excavate to depths required by Engineer for testing and backfill test holes to density specified. Testing to be paid for by Owner.

D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

3.09 PAYMENT FOR TESTING

A. Owner responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

END OF SECTION
SECTION 02222
EMBEDMENT AND BASE COURSE AGGREGATE

PART 1 GENERAL

1.01 SUMMARY

A. This work shall consist of furnishing and placing one or more courses of aggregate on the prepared surface in accordance with these Specifications in reasonably close conformity with the lines, grades and typical cross sections shown on the drawings or established by the Engineer in the field.

1.02 REFERENCE STANDARDS


1.03 SUBMITTALS

A. Aggregates. Certified statement from independent testing laboratory, acceptable to Engineer, of material compliance.

PART 2 PRODUCTS

A. Aggregate used for pipeline bedding, base course and subbase course and specified by Class in other sections of this Specification shall conform to the gradation schedule shown below.

CLASSIFICATION TABLE FOR AGGREGATE BASE COURSE*

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</table>
PART 3 EXECUTION

3.01 PLACING

A. The base course material shall be placed on the previously prepared subgrade at the locations and in the proper quantities to conform to the typical cross sections as shown on the Drawings and as directed by the Engineer. Placing and spreading shall be done by means of spreader machine, moving vehicle, motor grader or other approved equipment methods. The material shall be placed without segregation. Any segregated areas shall be removed and replaced with uniformly graded material at the Contractor's expense.

B. The base material may be placed in lifts of up to 6 inches, providing that after compaction, uniform density is obtained throughout the entire depth of the lift. If the required depth exceeds 6 inches, it shall be placed in two or more lifts of approximately equal thickness. If uniform density cannot be obtained by 6-inch lifts, the maximum lift shall not exceed 4 inches in final thickness.

3.02 COMPACTING

A. Rolling will be continuous until the base material has been compacted to not less than 95% of maximum density as determined by ASTM D698 or AASHTO T99. Water shall be uniformly applied as necessary during compaction to obtain optimum moisture content and to aid in consolidation. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly keyed.

B. The finished base course surface shall be smooth and free of ruts and irregularities and true to grade and crown as shown on the plans or as directed by the Engineer. The final surface shall be finished with a surface smoothness tolerance of ¼ inch, measured as vertical ordinate from the face to a ten-foot straight edge. The base course shall be maintained in this condition by watering, drying, rolling or blading as necessary, or as the Engineer may direct, until the surface material is placed.

3.03 INSPECTION AND TESTING

A. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance to these Specifications.

3.04 DENSITY TESTING AND CONTROL

A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or ASSHTO T99.
B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.

C. Frequency of Testing. Conduct a minimum of one test for each layer of specified depth of fill or backfill as follows:

- **Foundations:** For each 100 lineal feet or less of trench.
- **Slabs on Grade:** For each 2,000 square feet or less of building area.
- **Pavement and Walks:** For each 2,000 square feet or less.
- **All Other Areas:** For each 5,000 square feet or less.
- **Utility Trenches:** For each 250 lineal feet or less of trench.

### 3.05 PAYMENT FOR TESTING

A. Owner is responsible for all costs of initial testing of backfill. Contractor to pay for all costs of any retesting required.

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. Work to be performed under this Section shall include all labor, materials, equipment and miscellaneous items necessary to perform all excavation, installation of casing and carrier pipe, backfilling and site restoration shown on the Drawings and specified herein.

B. All work within the rights-of-way of the Railroad Union Pacific Transportation Co, Colorado Department of Transportation, county governments or municipal governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these specifications. It shall be the Contractor's responsibility to secure all required excavation permits and pay all costs thereof.

1.02 PROTECTION OF WORK

A. All pipe, fittings and equipment shall be carefully handled, stored and protected in such a manner as to prevent damage to materials. At no time shall such materials be dropped or dumped into trench.

B. Precaution shall be taken to prevent foreign matter from entering the pipe and fittings prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.

C. At such time as pipe installation is suspended, either temporarily or overnight, the open end of the pipe shall be sealed with a water-tight plug to prevent entrance of trench water, debris or foreign matter.

D. Under no circumstances shall trench water be allowed to enter the pipeline. When water is present in the trench, the seal shall remain in place until such time as the trench is pumped dry. Whenever trench water becomes evident, adequate measures shall be taken to prevent pipe flotation.

E. During work in right-of-way of state highways, warning signs shall be placed in accordance with "The Manual of Uniform Traffic Control Devices".

1.03 SUBMITTALS

A. Materials. Submit statement on casing pipe, spacing system, and end seals to be used.

B. Jacking and Boring Equipment. Submit statement on procedure and specializing equipment to be used. Include information on jacking bands, jacking heads, bearing shims, jacking pit bracing, etc.
PART 2 MATERIALS

2.01 CASING PIPE
   A. Butt welded steel pipe with beveled ends.
   B. ASTM A-245 commercial grade or ASTM A-283, minimum wall thickness of 0.375”.

2.02 CARRIER PIPE
   A. Use same material as referenced in Sections 02555 or 02560.

2.03 EQUIPMENT
   A. Unless otherwise specified, the methods and equipment used in jacking casing or conduit shall be optional with the Contractor, provided that the proposed method is approved by the Engineer. Such approval, however, shall in no way relieve the Contractor of the responsibility for making a satisfactory installation meeting the criteria set forth herein.
   B. Only workers experienced in jacking operations shall be used.

2.04 SPACING SYSTEM
   A. Model CCS stainless steel casing spacer, Cascade Waterworks manufacturing Company, or equal.
   B. Spacer shall be bolt-on style minimum 14-gauge, T-304 stainless steel. They shall be lined with ribbed PVC extrusion. Bearing surfaces (runners) shall be made from UHMW polymer, mechanically fastened to spacer.

2.05 CASING END SEALS
   Style CCES casing end seals, Cascade Waterworks MFG, Co. or equal.

PART 3 METHODS AND PROCEDURES

3.01 INSTALLATION AND PROCEDURES
   A. Access Pits. Contractor shall excavate access pits on each end of the installation sufficient to provide working access during installation and to allow field check of completed installation.
   B. Jacking/Boring. Steel casing pipe shall be of minimum size as shown on the Drawings. Contractor shall supply casing pipe size necessary to allow installation to the line and grade shown on the Drawings and shall provide end fitting as required to prevent wobble or alignment variation.
   C. The joints of sections of casing to be jacked shall be welded with a continuous circumferential weld. It shall be the Contractor’s responsibility to provide stress
transfer across the joints which is capable of resisting the jacking forces involved. Welds shall be 90° to the longitudinal axis of the casing pipe.

D. The driving ends of the casing shall be properly protected against spalling and other damage, and intermediate joints shall be similarly protected by the installation of sufficient bearing shims to properly distribute the jacking stresses. Any section of casing showing signs of failure shall be removed and replaced with a new section of casing, or with a cast-in-place section, which is adequate to carry the loads imposed upon it.

E. Excavation shall not be made in excess of the outer dimensions of the casing being jacked unless approved by the Engineer. Every effort shall be made to avoid any loss of earth outside the jacking head. Excavated material shall be removed from the casing as excavation progresses, and no accumulation of such material within the casing will be permitted.

F. Upon completion of the jacking operations, all voids around the outside face of the casing shall be filled by grouting.

G. Grouting equipment and material shall be on the job site before jacking operations and drilling of grout holes are completed in order that grouting around the jacked casing may be started immediately after the jacking operations have finished.

H. Should appreciable loss of ground occur during the jacking operation, the voids shall be backpacked promptly to the extent practicable with soil cement consisting of a slightly moistened mixture of one part cement to five parts granular material. Where the soil is not suitable for this purpose, the Contractor shall import suitable material at his expense. The soil cement shall be thoroughly mixed and rammed into place as soon as possible after the loss of ground.

3.02 INSTALLATION OF CARRIER PIPE

A. **Spacer.** Install according to manufacturer’s recommendations.

B. **Bulkhead.** Provide a rubber seal clamp on both carrier pipe and casing pipe or a watertight seal at each end of casing pipe.

PART 4 QUALITY CONTROL

4.01 INSPECTION AND TESTING

A. Any section of casing showing signs of failure shall be removed and replaced. Casing shall be at the line and grade established in the field by the Engineer. Casing and carrier pipe shall be checked for grade and line prior to backfill.

5.00 MEASUREMENT AND BASIS OF PAYMENT

A. Items under this section shall be paid at the unit price given on the bid schedule and shall be full compensation for work complete in place.

END OF SECTION
SECTION 02255

DUST SUPPRESSION

PART 1 GENERAL

1.01 SCOPE

Work under this Section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to provide dust control over the entire project site.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

All Division 02000 Sections

1.03 SUBMITTALS.

A. Chemical Products. Descriptive literature defining chemical constituents.

PART 2 MATERIALS

2.01 MAGNESIUM CHLORIDE.

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Percentage by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium Chloride</td>
<td>Approximately 28%-36%</td>
</tr>
<tr>
<td>Sulfate</td>
<td>2.5%</td>
</tr>
<tr>
<td>Potassium, sodium, calcium</td>
<td>Less than 1%</td>
</tr>
<tr>
<td>Nitrate</td>
<td>-0-</td>
</tr>
</tbody>
</table>

PART 3 METHODS AND PROCEDURES

3.01 DUST CONTROL

Dust control to be considered an integral part of the Work. Control shall be provided from the start of construction until the Work is complete. Fugitive dust as a result of construction shall be controlled at all times.

3.02 WATERING

For road construction, the Contractor shall have a water truck on site at all times for dust control. It is the Contractor’s sole responsibility to provide adequate dust control. The Town may require the contractor to increase dust control efforts as it determines necessary. Any additional dust control, as ordered by the Town, shall be at the Contractor’s expense.

For utility construction, dust control may be accomplished by water truck or spray system from an on-site water system if approved. Contractor shall be prepared to provide dust control until the final surface is completed.

The Contractor shall obtain a water meter from the Town for metering any water taken from the municipal water system whether from fire hydrants or private taps.
3.03 CHEMICAL CONTROL.

Where required by the Engineer and approved by the Town, dust control shall be provided by the use of magnesium chloride chemical spray to the road surface.

After the surface has been prepared, the road shall be pre-wet to a very damp condition. The product shall be applied using a watering truck with spray applicator, providing an even distribution across the surface. Application rate shall be 1/3 - 1/2 gallon per square yard. The surface shall be re-sprayed until complete coverage is attained.

END OF SECTION
SECTION 02271
RIPRAP

PART 1 GENERAL

1.01 DESCRIPTION

A. Work shall consist of furnishing and placing of riprap according to the location shown on the Drawings.


PART 2 PRODUCTS

2.01 RIPRAP

A. Riprap shall consist of hard, dense rough fractured rock as nearly cubical as possible. Thin slab, flaking rock and sandstone shall not be used. The rock shall have a minimum specific gravity of 2.25. Removed concrete may not be substituted for rock. Round river rock shall not be used as riprap unless approved by Engineer.

B. The average diameter of rock shall be as shown on Drawings.

PART 3 CONSTRUCTION METHODS

3.01 SLOPE PREPARATION

Areas on which the riprap is to be placed will be trimmed and dressed to conform to cross sections shown on the Drawings within an allowable tolerance of plus or minus two inches (2") from the theoretical slope lines and grades. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with material similar to the adjacent material and well compacted with no additional compensation to be allowed to the Contractor for any extra materials thus required.

3.02 FILTER CLOTH

Provide Mirafi 140-N filter fabric under riprap, or equal. Fabric to be installed per Standard Erosion Control Details with anchor trenches, overlaps and staples.

3.03 BEDDING BLANKET.

To be six inches (6") thick placed on top of prepared slope and under riprap where called for on Drawings.
### 3.04 RIPRAPH PLACEMENT

Stone for riprap will be placed on the prepared slope in such a manner as to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids, and will be constructed within tolerances specified herein and to the slopes, lines and grades shown on the Drawings or as otherwise approved by Engineer in the field.

A tolerance of plus or minus three inches (3") from the slope lines and grades shown on the Drawings shall be allowed in the finished surface of the riprap. Placement of stones at the outlet of drainage structures shall allow positive flow in the direction intended with no stone placed to constrict or reduce flows (also see Section 506.03).

Riprap will be placed to its full course of thickness in one operation. The placing shall progress upwards on the slopes. The riprap will be carefully placed on the prepared slope in such a manner that adjacent stones are in close contact and, in general, have their greatest dimensions across or perpendicular to the slope. Through stones will be well distributed throughout the mass.

As used herein, a "through stone" is defined as a stone whose dimension as normal to the surface being riprapped is not less than the full depth of riprap. The finished riprap will be free form objectionable pockets of small stone clusters of larger stones. Placing riprap in layers will not be permitted.

END OF SECTION
SECTION 02520
DRAINAGE PIPE

PART 1 GENERAL

1.01 SCOPE

A. Work under this section includes furnishing, installing, cleaning and testing drainage pipe (including culverts) underdrains, trench drains, bands, collars, inlet section, outlet sections and all other items appurtenant to drainage pipe.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

Section 02200 - Excavation and Embankment
Section 02201 - Excavation and Backfill For Structures
Section 02222 - Embedment and Base Course Aggregate

1.03 REFERENCE STANDARDS.

Colorado State Department of Transportation Standards
Specifications for Road and Bridge Construction Section 707 and M-Standards

1.04 SUBMITTALS

Product date including catalogue cut sheets and descriptive literature.

1.05 PROTECTION OF WORK

All pipe and appurtenances shall be carefully handled, stored and protected in such a manner as to prevent damage to materials and protective coatings and linings. At no time shall such materials be dropped or dumped into trench.

Precaution shall be taken to prevent foreign matter from entering the pipe and appurtenances prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.

PART 2 MATERIALS

This item covers the types of material that will be required for the construction and installation of drainage pipe. All materials used shall be new and the best quality available. All material used shall be in accordance with applicable standards of the American National Standards Institute (ANSI), the American Standards Association (ASA), the American Society of Testing and Materials (ASTM) and the American Association of State Highway Transportation Officials (AASHTO).

2.01 CORRUGATED GALVANIZED STEEL PIPE AND PIPE ARCHES.

A. Pipe and Bands
   1. Conform to Section 707.02 and applicable section of AASHTO M-36.
2. Size, length and shape as shown on Drawings.
3. Corrugations to be 2-2/3" x ½" or 3" x 1" unless shown otherwise.
4. Gauge to be minimum 16 gauge (.064").
5. Bands to be "Hugger" type with forged steel bars secured to connecting bar with tension straps.
6. Gasket use rubber O-ring, two for each joint.
7. Pipe seams shall be continuous weld type.

B. End Sections
1. Conform to M-603-CA.

2.02 CORRUGATED ALUMINUM PIPE.

A. Pipe and Bands.
1. Conform to Section 707.06 and AASHTO M-196.
2. Size, length and shape as shown on Drawings.
3. Corrugations to be 2-2/3" x ½" unless shown otherwise.
4. Thickness to be minimum 0.060".
5. Bands to be "Hugger" type with forged steel bars secured to connecting bar with tension straps.
6. Gasket use rubber O-ring, two for each joint.
7. Pipe seams shall be continuous weld type.

B. End Sections.
1. Conform to M-603-CA.

2.03 CORRUGATED POLYETHYLENE PIPE.

A. Pipe, bands and fittings.
1. Conform to the following applicable specifications:
   ASTM F405, standard specification for corrugated polyethylene tubing and fittings.
   ASTM F667, standard specifications for large diameter corrugated polyethylene tubing and fittings.
   AASHTO M252, standard specification for polyethylene corrugated drainage tubing.
2. Size, length and shape as shown on Drawings.
3. Provide perforated tubing in locations shown on Drawings and in accordance with these Specifications.
4. Couplings shall be screw-on type or as approved.
5. Perforation Dimensional Requirements:

<table>
<thead>
<tr>
<th>Nominal I.D.</th>
<th>Number of Perforations Per Foot</th>
<th>Maximum Width (inch)</th>
<th>Maximum Length (inch)</th>
<th>Inlet Area Minimum Sq.in./ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 Inch</td>
<td>106</td>
<td>0.125</td>
<td>1.25</td>
<td>1.0</td>
</tr>
<tr>
<td>6 Inch</td>
<td>106</td>
<td>0.125</td>
<td>1.50</td>
<td>1.0</td>
</tr>
<tr>
<td>8 Inch</td>
<td>18</td>
<td>0.125</td>
<td>1.50</td>
<td>1.0</td>
</tr>
<tr>
<td>10 Inch</td>
<td>12</td>
<td>0.125</td>
<td>1.75</td>
<td>1.0</td>
</tr>
<tr>
<td>12 Inch</td>
<td>36</td>
<td>0.125</td>
<td>1.75</td>
<td>1.0</td>
</tr>
</tbody>
</table>
2.04 SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE.

A. Pipe. This specification applies to high-density polyethylene corrugated pipe with an integrally formed smooth waterway. (Hancor Hi-Q or ADS N-12).

Nominal Sizes: 4” to 10” diameter  
               12” to 60” diameter (AASHTO M259, Type S)

Pipe to have a full circular cross-section, with an outer corrugated pipe wall and an essentially smooth inner wall (waterway). Corrugations for sizes listed may be either annular or spiral. Corrugation type must compliment the bands and fittings supplied with the pipe.

Pipe manufactured for this specification shall comply with the requirements for test methods, dimensions, and markings found in AASHTO Designations M252 and M294.

Pipe and fittings shall be made from virgin PE compounds which conform with the requirements of cell class 324420C as defined and described in ASTM D3350.

Minimum parallel plate stiffness values when tested in accordance with ASTM D2412 shall be as follows:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Pipe Stiffness</th>
<th>Diameter</th>
<th>Pipe Stiffness</th>
</tr>
</thead>
<tbody>
<tr>
<td>4”</td>
<td>50 psi</td>
<td>18”</td>
<td>40 psi</td>
</tr>
<tr>
<td>6”</td>
<td>50 psi</td>
<td>24”</td>
<td>34 psi</td>
</tr>
<tr>
<td>8”</td>
<td>50 psi</td>
<td>30”</td>
<td>28 psi</td>
</tr>
<tr>
<td>10”</td>
<td>50 psi</td>
<td>36”</td>
<td>22 psi</td>
</tr>
<tr>
<td>12”</td>
<td>50 psi</td>
<td>42”</td>
<td>19 psi</td>
</tr>
<tr>
<td>15”</td>
<td>42 psi</td>
<td>48”</td>
<td>17 psi</td>
</tr>
</tbody>
</table>

B. Fittings.

The fittings shall not reduce or impair the overall integrity or function of the pipe. Fittings may be either molded or fabricated. Common corrugated fittings include inline joint fittings, such as couplers and reducers, and branch or complimentary assembly fittings such as tees, wyes, and end caps. These fittings may be installed by various methods, such as snap-on, screw-on, bell and spigot, and wrap around. Couplings shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Only fittings supplied or recommended by the pipe manufacturer shall be used. Where designated on the plans, a neoprene or rubber gasket shall be supplied.

C. Installation.

Installation of the pipe specified above shall be in accordance with ASTM Recommended Practice D2321 as covered elsewhere in these specifications.

2.05 PERFORATED ASTM 2729 LEACH FIELD PIPE.

A. Pipe couplings and fittings.
1. Conform to requirements of ASTM 2729.
2. Size, length and shape as shown on the Drawings.

2.06 FILTER WRAPPED POLYETHYLENE PIPE.

A. Pipe and bands.
   1. Conform to Section 2.03 above.

B. Filter material.
   1. Conform to properties equal to or better than those found with Mirafi 140N drainage fabric.
   2. Size, length and location as shown on Drawings.

PART 3 METHODS AND PROCEDURES

3.01 CLEANING AND INSPECTION

Clean all pipe and appurtenances thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from job site.

3.02 PIPE INSTALLATION

Pipe shall be laid in straight sections except as noted on the plans. Jointing of the pipe shall be made in accordance with the directions of the manufacturer of the pipe and the manufacturer of the coupling and shall have rubber gaskets or joint sealing compound as approved. All pipe to be installed with minimum cover of 12 inches.

3.03 PIPE EMBEDMENT

Pipe shall be embedded according to applicable details on the Drawings.

3.04 METAL APRON ENDWALLS

Metal apron endwalls (end sections) shall be constructed at the ends of all drainage pipe as shown on the plans. All entrance endwalls shall have toe plates. Excavation for endwalls shall be such that the endwall rests on undisturbed soil in its final position. Excavation for toe plates shall be such that the inside of the toe plate rests on undisturbed soil in its final position. Backfill shall be done as in Part 3.03 of this section.

PART 4 QUALITY CONTROL - FIELD

4.01 INSPECTION AND TESTING

Inspection and testing to be performed at direction of the Engineer. Contractor to cooperate fully with all testing procedures.
Any pipe section which has been damaged in any way which, in the opinion of the Engineer, may affect the structural integrity of the pipe or reduce the expected corrosion resistance of the pipe, shall be removed and replaced. At the option of the Engineer, re-coating of minor dents and deformities with an approved fluid applied galvanized material may be allowed.
SECTION 02545
CHIP SEAL COAT SURFACING

1.00 GENERAL

1.01 Scope. Work under this section shall consist of all labor, materials, equipment, traffic control and safety devices required for chip sealing of the roads listed in the construction schedule and in conformance with the Drawings, Specifications, typical sections and Contract Documents.

1.02 Related Work Specified Elsewhere.

Section 02200 - Excavation and Embankment
Section 02201 - Excavation and Backfill For Structures
Section 02222 - Embedment and Base Course Aggregate

2.00 MATERIALS

2.01 Bituminous Material.

A. The Asphaltic Prime Coat shall be AEP or equivalent and shall be in accordance with Section 702 of the 1999 Colorado Department of Transportation "Standard Specifications for Road and Bridge Construction, 1999".

B. The Asphaltic Binder shall be HEMS-2P and shall be in accordance with Section 702 of the 1999 Colorado Department of Transportation “Standard Specifications for Road and Bridge Construction, 1999”.

2.02 Mineral Aggregate.

A. Type IV. The 3/4" No. 6, aggregate coat shall meet the requirements of Section 703.5 of the 1999 Colorado Department of Transportation "Standard Specifications for Road and Bridge Construction, 1999", except that;

1) The gradation shall be gradation No. 6 from the concrete aggregate gradation table found on Page 880 and additionally shall have less than 2% passing the No. 200 sieve;

2) The aggregate shall be washed or tested in accordance with AASHTO T182 and be shown to have a retained bituminous film about 95% with or without the addition of anti-stripping additives, meeting the requirements of Section 712.10;

3) The aggregate shall have a percentage of wear not greater than 35 when tested per AASHTO T96; and

4) The aggregate shall be at least 50% of the gravel retained on the No. 4 sieve and shall have at least one fractured face instead of 90%.
B. Type I. The 3/8" aggregate coat shall meet the requirements of Section 703.05 of the 1999 Colorado Department of Transportation "Standard Specifications for Road and Bridge Construction".

1) The aggregate shall be washed or tested in accordance with AASHTO T182 and be shown to have a retained bituminous film about 95% with or without the addition of anti-stripping additives, meeting the requirements of Section 712.10.

2) The aggregate shall have a percentage of wear not greater than 35 when tested per AASHTO T96.

3.00 CONSTRUCTION REQUIREMENTS

A. Chip and Seal Mat - Typical Section "B". This work shall consist of furnishing and applying bituminous materials and cover coat materials in both single coat application and a double coat application in accordance with these Specifications and in reasonably close conformity with the lines shown on the Drawings or established.

B. An analysis of a representative sample of the aggregate proposed to be used, performed by an independent laboratory, shall be furnished to Schmueser Gordon Meyer. The analysis shall test abrasion, sieve analysis, unit weight, and material finer than No. 200 sieve.

C. Per Colorado Department of Transportation "Standard Specifications for Road and Bridge Construction, 1999", Subsection 409.04 through 409.08, except as follows:

409.04 - Weather Limitations (substitute the following)

Bituminous material shall not be applied on a damp surface, when either the air or pavement surface temperature is below 60°F, or when weather conditions would prevent the proper construction for the seal coat.

409.07 - Applying Bituminous Material (Add the following)

The bituminous coat for the 3/4" chips shall be applied at a rate of 0.50 to 0.60 gallons per square yard and 0.30 to 0.40 gallons per square yard for the 3/8" chips.

409.08 - Application of Cover Coat Material (Delete the last paragraph; add the following):

After the first lane of a two-lane roads is chipped, the loose chips shall be swept back from the centerline for at least 6 inches, and the second lane bituminous and chip application shall overlap 6 inches onto the first lane application.

Where applicable, excess material shall be swept from the entire surface by means of rotary power brooms within 24 hours after application of cover coat.
material. Said excess material shall be collected in residential areas, and disposed of off site by the Contractor.

Unless otherwise approved by the Engineer, the 3/4” aggregate shall be applied at a rate of 40 to 50 pounds per square yard and the 3/8” aggregate shall be applied at a rate of 20 to 30 pounds per square yard.

Where multiple layers of chips are to be placed, a period of seven (7) days of temperatures above 60°F shall be allowed between the first chip seal and the second chip seal for curing, unless otherwise approved by the Engineer.

4.00 SAMPLES

Sampling of asphalt materials shall be in accordance with the latest revision of AASHTO Designation T40 (ASTM Designation D140). Sampling of mineral aggregate shall be in accordance with the latest revision of AASHTO Designation T2 (ASTM Designation D75).

5.00 METHODS OF TESTING

Asphalt materials shall be tested using the appropriate methods of test of the American Association of State Highway and Transportation Officials (AASHTO). If an AASHTO method of test is not available, the approximated American Society for Testing and Materials (ASTM) method shall be used.

Mineral aggregate shall be tested as designated in the detailed requirements of those specifications, by one or more of the following AASHTO methods of test. If an AASHTO method is not available, the approximate ASTM method shall be used.

6.00 CHARACTERISTIC

<table>
<thead>
<tr>
<th>Method of Testing</th>
<th>AASHTO</th>
<th>ASTM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrasion of Coarse Aggregate Los Angeles Machine</td>
<td>T96</td>
<td>C131</td>
</tr>
<tr>
<td>Sieve Analysis, Fine and Coarse Aggregates</td>
<td>T27</td>
<td>C136</td>
</tr>
<tr>
<td>Unit Weight of Aggregate</td>
<td>T19</td>
<td>C19</td>
</tr>
<tr>
<td>Amount of Material Fine than No. 200 Sieve in Aggregate</td>
<td>T11</td>
<td>C117</td>
</tr>
</tbody>
</table>

7.00 METHOD OF MEASUREMENT.

Chip seal coat will be measured by the mile along the centerline of finished chip seal coated surface roadway or by square yardage of total surfaced roadway (centerline length by average width).

8.00 BASIS OF PAYMENT

The accepted quantities of chip seal coat will be paid for at the contract price per mile or square yard.
Payment will be made under:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Size) Chip Seal</td>
<td>Square Yard</td>
</tr>
<tr>
<td>(Bituminous Material)</td>
<td></td>
</tr>
<tr>
<td>(Road Name)</td>
<td></td>
</tr>
<tr>
<td>(General Location - Optional)</td>
<td></td>
</tr>
<tr>
<td>(Nominal Roadway Width)</td>
<td></td>
</tr>
</tbody>
</table>

Bituminous material, prime coat, and sampling & testing will not be paid for under separate items, but will be considered incidental to this Work.

9.00 FOG SEAL

The Fog Seal shall be a 50-50 dilution of bituminous materials HFMS-2P and water. This solution shall be applied at a rate of 0.08 to 0.15 gallons per square yard.

A light dusting of sand may be applied to the Fog Seal to accommodate traffic as soon as possible, if needed.

10.00 CONSTRUCTION ZONE TRAFFIC CONTROL

Construction Zone Traffic Control per the construct Zone Traffic Control per Colorado Department of Transportation "Standard Specifications for Road and Bridge Construction, 1999, Subsection 630.01 through 630.14, inclusive, except as follows:

630.07 - General

Traffic shall be kept off freshly placed chips until rolling is complete. When it is necessary to route traffic over the new treatment, speed shall be restricted to twenty (20 mph, or less, for twenty-four (24) hours after application.

630.13 - Methods of Measurement

Construction Zone Traffic Control will be measured on a lump sum basis.

630.14 - Basis of Payment

Payment will be made under:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Zone</td>
<td>Lump Sum</td>
</tr>
<tr>
<td>Traffic Control</td>
<td></td>
</tr>
</tbody>
</table>

The Contractor shall be required to submit a Traffic Control Plan at a Preconstruction Conference, the time and place which will be decided after the presentation of the Notice of Award. **STRICT IMPLEMENTATION OF THE CONTRACTOR’S TRAFFIC CONTROL PLAN TO SLOW TRAFFIC ON THE FRESHLY-CHIPPED ROAD SURFACES IS A PRIORITY.**
11.00 HIGHWAY PAINTING AND STRIPING

This Work shall consist of the furnishing and applying pavement markings, and furnishing, installing, and removing temporary pavement marking in accordance with the Colorado Department of Transportation "Standard Specifications for Road and Bridge Construction, 1999", Section 627 Pavement Marking, the Manual of Uniform Traffic Control devices for Streets and Highways (MUTCD), the Colorado supplement thereto, and in conformity to the lines, dimensions, patterns, locations and details shown on the plans or established, except as follows:

627.10 - Method of Measurement

Highway Painting and Striping will be measured on a lump sum basis.

627.11 - Basis of Payment

Payment will be made under:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway Painting and Striping</td>
<td>Lump Sum</td>
</tr>
</tbody>
</table>

END OF SECTION
SECTION 02555

WATER TRANSMISSION AND DISTRIBUTION LINES

PART 1 GENERAL

1.01 SCOPE

A. Work under this Section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to install, disinfect, and test all raw water and potable water transmission and distribution pipelines and appurtenances as specified herein and shown on the Drawings.

1.02 SUBMITTALS

A. Product data including catalog sheets and descriptive literature shall be submitted for all materials and equipment specified. Submittal shall include certificates of compliance as stated in section 01700 subsection 1.08 of these specifications.

1.03 PROTECTION OF WORK

A. All pipe fittings, valves and equipment shall be carefully handled, stored and protected in such a manner as to prevent damage to materials and protective coatings and linings. At no time shall such materials be dropped or dumped into trench.

B. Precaution shall be taken to prevent foreign matter from entering the pipe, fittings and valves prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.

C. At such time as pipe installation is suspended, either temporarily or overnight, the open end of the pipe shall be sealed with a watertight plug to prevent entrance of trench water, debris or foreign matter.

D. Under no circumstances shall trench water be allowed to enter the pipeline. When water is present in the trench, the seal shall remain in place until such time as the trench is pumped dry. Whenever trench water becomes evident, adequate measures shall be taken to prevent pipe floatation.

E. If, in the opinion of the Engineer, the Contractor is incapable of keeping the pipe free of foreign matter during installation, the Engineer shall require the Contractor to cover the pipe ends with close woven bags until the start of the joining operation.

PART 2 MATERIALS

This section covers the types of materials that will be required for the construction and installation of water lines. All materials used shall be new, of the best quality available, and conform with applicable standards as indicated herein. [NOTE: Local jurisdiction specifications (i.e.,
Section 02555 – Water Transmission and Distribution Lines

municipality, district, etc.), will govern when two or more alternatives are given in these specifications, or where there is a discrepancy between these specifications and local jurisdiction specifications.

2.01 DUCTILE IRON PIPE AND FITTINGS

A. Ductile Iron Pipe.
   2. Thickness Class - 52
   3. Pipe joints shall be push on joints, except where specifically shown or detailed otherwise.
   4. Pressure Rating - 350 psi

B. Fittings
   1. Type - All fittings shall be mechanical joint, except where specifically shown or detailed otherwise.
   3. Material - Ductile iron
   4. Pressure Rating - 350 psi

C. Joints
   3. Flanged, Reference Standard - ANSI B 16.1, Class 125

D. Gaskets
   1. Type - Rubber-ring gasket shall be suitable for the specified pipe sizes and pressure
   3. Lubricant - A non-toxic vegetable soap lubricant shall be supplied with the pipe

E. Protective Coating
   1. Underground Service - Manufacturer's standard bituminous coating - minimum 1 mil thickness.
   2. Polyethylene Film Envelope - Polyethylene encasement shall conform to AWWA C105, latest edition, or ANSI A.21.5. Film shall be Class C with a nominal thickness of 8 mils. Tape for securing the film shall have a minimum thickness of 8 mils and a minimum width of 1 inch. The polyethylene film shall be free of streaks, pinholes, tears or blisters.

F. Protective Lining
   1. Type - Cement mortar
   3. Thickness – Standard
2.02 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. PVC Pipe
1. Materials - ASTM D1784, Type 1, Grade 1, PVC 1120, 2000 psi design stress.
2. Reference Standard - AWWA C900, latest edition, 4" - 12".
3. Class - 200 (DR-14), 4" - 12".
5. Class - 235 (DR-18), 14" - 30".
6. Markings - Manufacturer's name, nominal size, class pressure rating, PVC 1120, NSF logo, identification code.
7. Specialties - Electric tracing wire, 14 gauge solid copper insulated wire.
8. Size - Shall conform to outside diameter of DIP.

B. Fittings
1. Type - All fittings shall be mechanical joint except where specifically shown or detailed otherwise.

C. Joints
1. Push-on rubber gasket.

2.03 FIRE HYDRANTS

A. Dry Barrel Type
2. Outlet Size - one 4 l/2 inch, two 2 1/2 inch.
3. Hydrant Size - 5 1/4 inch.
4. Inlet Size - 6 inch.
5. Operation - 1 1/8-inch pentagonal national standard operating nut, open counter clockwise.
6. Special Features - outlet hydrant shall open when turned to the left (counter clockwise).
7. Depth of Bury - As shown on Drawings.
8. Additional Requirements - Furnish hydrant complete with pipe and tee, 6 inch (6") restrained mechanical joint gate valve and thrust blocks. Hydrant shall be restrain-to the hydrant tee by 3/4 inch threaded rods protected from corrosion by the use of an approved bituminous coating, or approved equal.
2.04 VALVES

A. Gate Valves
   1. Resilient
      a. Size as shown on Drawings.
      c. Style - Iron body, bronze stem resilient seat gate valves, lubrication free, unobstructed through port to minimize head loss, entire body encapsulated inside and out with epoxy coating.
      d. Pressure Rating - 200 psi.
      e. Wrench Nut - 2 inch square.
      f. Manufacturer’s Reference - Dresser M&H RSGV.

B. Combination Air Release Valve.
   1. Size - 1” Orifice, or as recommended by manufacturer for correct application.
   2. Inlet - 1” Pipe Thread
   3. Materials
      Body - Cast Iron
      Float - Stainless Steel
      Seat - Buna-N
      Lever Frame - Delsrin
   4. Pressure Rating - 200 psi
   5. Manufacturer's Reference - APCO
   6. Performance - Permits efficient filling or draining of long pipelines, for protection against vacuum, and will continuously vent pockets of air as they accumulate in pipeline.

C. Pressure Reducing Valves.
   All pressure reducing valves shall be Golden-Anderson cushioned, single globe, pilot pattern, hydraulically operated with flanged ends (Figure 4500) or equal. The valve body shall be of cast iron ASTM-126 with flanges conforming to the latest ANSI standards. The valve body shall be extra heavy construction throughout. The valve interior trim shall be bronze B-62 as well as the main valve operation. The valve seals shall be easily renewable while no diaphragm shall be permitted within the main valve body. All controls and piping shall be non-corrosive construction.

2.05 VALVE BOXES

A. Screw Type - Three Piece
   1. Material - Cast Iron
   2. Size - 5 1/4 inch diameter
   3. Type - Three piece adjustable screw type
   4. Cover - Deep socket type with the word "water" cast in the top
   5. Base - #160 type with 20.5” bottom opening

2.06 MECHANICAL JOINTS

Only M.J. solid sleeves allowed.
2.07 WATER SERVICE AND COMPONENTS

A. Corporation Stops
   1. Material - Brass or bronze
   2. Size - As shown on Drawings
   4. Thread inlet - Tapered (CC) Type
   5. Thread outlet - Copper Service Thread for compression connection if local jurisdiction permits.

B. Copper Service Pipe
   1. Reference Standard - AWWA 75-CR Type K
   2. Size - As shown on Drawings.

C. Curb Box
   1. Material - Cast iron box, complete w/lid and red brass screw.
   2. Type - McDonald 5605 with stationary rod.
   3. Size - 1" thru 2", depending on local jurisdiction preference.

D. Curb Stop
   2. Size - As shown on Drawings.
   3. Inlet - Copper service thread for compression connection or compression connection if local jurisdiction permits.
   4. Outlet - Copper service thread for compression connection if local jurisdiction permits.

E. Service Clamps
   1. For use with Ductile Iron Pipe:
   2. For use with PVC Pipe:
      a. Materials - Bronze service clamp, O-ring gasket, two section of three section clamp, (CC) threads.
      b. Manufacturer's Reference - Mueller BR2S Series, Smith Blair 397, or equal.

2.08 CONCRETE FOR THRUST BLOCKS AND ENCASING OF PIPE

Concrete for thrust blocks and for encasing the water pipe line shall have a 28-day compressive strength of not less than 3000 psi.

2.09 TRACER WIRE
No. 15 or larger, insulated, stranded copper. All splices to be watertight, underground type.

2.10 DETECTABLE METALLIC UNDERGROUND TAPE

Shall be blue in color and marked "'Caution -Buried Waterlines below". Follow manufacturer's recommendations for installation procedures.

PART 3 METHODS AND PROCEDURES

3.01 CLEANING AND INSPECTION

A. Clean all pipe, fittings, valves and related material thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from jobsite.

B. The Contractor shall take all necessary precautions to prevent any construction debris from entering the water lines during construction of water lines and appurtenances. If this debris should enter the distribution system, the Contractor shall furnish all labor and material necessary to clean the system. Under no circumstances will the Contractor flush the debris into an existing distribution system.

3.02 VERIFICATION

Verify dimensions and class of all existing and proposed pipe, valves, fittings and equipment prior to installation to ensure the piping system will fit together properly.

3.03 PIPE EMBEDMENT

A. Placing Embedment Material - Refer to Section 02221 for placement methods.

B. Embedment Classes - Refer to Section 02222 for embedment materials as listed below.

   Use Class 6 aggregate 4” below pipe and 12” above pipe for all pipe materials. Contractor shall compact trench bottom before placing bedding and shall compact bedding.

3.04 PIPE INSTALLATION

A. Methodology - Pipe shall be laid in straight section with bell ends facing the direction of laying unless otherwise directed by the Engineer. Where pipe is laid on a grade of ten percent (10%) or greater, the installation shall proceed uphill with the bell ends facing upgrade. The pipeline shall be installed so that a continuous positive or negative grade is maintained between high and low points to avoid air pockets. Jointing of the pipe shall be made in accordance with the directions of the manufacturer of the pipe and the manufacturer of the coupling.
The pipe shall be brought to correct line and grade, and secured in place with the specified bedding material as directed in Section 02221.

B. Pipeline Depth - as indicated on Drawings, or as per local jurisdiction but always below frost level. Depth shall be based on depth below finished grade of a project and not existing grade. Contractor shall be responsible for keeping pipelines from freezing if fire line is temporarily installed above frost line before fill material is installed.

C. Concrete Encasement - Install concrete encasement where indicated on the drawings or as required by other sections of this Specification. Concrete shall have a three thousand (3000)psi compressive strength. Reinforcing shall consist of four (4) evenly spaced longitudinal No. 4 rebars.

D. Installation of Ductile Iron Pipelines.
1. Pipe Handling. Pipe should be lowered into the trench with ropes, slings or machinery. Under no circumstances should the pipe be pushed off the bank and allowed to fall into the trench.
2. Pipe Laying. Pipe shall be laid in straight sections, in an uphill direction, with bell ends facing in the direction of laying, unless directed otherwise by the Engineer.
3. Jointing of Push-on Joints. In joining the pipe, the exterior four inches of the pipe at the spigot end and the inside of the adjoining bell shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating) and other foreign matter. The gasket shall be placed in the bell as per manufacturer's installation instruction. A thick film of the pipe manufacturer's joint lubricant shall be applied to the gasket over its entire surface. The spigot end of the pipe shall then be wiped clean and inserted into the bell to contact the gasket. The pipe shall be forced all the way into the bell by crowbar or by jack and choker slings. Check the position of the gasket with a feeler gauge to ensure it is not rolled.
4. Pipe Cutting. The cutting of pipe for fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. The flame cutting of pipe by means of an oxyacetylene torch will not be allowed.
5. Polyethylene Film Envelope. Encase main and fittings using procedures recommended by manufacturer. Special care shall be used at all overlap joints.

E. Installation of Polyvinyl Chloride (PVC) Pipe.
1. Pipe Handling. Pipe should be carefully lowered into the trench to avoid pipe falling into trench.
2. Pipe Laying. Pipe shall be laid in straight sections with bell ends facing the direction of laying. When pipe laying is not in progress, the open end of the pipe shall be closed by a water-tight plug.
3. Jointing the Pipe. The outside of the spigot and the inside of the bell shall be thoroughly wiped clean. Set the rubber ring in the bell with the marked edge facing toward the end of the bell. Lubricate the spigot end using a thin film of the manufacturer-supplied lubricant. Push the pipe spigot into
Position the completed joint so that the mark on the pipe end is in line with the end of the bell.

4. Pipe Cutting. The cutting of pipe for fitting or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe and so as to leave a smooth end at right angles to the axis of the pipe. Bevel the end of the pipe with a beveling tool after the pipe is cut. Place a clearly visible position mark at the correct distance from the end of the field-cut pipe.

3.05 INSTALLATION OF PIPELINE APPURTENANCES

A. General. Install all valves, meters, manholes, and other equipment appurtenant to pipeline at the locations indicated on the drawings or as otherwise designated by the Engineer to accommodate field conditions. Document "record" measurements prior to backfill referencing all appurtenant equipment to the nearest permanent surface improvement.

B. Installation of Valves. Install valves in the pipeline in the same manner specified for laying and jointing the pipe and in accordance with details included in Drawings.

C. Valve Boxes. Except where specified otherwise, install valve boxes on all buried valves. Install boxes such that no stress is transmitted to the valve. Set boxes plumb and directly over the valve with the top of the box placed flush with the finished grade. Backfill and thoroughly compact around each box. Provide extended stems on valves where required such that the operating nut is not lower than seven feet (7') below finished grade.

D. Debris Caps. Install debris caps in valve boxes per plan details. All valve boxes shall have debris caps installed.

E. Fire Hydrants. Install hydrants in accordance with the standard details on the drawings. All tie rods and appurtenances to be completely covered with a bitumastic coating prior to backfill. Hydrant to be set plumb and true to grade. Contractor to bag or cover the fire hydrant that is not in operation.

F. Reaction Anchor and Blocking. Concrete thrust blocks shall be provided, as shown in the details included with the Drawings for all tees, elbows, plugs, reducers, valves, fire hydrants and crosses if one or more sides of the cross is plugged. The bearing area of the block shall be at least equal to that stated on the drawings. The bearing surface shall be against undisturbed earth. The block shall be placed normal to the thrust as shown on the drawings. Concrete for thrust blocks shall have three thousand (3000) psi compressive strength.

Contractor will be required to use either plywood forms or plastic to protect the nuts and bolts on the fittings when the concrete reaction block is placed.

Contractor to also use star clamps or wood blocking as a method of temporary restraint to secure fittings while concrete reaction blocks set up. (Note: Temporary restraint to be used for those cases where a tie-in is being made and the water needs to be turned back on as soon as possible).
3.06 CONNECTION TO EXISTING WATER FACILITIES

A. All main line connections between existing and proposed piping shall be made during non-business hours or at a time which is acceptable to the Owner. All scheduled shut-offs shall be planned and approved in advance to allow ample time for notifications. All persons affected by the shut-off shall be given a 24 hour notice in the local newspaper and/or local radio at the Contractor's expense. In addition, the Contractor shall personally warn those affected 1 hour before the water is shut off.

B. The tie-ins between existing and proposed mains shall be made so that both the proposed main and existing main are in service at the same time. Only after both mains are tested, approved and in service can the individual proposed service lines tie into the existing service line on the building side of the curb valve. The affected property shall be given a minimum of one (1) hour notice before the water is shut off. The new line must have passed the pressure testing and bacteriological test prior to connecting the services to the proposed water line.

C. Remove existing curb boxes and locate new curb boxes on property line unless otherwise instructed by Project Engineer. Contractor is to provide all necessary fittings needed to reconnect service line on property side of curb box. Contractor shall notify Project Engineer if existing service line is leaking prior to connection. Contractor shall be responsible for repair of existing service line if it leaking after connection is made. Contractor shall keep the connection to existing pipe exposed, and notify Project Inspector, and again approval from Project Inspector prior to backfilling over connection to existing service line.

D. Take all precautions to prevent contamination when making connections to existing potable water lines. No trench water, mud or other contaminating substances shall be permitted to enter the pipeline.

E. Swab the interior of all new pipe, fittings and valves installed in the existing pipeline with a 5 percent (50,000 ppm) chlorine solution prior to installation. After the connection is completed, flush the main to remove all contaminated water.

3.07 PROTECTION OF WATER SUPPLIES

A. Water lines shall be located a minimum of ten feet (10') horizontally from existing or proposed sewer mains. Wherever the sewer line crosses above or within eighteen inches (18") beneath the water mains, the sewer line shall be made impervious by the method listed below:

1. For twenty feet centered over the waterline.

In all cases, select granular backfill shall be used to prevent any settling of the higher pipe.

3.08 SERVICE CONNECTIONS

Customer service connections shall be installed in accordance with the details set forth on
the Drawings. Terminate the service with a curb stop and box and mark with a stake except where shown otherwise on the Drawings.

3.09 TRACER WIRE

Tape electrical tracing wire to the top of the pipe at 20-foot intervals to prevent dislocation of the wire during backfilling. Extend wire to ground surface at all valves, fire hydrants, and other locations shown on drawings. The tracing wire shall be brought up on the outside of the valve box. When the wire is within 4" of the top of the lid, the wire shall be brought back inside the box and securely fastened. Provide sufficient slack in the wire outside of the box to compensate for any future adjustment to the valve box. Required on all water mains. Prior to final acceptance of the water line but not before final restoration and grading, a continuity test shall be made on all tracer wire. The contractor will be responsible for performing this test and shall do so in the presence of the Resident Project Representative.

PART 4 FIELD QUALITY CONTROL

4.01 HYDROSTATIC TESTS

A. Make pressure and leakage tests on all newly laid pipe. Furnish all necessary equipment and material, make all taps in the pipe as required, and conduct the tests. The tests shall be conducted between valved sections of the pipeline, or as approved by the Engineer. The Engineer will monitor the tests.

B. Furnish the following equipment and material for the tests:

<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Approved graduated containers</td>
</tr>
<tr>
<td>2</td>
<td>Pressure gauges</td>
</tr>
<tr>
<td>1</td>
<td>Hydraulic force pump approved by the Engineer</td>
</tr>
<tr>
<td>1</td>
<td>Additional 1/2 inch pressure tap for Engineer's test gauge</td>
</tr>
<tr>
<td></td>
<td>Suitable hose and suction pipe as required</td>
</tr>
</tbody>
</table>

C. Conduct the tests after the trench has been partially backfilled with the joints left exposed for inspection, or when completely backfilled, as permitted by the Engineer. Where any section of pipe is provided with concrete reaction blocking, do not make the pressure test until at least 5 days have elapsed after the concrete thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut to 2 days.

D. Conduct pressure test in the following manner, unless otherwise approved by the Engineer: after the trench has been backfilled or partially backfilled as hereinbefore specified, fill the pipe with water, expelling all air during the filling. The test pressure shall be 1½ times normal working pressure at the point of lowest elevation of the test gauge, or 150 psi.

E. Duration: The duration of each pressure test shall be 2 hours, unless otherwise directed by the Engineer.
F. Procedure
1. Slowly fill the pipe with water and allow to stand for 24 hours. Expel all air from the pipe. Allow and maintain the specified test pressure by continuous pumping if necessary for the entire test period. The test pressure shall be calculated for the point of lowest elevation, or as specified by the Engineer. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately.
2. Before the line is pressurized, the Engineer shall verify that all necessary main line valves are open or closed with regard to the section of line being tested. In addition, the Engineer shall verify that all hydrant valves are open.

G. Leakage Allowance:
1. Leakage allowance shall be defined as the maximum quantity of makeup water that can be added into a pipeline undergoing hydrostatic pressure testing, or any valved section thereof, to maintain pressure within +/-5 psi. The leakage allowance is exceeded if the quantity of makeup water is greater than that determined by the following formula:

\[ Q = \frac{LD\sqrt{P}}{148,000} \]

In the above formula:

- \( Q \) = Allowable leakage (gallons per hour)
- \( L \) = Tested length of pipe (feet)
- \( D \) = Nominal diameter of pipe (inches)
- \( P \) = Average test pressure during the test (psi)

H. Correction of Excessive Leakage:
Should any test of pipe laid disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage of a subsequent test is within the specified allowance.

PART 5 DISINFECTION OF POTABLE WATERLINES

5.01 GENERAL
A. Flush and disinfect potable waterlines in accordance with the procedure set forth in AWWA C601, latest edition, Disinfecting Water Mains.
B. Provide all temporary blow-offs, pumps, chlorination equipment, chlorine and all other necessary apparatus required.

5.02 PIPE CLEANING
A. If the pipe contains dirt or heavy encrusted matter that, in the opinion of the Engineer, will not be removed during the flushing operation, the Contractor shall clean and swab the interior of the pipe with a five percent (50,000 ppm) chlorine solution.
B. Preliminary Flushing. Flush pipeline to disinfection, except when the tablet method is used, to remove all remaining foreign material. The flushing operation shall develop a minimum velocity of 2.5 ft./sec.

5.03 CHLORINE APPLICATION

A. In general, chlorine shall be applied using the continuous feed method. However, on large diameter lines where this would not be practical, the slug method may be used. The tablet method may be used on short extensions (up to 2500 feet) of small diameter mains (12 inches and smaller).

B. Continuous Feed Method. Introduce water into the line at a constant rate while adding chlorine at a minimum concentration of 50 mg/l. Maintain the chlorinated water in the pipeline for a minimum of 24 hours after which period the treated water shall contain no less than 25 mg/l of chlorine throughout the entire length. Repeat the above procedure if the residual at the end of 24 hours fails to meet the minimum concentration.

C. Slug Method. Introduce water with a minimum chlorine concentration of 300 mg/l at a constant measured rate into the pipeline. Apply column or slug of chlorinated water that will, as it passes along the line, expose all interior surfaces for a period of three hours. Check the application at the upstream end of the line.

D. Tablet Method. This method shall not be used if trench water or foreign material has entered the line or if the water is below 52°C (41°F). Because preliminary flushing cannot be used, this method shall only be used when scrupulous cleanliness has been exercised.

E. Place tablets in each section of pipe in sufficient number to produce a dose of 50 mg/l. Refer to Table 3 of AWWA C601, latest edition, for the required minimum number of tablets. All tablets within the main must be attached at the top of the pipe. Introduce water into the pipeline at a rate no greater than 1 ft./sec. and retain the water in the pipeline for a period of 24 hours.

5.04 FINAL FLUSHING

After the required retention period, flush all heavily chlorinated water from the main until the chlorine concentration is no higher than that prevailing in the system, or less than 1 mg/l.

5.05 BACTERIOLOGIC TESTS

A. After completion of the final flushing and prior to placing the pipeline in service, collect samples from the end of the line and test for bacteriologic quality to show the absence of coliform organisms. The number and frequency of samples shall conform to the requirements of the Public Health Authority having jurisdiction, but in no case shall the number be less than one for chlorinated supplies.

B. Collect samples in sterile bottles from a standard corporation stop furnished and installed by the Contractor in the main. Do not collect samples using a hose or fire hydrant.

5.06 REPITITION OF PROCEDURE
If the original disinfection fails to produce satisfactory samples, repeat the disinfection procedure until satisfactory results are obtained.

6.00 MEASUREMENT AND BASIS OF PAYMENT

Payment will be made at the unit price given on the bid schedule for each item of work and will be full compensation for that item complete in place.

END OF SECTION
1.00 GENERAL

1.01 Scope. Work under this section shall include furnishing all materials, labor and tools necessary to perform all installation, cleaning and testing of all sanitary sewer lines and appurtenances as specified herein and shown on the Drawings.

1.02 Related Work Specified Elsewhere.

Section 02221 - Trenching, Backfilling and Compaction
Section 02222 - Embedment and Base Course Aggregate

1.03 Submittals. Product data including catalog sheets and descriptive literature shall be submitted for all materials and equipment specified. Submittals shall state manufacturer's compliance with all published standards referenced herein.

1.04 Protection of Work. All pipe, fittings and equipment shall be carefully handled, stored and protected in such a manner as to prevent damage to materials. At no time shall such materials be dropped or dumped into trench.

Precaution shall be taken to prevent foreign matter from entering the pipe and fittings prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.

At such time as pipe installation is suspended, either temporarily or over night, the open end of the pipe shall be sealed with a watertight plug to prevent entrance of trench water, debris or foreign matter. A mechanical-type fitting shall be used for this seal. At no time shall duct tape or any other tape be used for this seal.

Under no circumstances shall trench water be allowed to enter the pipeline. When water is present in the trench, the seal shall remain in place until such time the trench is pumped dry. Whenever trench water becomes evident, adequate measures shall be taken to prevent pipe flotation. Contract shall bear all costs associated with keeping trench free of liquids.

If, in the opinion of the Engineer, the Contractor is incapable of keeping the pipe free of foreign matter during installation, the Engineer shall require the Contractor to cover the pipe ends with close woven bags until the start of the jointing operation.

2.00 MATERIALS

This item covers the types of materials that will be allowed for the construction and installation of sewer lines. All materials used shall be new, of the best quality available and conform to applicable standards as indicated herein.

2.01 Ductile Iron Pipe and Fittings. Not permitted.

2.02 Polyvinyl Chloride (PVC) Pipe and Fittings (Gravity Main)
A. PVC Pipe, through 15” diameter.
   1. Material Reference Standard - ASTM D1784
   2. Pipe Reference Standard - ASTM D3034
   3. Class - SDR35
   4. Markings - Manufacturer's name, nominal size, PVC classification, Type PSM, SDR-35, PVC gravity sewer pipe, ASTM D3034 and code number, green coloring dyed into PVC.

B. PVC Pipe, 18” to 27” diameter.
   1. Material Reference Standard - ASTM D1784
   2. Pipe Reference Standard - ASTM F679
   3. Markings - Manufacturer's name, nominal size, PVC cell classification, PS46 PVC Sewer Pipe and ASTM F679. Green coloring dyed into PVC.
   4. Variance - PVC piping meeting the stiffness requirement of ASTM F679 but not meeting wall thickness requirement will be allowed under this specification. Manufacturers will be required to provide a list of at least five (5) similar projects with references in which pipe has been successfully used and laboratory testing data showing the pipe meets the structural requirements of ASTM F679.

C. Fittings
   1. Type - PVC push-join
   2. Materials - ASTM D1784
   3. Reference Standard - ASTM D3034 or ASTM F679

D. Joints
   1. Type - push-on rubber gasket
   2. Gasket reference standard - ASTM F477

E. Restraint-type Glands.

2.03 Force Main.

A. PVC Pipe.
   1. Materials - ASTM D 1784, Type 1, Grade 1, PVC 1120, 2000 psi design stress.
   3. Class- 150 (DR-18).
   4. Markings - Manufacturer's name, nominal size, class pressure rating, PVC 1120, NSF logo, identification code.
   5. Specialties - Electrical tracing wire, 14 gauge solid copper insulated wire.
   6. Size - Shall conform to outside diameter of DIP.

B. Fittings
   1. Type - All fittings shall be restrained mechanical joint except where
specifically shown or detailed otherwise.

2. Reference Standard - AWWA/ANSI C153/A 21.53
3. Pressure Rating - 250 psi
4. Gasket Reference Standard - AWWA C-111

C. Testing

1. Force main to follow waterline leakage testing procedures.

2.04 Concrete for Thrust Blocks and Encasing of Pipe. Concrete for thrust blocks and for encasing the sewer pipeline shall have 28-day compressive strength of not less than 3000 psi.

2.05 Manholes.

A. Concrete Rings/Cones

1. Type - Precast
2. Reference Standard - ASTM C478
3. Size - Four-foot or five-foot inside diameter

B. Manhole Bases

1. Shall be precast or cast-in-place, depending upon local jurisdiction standards, with integrally cast-in water stops. Tee tops of base shall be at least 12 inches above top of pipe.
2. Reference Concrete Standard - ASTM C150 Type II modified or Type V

C. Manhole Steps

1. Material - Aluminum, ASTM C478
2. Size/Type - ½" round stock x 10" wide aluminum with slip-proof tread.
3. Mounting - Grouted in place on concrete ring with ASTM C150 Type II modified Portland Cement mortar and sand grout for watertight joint.

D. Joints

1. Type - Rub'r Nek preformed gasket as manufactured by K.T. Snyder Co., Inc., Houston, Texas or equal.
2. Cement Mortar Material Reference Standard - One part Portland Cement, Type II, modified with three parts of sand. Cement mortar to be used with concrete grade rings only.

E. Grade Adjustment Rings

1. Type - Precast ASTM C150 Type II modified concrete or HDPE ASTM D 1248.
2. Size - Not less than 6" wide x heights to allow for one-inch adjustments.

F. Frame and Cover

1. Material Reference - Grey Iron, ASTM A48, Class 30
2. Cover - Stamped with "SEWER", machined bearing surface with ring
3. Type - Heavy, combined weight of ring and cover greater than 375 pounds.
4. Manufacturer Reference - Neenah, R-1706

2.06 Sewer Service Line Materials.

A. Wyes - Required for all new sewer line construction.
   1. Material - ASTM D3034 PVC
   2. Strength - for use with SDR-35
   3. Joint - Slip-on rubber gasket

B. Saddles (Required for tapping existing mains).
   1. Material - ASTM D3034 PVC
   2. Joint - Rubber seal to main with stainless steel compression bands. Slip-on service joint with rubber gasket.

3.00 METHODS AND PROCEDURES

3.01 Cleaning and Inspection. Clean all pipe, fittings and related materials thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from job site.

The Contractor shall take all necessary precautions to prevent any construction debris from entering the sewer lines during construction. If this debris should enter the pipeline system, the Contractor shall furnish all labor and materials necessary to clean the system. Under no circumstances will the Contractor flush the debris into an existing sanitary sewer system.

3.02 Placement of Pipe.

A. Laser Beam. All sanitary sewer pipe must be installed with a laser. If bending of the beam due to air temperature variations becomes apparent with "in pipe" units, a fan shall be provided to circulate air in the pipe. Air velocity shall not be so excessive as to cause pulsating or vibrating of the beam. If, in the opinion of the Engineer, the beam cannot be accurately controlled, this method of setting line and grade shall be abandoned.

3.03 Pipe Embedment.

A. Placing embedment material - Refer to Section 02221 for placement methods.

B. Embedment Classes - Refer to Section 02221 and Construction Drawings for embedment materials for each class listed below:
   1. Pipe shall be embedded according to applicable details on the Construction Drawings.

3.04 Pipe Installation.

A. Installation of Ductile Iron Pipe Lines. Not applicable.

Section 02560 – Sanitary Sewerlines
B. **Installation of Polyvinyl Chloride (PVC) Pipe.**

1. **Pipe Handling.** Pipe should be carefully lowered into the trench to avoid pipe falling into trench.

2. **Pipe Laying.** Pipe shall be laid true to line and grade, in an uphill direction, with bell ends facing in the direction of laying. When pipe laying is not in progress, the open end of the pipe shall be closed by a watertight plug.

3. **Jointing the Pipe.** The outside of the spigot and the inside of the bell shall be thoroughly wiped clean. Set the rubber ring in the bell with the marked edge facing toward the end of the bell. Lubricate the spigot end using a thin film of the manufacturer-supplied lubricant. Push the pipe spigot into the bell. Position the completed joint so that the mark on the pipe end is in line with the end of the bell.

4. **Pipe Cutting.** The cutting of pipe for manholes or for fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. Bevel the end of the pipe with a beveling tool after the pipe is field cut. Place a clearly visible position mark at the correct distance from the end of the field-cut pipe.

C. **Installation of Slipline Pipe.** Not applicable.

### 3.05 Sewer Manhole Installation.

A. **General.** Manholes shall be furnished and installed to depths and dimensions shown on the Construction Drawings and/or staked in the field. Manholes shall be constructed of precast concrete rings in accordance with details shown on the Construction Drawings.

B. **Connections to Manholes.** Connection of manhole with pipe shall be made with flexible connector detail. See details on Construction Drawings. In addition, extra care shall be taken by grouting or other means of sealing to assure positive watertight manholes around the inlet or outlet pipes.

C. **Manhole Floor and Inverts.** Manhole bases shall be constructed to conform to the details shown on the Drawings. The invert channels shall be smooth and semicircular in shape, conforming to the inside of the incoming and outgoing sewer pipelines. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. Where large differences in invert elevations exist, sloped flow channels shall be formed so the wastewater does not undergo a vertical drop. The invert channels may be formed directly in the concrete of the manhole base. The floor of the manhole outside the channel shall be smooth and shall slope toward the channels.

D. **Finish Grade and Adjustment.** To bring the manhole cover to the correct
Section 02560 – Sanitary Sewerlines

elevation, the top section of each manhole shall be constructed of pre-cast concrete grade adjustment rings. These rings shall be not less than six inches (6") wide and furnished in heights to allow for two-inch (2") adjustments. Grade adjustment with rings shall be eight inches (8") maximum and two inches (2") minimum. All rings shall be grouted in place.

Finish Grade and Adjustment HDPE Alternate. High-density polyethylene grade rings may also be used to bring manhole cover to correct elevation. Grade rings shall be molded from HDPE as defined in ASTM Specification D1248-84. Available thicknesses are 1.25", 1.50", 2.00" 4.00" and a sloped thickness .75" x 1.50". When this alternate is used, pavement slope should be matched using one or more sloped rings. Manufacturer's reference - Ludtech, Inc.

E. Manhole Stubs. All pipe stubs required form manholes are shown on the Drawings. Stubs shall extend approximately 24" from the outside face of the manhole and shall be capped or plugged with manufactured fittings to form a watertight installation.

3.06 Connection to Existing Sewer Facilities. Connections to existing sewer facilities where live flows exist shall be made only after prior consultation with and receipt of written permission from the Engineer. No bypass of sewage to the surface will be allowed in the completion of this connection. Connections shall be made as shown on the Drawings. All connections between pipes of different materials shall be made with approved manufactured connectors. All taps must be watertight and root tight.

3.07 Protection of Water Supplies. Sewer lines shall be located a minimum of ten feet (10’) horizontally from existing or proposed water mains. Where the sewer line crosses above the waterline, or is less than eighteen inches (18") vertically below the invert of the water line, or is less than 10 feet (10’) horizontally from the water main, the sewer line shall be made impervious by either of the methods listed below:

A. The sewer pipe shall be reinforced with a concrete encasement. The encasement shall be at least six inches (6") thick on all sides of the sewer pipe and extend ten feet (10’) on either side of the water main. Use three No. 4 rebar the length of the encasement.

B. Install one piece of C-900 PVC pipe centered over the waterline.

C. Install a grout collar over the two sewer joints on either side of the water crossing. The grout collar shall be around the entire perimeter of the joint.

If clearance is less than 12 inches vertically, the space between the water and sewer mains shall be filled by 3000 psi concrete.

In all cases, bedding material shall be used to prevent any settling of the higher pipe.

3.08 Service Connections. Customer service connections shall be installed in accordance with the details set forth on the construction Drawings. After the service connection is installed, the end shall be plugged watertight with a manufactured plug and marked with a stake except as shown otherwise on the Drawings.
4.00 FIELD QUALITY CONTROL

4.01 Alignment and Grade. Sewer pipelines will be checked by the Engineer to determine whether any displacement of the pipe has occurred after the trench has been backfilled. The test will be as follows:

A light will be flashed between manholes, or if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight. If the illuminated interior of the pipeline shows poor alignment, displaced pipe, earth or other debris in the pipe, or any other kind of defect, the defects determined by the Engineer shall be remedied by the Contractor at his own expense. Test will be repeated after completion of backfilling and any poor alignment, displaced pipe, or other defects determined by the Engineer, shall be corrected.

4.02 Leakage Test. Sewerlines shall be tested using a low-pressure air test only; water tests will not be allowed. Only after the sanitary sewers, including appurtenances and sanitary laterals have been installed, backfilled and cleaned, shall the Contractor proceed with an air test on the installed facilities.

A. Low Pressure Air Test Procedure. The section of sewerline to be tested should be flushed and cleaned prior to conducting the low-pressure air test. This serves to clean out any debris, wet the pipe, and produce more consistent results. Isolate the section of sewerline to be tested by means of inflatable stoppers or other suitable test plugs. One of the plugs should have an inlet tap, or other provision for connecting a hose to a portable air control source.

If the test section is below the groundwater level, determine the height of the ground water above the spring line of the pipe at each end of the test section and compute the average. For every foot of groundwater above the pipe spring line, increase the gauge test pressure by 0.43 pounds per square inch. Connect the air hose to the inlet tap and a portable air control source. The air equipment should consist of necessary valves and pressure gates to control the rate at which air flows into the test section and to enable monitoring of the air pressure within the test section. Also, the testing apparatus should be equipped with a pressure relief device to avoid the possibility of loading the test section with the full capacity of the compressor.

Add air slowly to the test section until the pressure inside the pipe is raised to 5.0 psig greater than the average backpressure of any groundwater that may be over the pipe. After a pressure of 5.0 psig is obtained, regulate the air supply so that the pressure is maintained between 4.5 and 5.0 psig (above the average ground water back pressure) for a period of two minutes. This allows the air temperature to stabilize in equilibrium with the temperature of the pipe walls. The pressure will normally drop slightly until temperature equilibrium is obtained.

Determine the rate of air loss by the time/pressure drop method. After the two-minute air stabilization period, the air supply is disconnected and the test pressure allowed to decrease to 4.5 psig. The time required for the test pressure to drop from 4.5 psig to 4.0 psig is determined by means of a stopwatch and this time interval is then compared to the required time in the attached table to determine if the rate of air loss is within the allowable time limit. If the time is
equal to or greater than the times indicated in the tables, the pipeline shall be deemed acceptable.

**MINIMUM DURATION FOR AIR TEST PRESSURE DROP**

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches.</td>
<td>mm.</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
</tr>
<tr>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>10</td>
<td>225</td>
</tr>
<tr>
<td>12</td>
<td>305</td>
</tr>
<tr>
<td>15</td>
<td>380</td>
</tr>
</tbody>
</table>

Upon completion of the test, open the bleeder valve to allow air to escape. Plugs should not be removed until all air pressure in the test section has been released. During this time, no one should be allowed in the trench or manhole while the pipe is being decompressed. Air test shall also include service lines and appurtenances.

4.03 **Manhole Inspection.** During the construction of the manholes, the Contractor shall, in accordance with good practice, ensure that no earth, sand, rocks or other foreign material exists on the joint surfaces during assembly of the section. The Engineer shall check each manhole to determine whether the manhole fulfills the requirements of the Drawings and Specifications.

A. **Visual Examination.** The Engineer shall visually check each manhole, both exterior and interior, for flaws, cracks, holes, or other inadequacies, which might affect the operation or watertight integrity of the manhole. Should any inadequacies be found, the Contractor, at his own expense, shall make any repairs deemed necessary by the Engineer.

B. **Leakage Test.** All manholes shall be tested for leakage and all tests shall be witnessed by the Engineer. The leakage test shall be conducted prior to backfilling around the manhole and shall be carried out in the following manner:

1. Stubouts, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn.

2. Installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specifications for which performance information has been provided by the manufacturer and approved by the Engineer.

3. A measured vacuum of 10" of mercury shall be established in the manhole. The time for the vacuum to drop to 9" of mercury shall be recorded.
4. Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from 10" to 9" of mercury. The maximum allowable leakage rate for a 4' diameter manhole shall be in accordance with the following:

<table>
<thead>
<tr>
<th>MANHOLE DEPTH</th>
<th>MINIMUM ELAPSED TIME FOR A PRESSURE CHANGE OF 1 INCH Hg</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 ft. or less</td>
<td>60 seconds</td>
</tr>
<tr>
<td>&gt; 10 ft. but &lt; 15 ft.</td>
<td>75 seconds</td>
</tr>
<tr>
<td>&gt; 15 ft. but &lt; 25 ft.</td>
<td>90 seconds</td>
</tr>
</tbody>
</table>

For manholes 5' in diameter, add an additional 15 seconds and for manholes 6' in diameter, add an additional 30 seconds to the time requirements for 4-foot diameter manholes.

5. If the manhole fails the test, necessary repairs shall be made and the vacuum test and repairs shall be repeated until the manhole passes the test or the manhole shall be tested in accordance with the standard exfiltration test and rated accordingly.

6. If a manhole joint mastic is completely pulled out during the vacuum test, the manhole shall be disassembled and the mastic replaced.

4.04 Deflection Test for Non-Rigid Pipe. The maximum allowable pipe deflection for a completely backfilled, non-rigid sewer pipe shall not exceed five percent (5%) of the nominal internal pipe diameter. Deflections in non-rigid pipe shall be checked by measurement or by pulling a mandrel with the minimum allowable diameter through the pipe. The minimum allowable diameter shall be equal to the minimum interior diameter of the pipe, as specified in the applicable portions of the ASTM Standard Specifications or the pipe manufacturer's recommendations, minus five percent of the minimal interior diameter of the pipe. Those sections of non-rigid pipe with deflections greater than the maximum allowable five percent shall not be acceptable and the Contractor will remove and replace these sections at his own expense.

Deflection tests will be run if in the opinion of the Engineer testing is warranted. The program for testing shall be mutually determined by the Engineer and the Contractor. The Contractor shall furnish all labor, tools and equipment necessary to make the tests and to perform any work incidental thereto.

4.05 Pressure Testing of Force Main. Make pressure and leakage tests on all newly laid pipe. Furnish all necessary equipment and material, make all taps in the pipe as required, and conduct the tests. The tests shall be conducted between valved sections of the pipeline, or as approved by the Engineer. The Engineer will monitor the tests.

Furnish the following equipment and material for the tests:
<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Approved graduated containers</td>
</tr>
<tr>
<td>2</td>
<td>Pressure gauges</td>
</tr>
<tr>
<td>1</td>
<td>Hydraulic force pump approved by the Engineer</td>
</tr>
<tr>
<td>1</td>
<td>Additional ½-inch pressure tap for Engineer's test gauge</td>
</tr>
</tbody>
</table>

Suitable hose and suction pipe as required

Conduct the tests after the trench has been partially backfilled with the joints left exposed for inspection, or when completely backfilled, as permitted by the Engineer. Where any section of pipe is provided with concrete reaction blocking, do not make the pressure test until at least 5 days have elapsed after the concrete thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut to 2 days.

Conduct pressure test in the following manner, unless otherwise approved by the Engineer: after the trench has been backfilled or partially backfilled as herein before specified, fill the pipe with water, expelling all air during the filling. The test pressure shall be 1½ times normal working pressure at the point of lowest elevation of the test gauge.

A. Duration

1. The duration of each pressure test shall be 2 hours, unless otherwise directed by the Engineer.

B. Procedure

1. Slowly fill the pipe with water and allow to stand for 24 hours. Expel all air from the pipe. Allow and maintain the specified test pressure by continuous pumping if necessary for the entire test period. The test pressure shall be calculated for the point of lowest elevation, or as specified by the Engineer. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately.

2. Before the line is pressurized, the Engineer shall verify that all necessary main line valves are open or closed with regard to the section of line being tested. In addition, the Engineer shall verify that all hydrant valves are open.

C. Leakage

1. Leakage shall be defined as the quantity of water necessary to hold the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

\[
L = \frac{ND\sqrt{P}}{7400}
\]

Section 02560 – Sanitary Sewerlines
In the above formula:

- \( L \) = Allowable leakage, in gallons per hour
- \( N \) = Number of joints in the length of pipe tested
- \( D \) = Nominal diameter of pipe, in inches
- \( P \) = Average test pressure during the leakage test, in pounds per square inch gauge.

D. The pressure testing of water service lines shall follow the same procedure as outlined in the section. In all cases, however, the corporation stop, service line and curb stop shall be visually inspected under full test pressure and any leaks fixed.

E. Correction of Excessive Leakage

1. Should any test of pipe laid disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage of a subsequent test is within the specified allowance.

4.06 Televising Main. All sewer connection lines eight inches (8") or larger shall be televised. The tape shall have a running footage meter showing the exact footage from the entry manhole. Tapes shall be provided with a log showing the location of all defects and service lines.

5.00 MEASUREMENT OF PAYMENT

See Bid Schedule

END OF SECTION
PART 1 GENERAL

1.01 SCOPE

Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to furnish and install one or more courses of bituminous mixture constructed on a prepared surface in accordance with the Specifications or as shown on the Drawings. The finished product shall be in close conformity with the lines, grades, thickness, and typical cross sections shown on the Drawings or as established in the field.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Section 02222 - Embedment and Base Course Aggregate

1.03 REFERENCE STANDARDS

A. All work is to be performed in accordance with Section 4 of this Public Works Manual.

B. Details in this specification reference Divisions 400 and 700 of the CDOT Standard Specifications.

1.04 SUBMITTALS.

A. Mix Design. Provide complete mix design by independent testing laboratory, including certifications of all material compliance.

B. Prime Coat. Certification of material.

C. Tack Coat. Certification of material.

1.05 COORDINATION

It shall be the responsibility of the Contractor under this section to coordinate this work with all other trades involved in the project. No paving work shall be started until the work of others has progressed to a point that a definable area can be paved; patching, blending, butting, etc. of work under this section will not be allowed except as required as part of the normal paving operation.

PART 2 MATERIALS

2.01 COMPOSITION OF MIXTURE

A. Use Grading SX (Reference Section 703.04); aggregate gradation per Table 703-3.

B. Asphalt Cement to be PG 58-28.
C. The design mix for Hot Bituminous Pavement shall conform to the following:

- **Marshall Design** -- 50 blow
- **Marshall Stability**: 1200 (min.)
- **Flow, 0.01"**: 8-16
- **Air Void in Mix**: 3-5
- **VMA, % min.**: See Table 403-2
- **Grade of Asphalt Cement**: PG 58-22
- **Accelerated Moisture Susceptibility Tensile Strength (Lottman)**: See Table 401-2
- **Voids filled with Asphalt**: 65-78

<table>
<thead>
<tr>
<th>Nominal Maximum Size*</th>
<th>Design Air Voids**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches (mm)</td>
<td>3.0%</td>
</tr>
<tr>
<td>3/4</td>
<td>19.0</td>
</tr>
<tr>
<td>1/2</td>
<td>12.5</td>
</tr>
<tr>
<td>3/8</td>
<td>9.5</td>
</tr>
</tbody>
</table>

* The nominal size is defined as one sieve larger than the first sieve to retain more than 10%.

** Minimum VMA must pass at 4% design air voids.

The Contractor shall prepare a quality control plan outlining the steps to be taken to minimize segregation of HBP. This plan shall be submitted to the Engineer prior to beginning the paving operations. When the Engineer determines that segregation is unacceptable, the paving shall stop and the cause of segregation corrected before paving operations will be allowed to resume.

D. Contractor to provide to the Engineer, a job mix composition meeting this section. Submittal shall include testing results sufficient to show compliance. Testing shall be under the certification of an independent testing laboratory acceptable to the Engineer. The mix design shall have been completed within the preceding 12 months.

E. Contractor may use an anti-stripping additive from the current CDOT approved list of additives.

2.02 PRIME COAT

A. Prime coat shall be MC-70 (ASTM D2026)

2.03 TACK COAT
A. Tack Coat to be SS-1h (ASTM D977) or CSS-1h (AASHTO M208).

2.04 PAVEMENT MARKING. REFERENCE CDOT SECTION 708.05 AND MUTCD STANDARDS.

A. No glass beads required. Pavement marking must follow MUTCD standards for retroreflectivity as follows:

<table>
<thead>
<tr>
<th>Posted Speed (mph)</th>
<th>≤ 30</th>
<th>35-50</th>
<th>≥ 55</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Lane Roads w/Centerline Markings Only</td>
<td>n/a</td>
<td>100</td>
<td>250</td>
</tr>
<tr>
<td>All other roads</td>
<td>n/a</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

Notes: 1 – Measured at standard 30-m geometry in units of mcd/m²/lux
2 – Exceptions:

A. When RRPMs supplement or substitute for a longitudinal line, minimum pavement markings retroreflectivity levels are not applicable as long as the RRPMs are maintained so that at least 3 are visible from any position along that line during nighttime conditions.

B. When continuous roadway lighting assures that the markings are visible, minimum pavement marking retroreflectivity levels are not applicable.

PART 3 METHODS AND PROCEDURES

A. Maximum compacted pavement depth per pass to be 3”.

B. Prime not required unless indicated on Drawings. Prepared base course or subgrade surfaces receiving pavement courses shall be primed at Contractor’s expense if the surface has deteriorated, due to traffic, weather or time lapse between surface preparation and placement of bituminous materials, such that in the opinion of the Engineer, use of prime coat is required.

C. Tack coat required between lifts, on all abutting old pavement surfaces and for overlays on existing pavements unless waived by Engineer. Application rate shall be 0.05 to 0.10 gallons per square yard diluted.

D. Dilution shall be one part tack emulsion to one part water.

E. All cut asphalt surfaces that are to butt new pavement sections shall be tacked with a liberal application of tack coat prior to paving.

3.01 COMPACTION

A. The plant mix bituminous pavement shall be compacted by rolling. The number, weight and type of rollers furnished shall be that which is sufficient to obtain the required density while the mixture is in a workable condition. Compaction shall begin immediately after the mixture is placed and be continuous until the required density is obtained. When the mixture surface temperature falls below 185 degrees F, no further compaction effort will be permitted unless approved.
B. All roller marks shall be removed with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted during surface course final rolling and will not be permitted on any rolling on bridge decks covered with waterproofing membrane.

C. Pavement shall be compacted to a density of 92 percent to 96 percent of the maximum theoretical density, determined according to AASHTO T209. Field density determinations will be made in accordance with Colorado Procedure 44 or 81.

D. Along forms, curbs, headers, walls and all other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers.

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

3.02 SURFACE TOLERANCES

The variations 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. No skin patching will be allowed.

PART 4 FIELD QUALITY CONTROL

4.01 INSPECTION AND TESTING

Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing.

4.02 DENSITY TESTING AND CONTROL

A. See Section 3.01 above.

B. Field Testing. Testing for density during compaction operations to be done using nuclear density methods.

C. Frequency of Testing. Minimum of one (1) test every 10,000 square feet or as directed by Engineer. Testing to be paid for by Owner.

D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-compact and/or replace defective work at direction of Engineer. All retesting to be paid for by Contractor and to be performed by testing firm approved by the Engineer.

END OF SECTION
SECTION 02626
CONCRETE CURB AND GUTTER, SIDEWALK, CURBWALK AND DRIVEWAY

PART 1 GENERAL

1.01 SUMMARY

A. This Work shall include furnishing all materials, labor, equipment and miscellaneous items necessary for the construction of concrete curb, gutter, sidewalk, handicap ramps, driveway or any combination thereof, all in accordance with these Specifications and in close conformity with the lines, grades, and typical sections as shown on the Construction Drawings or established in the field.

PART 2 PRODUCTS

A. The materials shall conform to the requirements specified in the following:
   1. Section 02222 - Embedment and Base Course Aggregate.

2.01 JOINT FILLER

A. Pre-molded, preformed conforming to AASHTO M213 to the full depth of the section.

2.02 STRUCTURAL CONCRETE

A. See Section 03300 for complete Specification.

2.03 FIBERMESH

A. Fibermesh additive at the rate of 1½ pounds/cubic yard shall be used with all concrete. Use shall be in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.01 EXCAVATION

A. Excavation shall be made to the required depth and width to permit the installation and bracing of the forms. The foundations shall be shaped and compacted to a firm even surface conforming to the section shown on the Construction Drawings. Material determined to be unsuitable or non-compact by the Engineer will be removed and replaced.

3.02 FORMS

A. Forms shall be wood or metal and shall extend for the full depth of the concrete. All forms shall be straight, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in alignment both horizontally and vertically until removal. Satisfactory slip forms may be used when approved. Use of curbing machine will be permitted providing line and grade tolerances can be met.
B. Steel plates that can be shaped to the desired radius shall be used on all short radii. Open joints shall be formed with a steel separator plate conforming to the section being installed.

C. Oil and clean all forms prior to placement of concrete.

3.03 MIXING AND PLACING

A. The foundations shall be thoroughly moistened immediately prior to the placing of the concrete. Compaction of the concrete shall have thorough consolidation achieved by tamping, spading, vibrating or other acceptable methods. Forms shall be left in place until the concrete has set sufficiently to prevent deformation due to removal. Upon removal of the forms, the curb face shall be immediately finished to a uniform surface. In the case of matching existing concrete finishes, an approved method shall be used.

3.04 FINISHING

A. The surface shall be floated with a wood or magnesium float and given a broom finish. No plastering of the surface will be permitted. All outside edges of slabs and joints shall be rounded to a ¼-inch radius. Broom marks to be perpendicular to traffic or pedestrian flow for installation of sidewalk or concrete flatwork. Broom marks to be parallel to traffic flow for installation of curb and gutter.

3.05 JOINTS

A. Expansion joints shall be made using ½” pre-molded expansion joint. Construction joints, using ½” pre-molded joint filler, shall be placed at the end of a day's run or during a day's work if there is more than a 30 minute delay in concrete delivery.

B. Construction joints shall be formed around all appurtenances such as manholes, utility poles, adjacent structures, etc., extending into or abutting the Work. Pre-molded expansion joint filler ¼" thick shall be installed in these joints. Expansion joint filler shall be installed between concrete sidewalks and any fixed structure.

C. Dummy joints (contraction joints) shall be made by a forming tool to a depth of ¼ of the section with a width of ½” to ¼”. Open joints shall be made with a separator plate, ⅛” to ¼” in width. Dummy joints in lieu of open joints will be permitted with use of curbing machine.

D. Joint spacing shall be located as follows:
   1. Expansion joints: Every 100’ on center; at end of corner radius; at driveway sections; as shown on Construction Drawings.
   2. Construction joints: As required during construction; at appurtenances and structures through or abutting Work.
   3. Dummy or open joints: Every 10’ on center for curb and gutter and curbwalk; equal to width of sidewalk for sidewalk; as shown on Construction Drawings.

3.06 CURING

A. Immediately upon completion of the finishing, concrete shall be moistened and kept moist for a minimum of 72 hours. In lieu of wetting, use of a membrane-curing compound, at the direction of the Engineer, will be permitted.
3.07 BACKFILLING

A. After the concrete has set sufficiently, the areas behind the curb shall be backfilled to the required elevations and shall be thoroughly compacted in accordance with Section 02200 - Earthwork.

3.08 FIELD QUALITY CONTROL

A. Tolerances

All vertical surfaces shall not vary more than ¼” in 10’ in the horizontal direction. Surface deviation shall not exceed ¼” when measured with a 16’ straight edge.

B. Concrete Strength

The Geo-technical Engineer may take field samples for purposes of testing concrete strength. All substandard strength concrete shall be removed and replaced at Contractor's expense.

END OF SECTION
SECTION 02700
FINISHED GRADING AND RESTORATION

1.00   GENERAL

1.01   Scope.  This Work shall consist of finish grading, restoration of grounds and clean-up.  This shall be a continuous process from project start-up to final acceptance of the Work.

1.02   Related Work Specified Elsewhere.  This section pertains to all other sections of these Specifications.

2.00   MATERIALS AND METHODS

2.01   General Cleanup.  Cleanup shall include the regrading, resurfacing, rebuilding and replacing of all surfaces on which construction took place, and rebuilding or replacing any areas disturbed by the construction.  The streets or roads where disturbed shall be resurfaced by the Contractor, including both gravel and oil roads, and shall be replaced in as good, or better condition than, that at the start of construction.  The Engineer shall be the sole judge as to whether streets, roads or property have been restored to a condition as good or better than at the start of construction.

The Contractor shall, at all times, keep property on which Work is in progress free from accumulation of waste material or rubbish caused by employees or caused by the Work, and he shall carry on a constant program to maintain Work area, structure sites, right-of-ways and the surface of streets and roads in a condition satisfactory to the appropriate authority, grantor of the right-of-way, and the Engineer.

Preliminary clean-up shall commence as soon as the construction site is occupied by the Contractor (including his employees, supplies, materials or equipment) and shall be a continuous process, if necessary, in order that the site of the Work shall have an appearance and/or utility equal to or better than the start of the Work.

Upon completion of the Work, the Contractor shall remove all remaining rubbish, tools, equipment, scaffolds and surplus materials from the job and leave the Work area clean and free of debris.

3.00   RESTORATION

3.01   General.  All driveways, retaining walls, concrete flatwork, drainage ditches, trees, shrubs, and other miscellaneous items shall be returned to as good or better than pre-construction conditions if they are impacted by Work.

3.02   Landscaping.  Not applicable.

3.03   Irrigation Ditches.  Because of the large amount of lateral irrigation ditches, special care shall be taken to ensure the ditches are restored to pre-construction conditions.

4.00   MEASUREMENT AND BASIS FOR PAYMENT
Cleanup and restoration shall not be measured and paid for as a separate bid item but shall be considered a part of the project.

END OF SECTION
PART 1 GENERAL

1.01 SCOPE

A. Furnish labor, materials, equipment and services to complete the following work which shall include but not necessarily be limited to:
1. Soil Preparation and Scarification
2. Topsoil Placement
3. Seeding or Hydroseeding
4. Fertilizing
5. Mulching
6. Maintaining areas

1.02 RELATED WORK SPECIFIED ELSEWHERE.

Section 02200 - Excavation and Embankment
Section 02700 - Finish Grading & Restoration

1.03 SUBMITTALS:

A. Seed mixture certifications stating botanical & common name, percentage by weight, and percentage of purity, germination, and weed seed of each grass species.

B. Certification for mulch as "weed free".

C. Certificates of compliance for fertilizer and tacifier.

PART 2 MATERIALS

2.01 SEED MIX

Seed shall be at least 98% pure and shall have a minimum germination percentage of 85%. Seed shall be furnished separately or in mixtures in standard containers with the same seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish seed tags or other official documentation to the Landscape Architect and BLM Glenwood Springs Field Office Authorized Officer at least 7 days before the date of proposed seeding for acceptance. This shall include a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within 6 months of date of delivery. This statement shall include: Name and address of laboratory, date of test, lot number of each kind of seed, and the results of tests as to name, percentage of weed content for each kind of seed furnished, and in case of a mixture, the proportions of each kind of seed.
### Required Dryland Seed Mix

<table>
<thead>
<tr>
<th>Variety</th>
<th>% of Total/1000 Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluebunch Wheatgrass</td>
<td>Goldar, P-7, Secar</td>
</tr>
<tr>
<td><em>(Pseudoroegneria spicata)</em></td>
<td>25%</td>
</tr>
<tr>
<td>Bottlebrush squirreltail</td>
<td>VNS</td>
</tr>
<tr>
<td><em>(Elymus elymoides)</em></td>
<td>25%</td>
</tr>
<tr>
<td>Western Wheatgrass</td>
<td>Arriba, Rosanna</td>
</tr>
<tr>
<td><em>(Paasopyrum smithii)</em></td>
<td>15%</td>
</tr>
<tr>
<td>Slender wheatgrass</td>
<td>San Luis</td>
</tr>
<tr>
<td><em>(Elymus trachycaulus)</em></td>
<td>15%</td>
</tr>
<tr>
<td>Indian Ricegrass</td>
<td>Paloma, Nezpar, Rimrock</td>
</tr>
<tr>
<td><em>(Achnatherum hymenoides)</em></td>
<td>10%</td>
</tr>
<tr>
<td>Mutton grass</td>
<td>VNS</td>
</tr>
<tr>
<td><em>(Poa fendleriana)</em></td>
<td>5%</td>
</tr>
</tbody>
</table>

### 2.02 FERTILIZER

Fertilize all seeded areas with a commercial type 15-40-5 mixture of similar ratio. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate specified in these Specifications and shall meet the specified requirements of the applicable Federal and State laws. They shall be furnished in standard containers with name, weight and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

### 2.03 TOPSOIL

Material stripped from site consisting of loose friable loam reasonably free of admixtures of subsoil, refuse, stumps, rocks, brush, weeds or other material detrimental to proper development of vegetative growth. Topsoil shall be a minimum depth of four inches (4”).

### 2.04 STRAW MULCH

Mulch all seeded and hydroseeded areas with straw mulch. Material for straw mulching shall consist of straw or oats, barley, wheat or rye and shall be certified as weed free. A copy of the certification shall be submitted to the Landscape Architect prior to placement of any materials. Clean field hay may be substituted for straw when approved by the Landscape Architect. Straw or hay in such an advanced stage of decomposition as to smother or retard the normal growth of grass will not be accepted.

### 2.05 TACIFIER

Straw mulch shall be secured by Plantago-based tacifier or similar, approved equal.
PART 3 EXECUTION

3.01 TIME OF YEAR TO SEED AND HYDROSEED (CONSTRUCTION ALLOWED JUNE 1 – OCTOBER 15).

<table>
<thead>
<tr>
<th>Spring Seeding</th>
<th>Fall Seeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not recommended (June 1 - June 15 borderline suitability)</td>
<td>September 15th to October 15th (Preferred timeframe)</td>
</tr>
</tbody>
</table>

Seeding at any time other than within the above seasons shall be allowed only when the Contractor submits a written request for permission to do so and permission is granted. In the request, the Contractor must agree to apply the specified seed at a rate of not less than 25 percent greater per unit area than the rates specified for use within the seeding season. The additional materials shall be furnished and placed at the Contractor's expense. The Contractor must also agree to reseed, re-mulch and repair any areas seeded out-of-season which fail to wind, erosion, lack of germination and/or disturbance by the Contractor.

3.02 TOPSOIL EXCAVATION

Remove all sod, topsoil, organic earth, stockpile topsoil as designated on Drawings or as directed by Landscape Architect.

3.03 TOPSOIL PLACEMENT.

A. General: When job site has been shaped and ready for placement of topsoil, cover all cut-fill areas and construction scars with topsoil to depth of 6". (Topsoil depth shall be increased up to a maximum of 12" where possible utilizing any extra stockpiled topsoil material on-site, prioritizing locations where trees and shrubs will be planted on the berm.) Contour all surfaces to approximate grade and blend with existing adjacent terrain in accordance with detail drawings. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

B. Slope Rounding: Round top and bottom of slopes and feather into undisturbed natural terrain. Avoid abrupt grade changes, making smooth transitions from slopes to more level areas.

C. Slope Molding: Avoid long continuous slope faces by molding face of slope to accent existing adjacent terrain. Steepened slope faces near ridges and bluffs, laid back to link to natural draws, creating an undulating face.

D. Surface Roughing: Gouge slope surfaces of 2:1 or steeper with horizontal ridges and trenches to depth of 6" minimum, creating roughened surface to lessen erosion, improve moisture percolation and soil layer binding. Trenches or ridges shall not be longer than 30' to prevent water accumulation and flowing water to cause rivulets.

3.04 SEEDING AND SODDING.

A. HYDROSEEDING

1. Seed and fertilizer shall be applied by spraying them on slopes of 3:1 or greater gradient in the form of an aqueous mixture and by using the methods and equipment described herein.
2. Spraying Equipment. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons per minute at a pressure of 100 pounds per square inch. The pump shall be mounted in a line which will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipelines shall be capable of providing clearance for 5/8" solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supported stand in such a manner that it can be rotated through 360° horizontally and inclined vertically from at least 20° below to at least 60° above the horizontal.

There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over a distance varying from 20 feet to 100 feet. One shall be a close-range jet nozzle. For case of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet in length shall be provided to which the nozzles may be connected.

3. Mixtures. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds of these combined solids shall be added to and mixed with each 100 gallons of water.

All water used shall be obtained from the Town of Basalt and shall be free from injurious chemicals and other toxic substances harmful to plant life.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within 2 hours from the time they were mixed or they shall be wasted and disposed of at locations acceptable to the Landscape Architect.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds. The mixture shall be applied by means of a high-pressure spray, which shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.
Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with Specifications shall be used to cover specified sections of known area. Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

Seeding shall be at 30-40 lbs. per acre.

B. DRYLAND SEEDING
1. A viable seed bed must be prepared by either disking or hand raking.
2. Do not use wet seed or seed which is moldy or is otherwise damaged in transit or storage.
3. Sow seed using a spreader, seeding machine or drill seeder. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
4. Sow not less than 1.5 lbs. per 1000 sq. ft.
5. Rake seed lightly into top 1/4” to 1/8” of soil, roll lightly, and water with a fine spray.

3.05 MULCHING

Mulch shall consist of certified weed-free straw or weed-free native grass hay. All seeded areas shall be mulched, as a separate process, with a 2” depth layer of straw mulch. Mulch shall be applied in a uniform manner using standard straw blowing equipment. Areas not accessible, by reach, to straw blowing equipment shall be mulched by hand. Mulching shall be applied within 24 hours following completion of seeding.

Areas not properly mulched or damaged shall be repaired and re-mulched in an acceptable manner, at Contractor’s expense. Mulch removed by circumstances beyond the Contractor’s control shall be repaired as ordered.

3.06 TACIFIER

Straw mulch not covered by erosion blanket shall be secured by Plantago-based tacifier or similar, approved equal. Tacifier shall be applied at a rate of 150 lbs/acre.

4.00 MEASUREMENT AND PAYMENT

See Bid Schedule

END OF SECTION
PART 1 GENERAL

1.01 SUMMARY

A. This work consists of furnishing and applying soil binding slurry over disturbed slopes as a temporary soil erosion inhibitor. Disturbed slopes that will not be re-worked and finished slopes that are not scheduled revegetation for a period 21 days or more shall be treated as construction progresses. As construction progresses into the Fall season, all disturbed slopes that will not be re-worked before spring and finished slopes that are not scheduled for revegetation until spring shall be treated before the onset of winter and far enough in advance, in order for the treatment to be applied in accordance of the climatic requirements of this specification. Contractor shall furnish the equipment and labor necessary for performing the work.

B. Soil binding agent shall be applied to all disturbed open slopes using standard mechanized hydraulic equipment used for broadcasting water based slurry products.

C. The soil-binding agent shall be added to the proportionate quantity of water and thoroughly mixed per manufacturer's recommendations.

D. This specification shall apply to all disturbed areas outside CDOT right-of-way.

PART 2 PRODUCTS

2.01 MATERIALS

A. Soil binder shall be Soil Master WR or approved equal. Soil binder shall be non-toxic, non-flammable and conform to the following properties:

- Copolymer of methacrylates/acrylates/acrylics/tripolycate: 60%
- Extgxoxyalted surfactants: 2%
- Silicates: 2%
- Inert ingredients: 36%
- pH: 4 - 5.1
- Color: Milky white
- Lbs. per U.S. gallon: 9 - 10 lbs.

B. Wood cellulose fiber mulch shall be Mat-Fiber, or approved equal. Wood cellulose fiber mulch shall conform to the following requirements:

- Moisture content (total weight basis): 12.0% ± 3%
- Organic matter (oven-dried weight basis, min.): 99.3%
- Inorganic content (oven-dried weight basis, max.): 0.7%
- pH at 3% consistency in water slurry (avg.): 4.9
- Water holding capacity (min.): 1.2 gal/lb.
- Color: Green
C. Water used for establishing the proper dilution ratio shall be clean, free of sediment and other debris and pollutants.

2.02 OTHER ACCEPTED DUST SUPPRESSION ADDITIVES

A. Starch-Based or other 100% Natural Polymer
   1. Accepted Product – DustStar by Chemstar or approved equal.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Liquefied soil binder (Soil Master WR) shall be thoroughly mixed with water and wood cellulose fiber mulch (Mat-Fiber) into a homogeneous mix and applied to the disturbed ground at the following rate per acre:

<table>
<thead>
<tr>
<th>Soil Binder/Acre</th>
<th>Cellulose Fiber/Acre</th>
<th>Water/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>165 gallons</td>
<td>200 pounds</td>
<td>2,000 gallons</td>
</tr>
</tbody>
</table>

B. The soil-binding product and cellulose fiber mulch shall be slowly poured into the slurry tank with agitators activated until homogeneous slurry is formed. The soil binding slurry shall be applied when the ground temperature is fifty degrees F. or greater at time of application and sustained while the slurry solidifies and stabilizes for a forty-eight hour period.

C. The soil binding slurry shall be sprayed uniformly over the disturbed areas. Application shall be in the form of a mist and avoid over saturation that results in the slurry running off the slope. Contractor may need to spray areas more than once to achieve the proper coverage and avoid over-saturation. The slurry shall be applied to a moistened ground, but not in the presence of freestanding surface water. Any areas not sealed with the soil binder properly or areas damaged due to the negligence of the Contractor shall be repair and retreated.

D. The Engineer may order test sections be established for adjusting the equipment and assure proper application and conformance to the specification.

END OF SECTION
SECTION 03100
CONCRETE FORMWORK

PART 1 GENERAL

1.01 SCOPE
The work in this section consists of the design, furnishing, erecting and removing of forms for cast-in-place concrete.

1.02 RELATED WORK SPECIFIED ELSEWHERE.
Section 03200 - Concrete Reinforcement
Section 03300 - Cast-in-Place Concrete

1.03 QUALITY ASSURANCE.
A. Reference Standards - American Concrete Institute Standards (ACI).
   301 Specifications for Structural Concrete for Buildings, Chapter 4, Formwork. ACI 347, Recommended Practice for Concrete Formwork (Chapters 1 through 5) as modified herein.

B. Design Criteria - Design formwork for the loads, lateral pressure and allowable stresses outlined in Chapter 1 of ACI 347.

C. Maximum Allowable Tolerances
   1. Variation from plumb:
      a. Lines and surfaces of columns and walls in any ten feet of length, ¼-inch; in 40 feet or more, ½-inch.
      b. Control joint grooves, and other conspicuous lines. In any 20 feet of length, ¼-inch; in 40 feet or more, ½-inch.
   2. Variation from level or specified grade in slabs. In any 10 feet of length; ¼-inch; in 40 feet or more, ½-inch.
   3. Variation of the linear building lines from established position in plan and related position of columns and walls, in any bay, ½-inch; in any 20 feet of length, ½-inch; in 40 feet or more, 1 inch.
   4. Refer to ACI 301, Table 4.3.1 for additional requirements.

PART 2 MATERIALS

2.01 GENERAL
Where "Smooth Form Finish", or "Grout Cleaned Finish" is specified, use prefabricated plywood panel forms, job-built plywood forms, forms lined with plywood, or steel forms. For reservoir walls, use two-foot wide form material to form the circular portion of the reservoir. The forms may be steel or plywood.

2.02 STEEL FORMS
Symons "Steel-Ply", Simplex "Industrial Steel Frame Forms", Universal "Uniform". Forms shall be clean, straight and true, without surface defects.

2.03 PLYWOOD FORMS
Product Standard PS-1, waterproof, resin-bonded exterior type. Forms shall be clean, straight and true, without surface defects.
2.04 LUMBER
Straight, uniform width and thickness, clean and free from offsets, holes, dents and other surface defects.

2.05 CHAMFER STRIPS
Clear white pine, surface against concrete planed.

2.06 FORM TIES
Permanently embedded one-inch break-back cone ties with water seal washers. Ties shall have a neoprene seal integral to the tie. Provide sufficient strength and rigidity to maintain forms in proper location without use of auxiliary spreaders. Form ties shall be uniformly spaced and aligned in vertical and horizontal rows.

2.07 JOINTS.
Joints in circular reservoir shall be formed as shown on the Drawings.

2.08 POLYETHYLENE FILM
Product Standard PS-17; 6 mil. See Drawings for application at the top of the reservoir wall.

2.09 FORM BOND BREAKING AGENT
Shall be non-staining agent that will allow the removal of forms without damaging or discoloring concrete.

PART 3 EXECUTION

3.01 GENERAL
Erect forms substantially tight to prevent leakage of mortar and braced or tied to maintain the desired position, shape and alignment before, during and after concrete placement. At vertical wall joints where forms overlay existing concrete, a mortar-tight joint shall be required. Use a bead of silicone caulking or foam joint filler against concrete before placing form.

Provide temporary openings at the bottom of column and wall forms and at other locations where necessary to facilitate cleaning and inspection.

Temporary openings in wall or column forms used to limit the free fall of concrete to a maximum of four feet shall be located to facilitate placing and compaction of the concrete. Such openings in walls shall not exceed 10 feet laterally to avoid moving concrete laterally more than five feet.

If tremies of proper length are used for depositing concrete in walls or columns, temporary openings for concrete placement will not be required.

Whenever the top of a wall will be exposed to weathering, do not extend the forms on one side above the top wall; bring to true line and grade.

At other locations, bring forms to a true line and grade, or provide a wooden guide strip at the proper location on the forms so that the top surface can be finished with a screed or template for concrete which is to have a specified elevation, slope or contour.

Flat segmental forms not more than 24 inches wide may be used for forming curved surfaces 25 feet in diameter or larger.
Where concrete is placed against rock, remove all loose pieces of rock and clean the exposed surface with a high-pressure hose.

The circular ring wall footing for the reservoir shall have a smooth steel troweled finish within the limits described on the Drawings.

3.02 EMBEDDED ITEMS
Anchor bolts, casting, steel shapes, conduits, sleeves and other materials that are to be embedded in the concrete shall be accurately positioned in the forms and securely anchored. Do not embed conduits, sleeves or other materials in the reservoir wall unless specifically shown on the Drawings.

Conduits shall not be installed in tank walls or slabs.

Assure embedments are clean when installed.

At pipe penetrations where a steel weep ring is not called for, provide a watertight seal between the pipe and wall using "Ramneck" butyl sealant.

3.03 PREPARATION OF FORM SURFACES. REMOVE MORTAR, GROUT AND OTHER FOREIGN MATERIAL FROM FORM SURFACES.

Coat form surfaces with form release agent before either the reinforcing steel, post-tensioning materials or concrete are placed. Do not allow form coating to:

a. Stand in puddles in the forms;
b. come in contact with the reinforced steel; or
c. come in contact with adjacent hardened concrete against which fresh concrete is to be placed.

3.04 EDGES AND CORNERS
Place chamfer strips in forms to bevel exposed edges and projected corners. Tool the top edges of walls and slabs not indicated on the Drawings to be beveled.

Form beveled edges for all vertical and horizontal corners of equipment bases unless indicated otherwise on the Drawings.

Chamfer strips shall be 3/4-inch, unless indicated otherwise on the Drawings.

3.05 REMOVAL
Carefully remove forms only after concrete is able to support all dead and live loads and curing requirements are met. Apply potable water safe curing compound to all formed surfaces immediately after form removal.

Determine the strength of concrete from site-cured cylinders, cured in the same manner as the formed concrete.

If job cured cylinder test reports are not available for formed concrete, the form supports shall remain in place for not less than the following periods of time. These periods represent cumulative number of days or fractions thereof, not necessarily consecutive, during which temperature of the concrete is above 50 degrees Fahrenheit (50°F).
Walls and columns  48 hours
Reservoir top slab  Only after satisfactory post-tensioned.
                   Re-shoring shall not be permitted.

After removal, ends of metal form ties shall be recessed a minimum of one inch from surfaces. Form tie holes shall be patched with high-strength, non-shrink grout in a manner as to be permanent.

END OF SECTION
SECTION 03200
CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 Scope
The work in this section covers furnishing and installing steel bars and welded wire fabric for concrete reinforcement.

1.02 Related Work Specified Elsewhere.
Section 03100 - Concrete Formwork
Section 03300 - Cast-in-Place Concrete

1.03 Quality Assurance.

A. Reference Standards. American Concrete Institute Standards (ACI).
   301 - Specifications for Structural Concrete for Buildings.
   318 - Building Code Requirements of Reinforced Concrete.
   350R - Concrete Sanitary Engineered Structures.
   344 - Design and Construction of Circular Prestressed Concrete Structures.

B. As modified herein or on the Drawings.

C. Allowable Tolerances. Fabrication Tolerances.
   1. Sheared length: + 1 inch
   2. Depth of truss: + 0, -1/2 inch for concrete thickness 24 inches or less and + 0, -1/2 inch for concrete thickness over 24 inches.
   3. Overall dimensions of stirrups, ties and spirals: + 0, 1/2-inch for concrete thickness 24 inches or less and + 0, -1/2 inch for concrete thickness over 24 inches.
   4. All other bends: + 1 inch.

D. Welding.
   Only A706 reinforcement may be welded and only with the approval of the Engineer.

1.04 SUBMITTAL OF SHOP DRAWINGS

A. Shop Drawings.
   1. Show sizes, quantity and dimensions for fabrication and placing of reinforced bars and bar supports.
   2. Indicate bar schedules, stirrup spacing, and diagram of bent bars.
   3. Reinforcement shop drawings shall be submitted on reproducible. Provide two sets of prints and reproducible. B. Certificates. Mill test certificates identifying chemical and physical analysis of each load of reinforced steel delivered.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver to site in bundles marked with metal tags indicating bar size and length. Carefully handle and store on supports, which will keep the steel from coming in contact with the new ground.
1.06 JOB CONDITIONS

Do not burn or weld in the vicinity of tendons.

PART 2 PRODUCTS

2.01 REINFORCEMENT BARS

A. Bars. Steel reinforcement shall be new, deformed billet steel, meeting ASTM Standard A615 or A706; for rebars No. 4 and larger, Grade 60; for No. 3 rebars and designated reinforcement, Grade 40 or Grade 60.

1. Bend Test: Meet 180 degree bend at 60 degrees F. minimum temperature without cracking when bent around pin diameter indicated.
   a. Number 3, 4 and 5 bars around pin diameter equal to 4 times nominal bar diameter.
   b. Number 6 through 11 bars around pin diameter equal to 5 times nominal bar diameter.

2. Bend test for 14 and 18: Meet 90 degree bend at 60 degrees F. minimum temperature without cracking when bent around a pin diameter qual to 10 times nominal bar diameter.


C. Bar Supports.
   2. Where concrete surface will be exposed to fluids, view or weather, the supports or accessories shall be completely comprised of non-metallic material such as plastic or shall be completely plastic or epoxy coated.

D. Splice Devices
   Provide Thermit (Cadweld) welding process only when called for on the Drawings. Where mechanical splice devices are called for on the Drawings, provide Lenton (or equal approved by Engineer) "Formsaver" threaded reinforcement splices to match the reinforcement size that the splice is intended to extend. Splices shall meet ACI 318, Chapter 12 strength criteria of developing 125 percent of the specified yield strength of the reinforcement bar it replaces. Install per manufacturer's recommendations.

E. Fabrication. In accordance with CRSI manual of Standard Practice, except for the allowable tolerances specified herein in Section 1.03 (C) of this specification.

2.02 WELDED WIRE FABRIC

ASTM A185 or A497.

PART 3 EXECUTION

3.01 PREPARATION

Remove all mud, oil, loose rust or mill scale and other foreign materials that may reduce bond. Rust or mill scale which is "tight" will be permissible without cleaning or brushing, provided weights, dimensions, cross sectional area, and tensile properties meet requirements ASTM A615.
3.02 INSTALLATION.

A. Bar Placement. Conform to CRSI-WCRSI "Placing Reinforcing Steel".

B. Bar Supports.
1. Provide minimum number of supports as required by ACI 315.
2. Do not use pebble, piece of broken stone, common or face brick, metal pipe or wood blocks to support reinforcement.
3. On ground, where necessary, solid concrete bricks may be used to support wire chairs that, in turn, support the reinforcing steel in the slabs on grade. Small squares of 1/2" plywood may be used to support grade lab chair on the compacted subgrade.

C. Placement Tolerances.
1. Clear distance to formed surface: See Section D. Concrete Cover below i) and ii).
2. Spacing between bars: -1/4 inch.
3. Top bars in lab and beams: See Section D. Concrete Cover below i) and ii).
4. Crosswise of members: Spaced evenly within 2 inches.
5. Lengthwise of members: +2 inches.
6. Maximum bar movement to avoid interference with other reinforcing steel, conduit or embedded items: One bar diameter.
   a. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars may be rejected by Engineer.

D. Concrete Cover
1. Except as otherwise indicated on the Drawing, provide the following minimum concrete cover for reinforcement:
2. Concrete cast against and permanently exposed to earth: 3"
3. Concrete poured in form, but exposed to earth, weather or chlorinated water:
   Bars larger than No. 5: 2"
   Bars #5 or smaller: 1-1/2"
   Beams: 2¾"
   Walls and slabs (not exposed a in 2 above): 3/4"

E. Reinforcing Adjustment
1. Do not heat, bend or cut bars without Engineer’ approval.

F. Splices
1. Do not splice bars except at locations shown on the Drawings without Engineer’ approval.
2. Minimum lap distance shall be as shown on the Drawings. If not shown, splices shall be as specified in ACI 318.
3. Tie splices securely to prevent displacement during placement of concrete.
4. In horizontal wall reinforcement, alternate place vertically so that all splice are not in the same vertical plane.

G. Welded Wire Fabric
1. Install in longest practicable length.
2. Lap adjoining pieces one full mesh plus 2 inches minimum.
3. Do not make lap midway between simple separated members or directly over support members of continuous structures.
4. Offset lap in adjacent widths to prevent continuous lap.
5. Extend fabric through contraction joints and construction joint unless otherwise indicated on the Drawings.

END OF SECTION
SECTION 3300

CAST-IN-PLACE CONCRETE

1.00 GENERAL

1.01 Scope. Work to be completed under this section shall include all labor, equipment, plant and materials necessary to furnish and install all poured-in-place concrete, together with all miscellaneous and appurtenant items, as shown on the Drawings and as specified herein.

1.02 Related Work Specified Elsewhere.

Section 02200 - Excavation and Embankment
Section 02222 - Embedment and Base Course Aggregate
Section 02626 - Concrete Curb & Gutter, Sidewalk and Curbwalk

1.03 Reference Standards. Except as modified or supplemented herein, all Work shall conform to the following standards. Refer to standards for detailed requirements.

ACI 318 - Building Code Requirement for Reinforced Concrete
ACI 301 - Specifications for Structural Concrete for Buildings
ACI 347 - Recommended Practice for Concrete Framework
ACI 305 - Recommended Practice for Hot Weather Concreting
ACI 306 - Recommended Practice for Cold Weather Concreting

Publication SP-2, ACI Manual for Concrete Inspection

ASTM A 615 - Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement

ASTM A 185 - Specifications for Welded Steel Fabric for Concrete Reinforcement

1.04 Submittals.

A. Lab Design Mix. Prior to the start of Work, Contractor to submit a statement of the proportions for the concrete mixture. Statement to include:

1. Location & identification of aggregate source.

2. Batch quantities for one (1) cubic yard of concrete, including:

   a. Weight of fine aggregate in a saturated surface dry condition.
   b. Weight of coarse aggregate in a saturated surface dry condition.
   c. Weight or number of 94 pound bags of cement.
   d. Weight or gallons of water.
   e. Amount and description (including manufacturer, specific product name, and number) of all admixtures.

3. Test results on trial batch concrete made from the proposed mix design, including:
a. Cement factor in bags per cubic yard based on yield tests.
b. Water-cement ratio.
c. Percent of entrained air.
d. Consistency in inches of slump.
e. At least three 7-day compressive strength tests.

4. Brand, type and place of manufacture of cement.

5. Aggregate test results for grading, deleterious substances and physical properties using test procedures developed by AASHTO.

B. Reinforcing Steel. Product data sheet and statement of manufacturer's compliance with applicable standards.

1.05 Record of the Work. Contractor to keep a record of time, date and location of each concrete pour and submit these records to the Engineer.

1.06 Notice of Intention to Pour. Contractor shall notify the Engineer at least 48 hours before an intended cast-in-place concrete pour. No structural cast-in-place concrete shall be poured until all reinforcing, forms and foundation soils have been inspected by the Engineer.

1.07 Protection of the Work. Contractor to be responsible for protection of all Work prior to acceptance. In place concrete shall not be subjected to loadings or stress prematurely.

1.08 Storage of Materials. Cement and aggregate shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete.

All reinforcing steel shall be stored in a dry location and protected from excessive accumulation of rust or scale.

2.00 MATERIALS

2.01 Cement. All cement shall be Portland Cement Type II conforming to "Specifications for Portland cement" (ASTM C 150). Type III cement may not be used except upon written approval of the Engineer. The same brand cement for all exposed cast-in-place concrete shall be used.

2.02 Stone Aggregate. Fine and course aggregate shall conform to "Specifications for Concrete Aggregates" (ASTM C33). Fine aggregates shall be clean, hard, natural and free from all foreign matter. Course aggregate shall be sound, crushed rock or gravel, free from adherent coating, organic water or injurious amounts of flat or friable pieces. The aggregate shall comply with Concrete Class BZ, Reference Specification.

2.03 Water. Water used in mixing shall be potable, cleaned and free from deleterious amounts of oil, acids, alkalis and organic material.

2.04 Admixtures. "Protex" as manufactured by Protex Industries, Inc. and conforming to Specifications of Air-Entraining Admixtures for Concrete (ASTM C260) is an approved air-entraining admixture. Other admixtures for retarding or accelerating concrete may be used in
strict accordance with manufacturer’s recommendations and ASTM Specifications upon approval of the Engineer.

2.05 **Form Material.** For unexposed concrete surfaces, forms may be undressed lumber free from excessive knots. For exposed surfaces, use wood or metal forms as required to give finish as specified.

2.06 **Reinforcing Steel.** Reinforcing steel shall be deformed bars conforming to "Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement" (ASTM A615) and shall be Grade 60 for #5 bars and larger and Grade 40 or 60 for bars smaller than #5.

2.07 **Welded Wire Fabric.** Welded wire fabric shall conform to "Specifications for Welded Steel Fabric for Concrete Reinforcement" (ASTM A185) and shall have a minimum wire yield strength of 60,000 psi.

3.00 **METHODS AND PROCEDURES**

3.01 **Concrete Mix.**

   **A. Proportions.** Concrete is to be proportioned according to laboratory designed mixes using the type of aggregate specified and producing the minimum of twenty-eight (28) day ultimate compressive strength of 3,500 psi for all concrete Work. All concrete shall be made with stone aggregate unless specifically noted, and no concrete shall have a 28 day compressive strength of less than 3,500 psi.

   **B. Cement and Water Content.** The minimum quantity of cement used per cubic yard of concrete shall be 580 pounds. Water content shall not exceed 0.48 pounds water/pounds cement.

   **C. Air Entrainment.** An air-entraining agent shall be added to all stone concrete so as to entrain 5%-8% by volume. Air-entraining agents shall be in strict accordance with the recommendations of the manufacturer and the testing laboratory for the design mix to assure strength requirements are being fully met or exceeded.

   **D. Mixing of Materials.** The concrete shall be mixed until there is a uniform distribution of the materials and shall be discharged completely before the mixer is recharged. For job-mixed concrete, the mixer shall be rotated at the speed recommended by the manufacturer.

   For stone concrete, mixing shall continue for at least one minute after all materials are in the mixer. Ready mixed concrete shall be mixed and delivered in accordance with "Standard Specifications for Ready Mixed Concrete" (ASTM C94-69).

   Sufficient time shall be allowed for proper mixing on the concrete to provide uniformity throughout the batch. Long delays in concrete placement shall be avoided and any concrete that has not been placed within one (1) hour after water has been added to the mix shall be rejected. Over wet mixes shall be rejected and shall not be corrected by the addition of either aggregate or cement.
to the mixer. Mix not less than ten minutes in transit mix trucks after addition of the mixing water.

E. Consistency. Slumps shall be minimum, consistent with placing requirements. Slump test shall be made in accordance with “Slump Test for Consistency of Portland cement Concrete” (ASTM C143-58). Unless written approval is obtained from the Project Engineer or the Town, the maximum slump shall be three (3”) inches. No water shall be added on site unless authorized by the Project Engineer.

3.02 Concrete Forms.

A. Forms shall conform to the shape, lines, grades and dimensions of the concrete as detailed on the Drawings. All forms for exposed finished surfaces shall be built with the material needed to produce the form, texture and design specified in Concrete Finishes of this section.

B. Design of Forms. Forms shall be sufficiently tight to prevent leakage of mortar and shall be properly braced or tied together so as to maintain the desired position. The formwork shall be designed for the loads outlined in Part 3, Section 102 of "Recommended Practice for Concrete Form Work" (ACI 347). The forms shall be oiled for ease of removal of forms after setting of concrete.

C. Form Ties and Incidentals. Form ties shall be bolts and rods (adjustable for tightening) arranged so that no metal is within 3’-4” of surface after removal of forms. Ordinary wire ties will be allowed with the specific approval of the Engineer. No ties through exposed concrete will be allowed. Set forms for all required anchors, bolt inserts, slots, sleeves, supports, etc., furnished under portions of this Specification and installed under this section.

D. Removal of Forms. Forms shall not be disturbed until concrete has hardened sufficiently to permit their removal with safety. The removal of the forms shall be carried out in such a manner as to insure the safety of the structure. Unless otherwise permitted by the Engineer, forms shall not be removed until 24 hours after pouring.

3.03 Construction and Expansion Joints. Expansion and control joints shall be constructed in accordance with plan details. Unless otherwise indicated on the Drawings, install one inch (1”) thick asphalt impregnated fiberboard expansion joint filler (ASTM D1752) wherever concrete slabs abut buildings or footings or as shown on the plan details. All expansion joint filler shall extend the full depth of the slab.

3.04 Concrete Placement.

A. Preparation for Placing. Before placing concrete, all equipment for mixing and transporting concrete shall be cleaned and all debris and ice shall be removed from places to be occupied by concrete. Forms shall be properly treated and all reinforcement cleaned of ice and other coatings. Water shall be removed from place of deposit before concrete is placed.
B. Conveying. Concrete shall be conveyed from the mixer to the place of final deposit by methods, which will prevent the separation or loss of the materials. Equipment for chuting, pumping, or pneumatically conveying concrete shall be of such size and design as to insure a practically continuous flow of concrete at the delivery and without separation of the materials.

C. Other Trades. Install by way of example, anchor bolts, reinforcing steel, pipe and conduit openings and sleeves, bearing plates, and knockouts as provided by other trades and as required by other trades. Provide minimum 7 days notice to Engineer, Owner, or other trades prior to requiring materials or detailing information. Installation to meet location, dimension and alignment requirements of other trades.

D. Depositing. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the space between the bars. Concrete that has been partially hardened or been contaminated by foreign matter shall not be deposited on the Work, nor shall re-tempered concrete be used. When concreting is once started, it shall be carried on as a continuous operation until the placing of the panel or section is completed. Place concrete in approximately horizontal layers avoiding displacement of reinforcement above fresh concrete and formation of seams and planes of weakness in sections. When construction joints are necessary, they shall be located as specified in this section under Construction Joints. For bonding fresh concrete, roughen and clean exposed surface and brush with neat cement grout. Place new concrete before grout takes initial set.

E. Compaction. Place concrete in layers not over 24” deep; compact each layer by mechanical internal vibrating equipment supplemented by hand spading, rodding, tamping, as directed. Vibrators shall not be used to transport concrete inside forms. Limit vibration duration to the time necessary to produce satisfactory consolidation without causing objectionable segregation. Do not insert vibrator into lower courses that have begun to set.

F. Weather Conditions. Unless adequate protection is provided and the Engineer's approval is obtained, concrete shall not be placed during rain, sleet, or snow. When the mean temperature falls below 40°F for 3 successive days, concreting shall conform to "Recommended Practice for Cold Weather Conditions: (ACI 306 R). Concrete placed in hot weather shall meet the standards of "Recommended Practice for Hot Weather Concreting (ACI 305R). Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.

G. Protection and Curing. Concrete protection and curing shall be in conformance with ACI 308. Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected from loss of surface moisture. All concrete
shall be kept in a moist condition for at least five (5) days after placement. Curing compounds may be used upon approval of the Engineer.

3.05 Slabs on Grade. All slabs on grade shall be poured directly on the vapor barrier and prepared gravel subgrade where shown on the Drawings. Construction joints shall be placed such that no section of slab is greater than 25 feet on a side. Finishes, expansion & control joints & protection shall be as specified under other sections of this section.

Minimum six-inch (6") Class 6 aggregate base course shall be installed under the entire slab unless otherwise directed by the Engineer. The grading requirements as per Section 2140 for the aggregate course shall apply.

3.06 Concrete Finishes.

A. Patching. Patching shall be done on all concrete surfaces immediately after stripping forms; all exposed surfaces shall have fins and other projections carefully removed, offsets leveled, and voids saturated with water and patched to a true and even surface with a wood float. Patch all holes left by the removal of the form ties or bolts. Patching material shall be a stiff mixture of sand and cement, the color of which matches the concrete being patched. Any major area of faulty or honeycombed concrete shall be completely removed and patched at the direction of the Engineer.

B. Floor slabs. All concrete slabs shall be screened to levels or grades indicated and float finished monolithically completely free from humps or pits. Slabs shall not show surface deviation in excess of one-quarter inch (1/4") when tested with a 10 ft. straightedge. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine-grained, smooth but sanded texture.

C. Rubbed finish. All exposed concrete surfaces shall have a rubbed finish. After removal of forms, rubbing of all exterior surfaces shall be started as soon as its condition will permit. Immediately before starting this Work, the concrete shall be kept thoroughly saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. Surfaces to be finished shall be rubbed with a medium course carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in the same proportions as the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place.

After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and objectionable marks.
D. Chamfer. All exterior corners shall receive 3/4" chamfer.

3.07 Reinforcing.

A. Placing Reinforcement. Reinforcing steel, at the time concrete is placed, shall be free from scale, rust or other coatings that will destroy or reduce bond. Reinforcement shall be accurately placed as shown on the Drawings and shall be adequately secured in position by concrete or metal chairs and spacers.

Reinforcing shall be furnished in the full lengths indicated on the Drawings unless otherwise authorized by the Engineer. Splicing of bars, except where shown on the Drawings or specified, shall not be permitted without written approval by the Engineer. Reinforcement placed in any member shall be inspected before any concrete is placed and the Engineer shall be notified 24 hours in advance before any concrete placement.

The placing, fastening, splicing and supporting of reinforcing steel and welded wire fabric shall be in accordance with the Drawings and the latest edition of the CRSI "Recommended Practice for Placing Reinforcing Bars" and in accordance with ACI 318-77. Bars shall be placed around all corners to splice steel in adjacent walls, footers and slabs (such detailing may not be shown on Drawings).

B. Concrete Protection & Reinforcement. Where not otherwise indicated on the Drawings, the minimum thickness of concrete over the reinforcement shall be as follows:

1. Concrete deposited against earth - 3"
2. Slabs and walls not exposed to weather or earth - 3/4"
3. All other concrete placed in forms:
   - For bars larger than #5: 2"
   - For bars #5 or smaller: 1½"

C. Bearing Plates, anchor bolts, etc. Place all bearing plates, anchor bolts, reinforcing rods and other structural items furnished by other trades. Contractor to provide 7-day notice to all such trades prior to affected pour. Installation to be within tolerances required by other trades.

4.00 FIELD QUALITY CONTROL

4.01 Concrete Tests. 6" x 12" cylinders shall be taken at the point of placing in the forms, shall be job cured and tested in accordance with ASTM Standards by the Engineer. For each strength of concrete used, one set of four (4) cylinders for each day's pour, but not less than one (1) set of cylinders for each 100 cubic yards poured shall be taken. Two (2) cylinders at seven (7) days and two (2) cylinders at twenty-eight (28) days shall be tested. In addition, when
in the opinion of the Engineer there is a possibility of the surrounding air temperature falling below 40º F, additional specimens to be cured under job conditions may be required.

4.02 **Enforcement of Strength Requirements.** Should the strengths shown by the test specimens fall below the specified values, the Engineer shall have the right to require changes in proportions to apply on the remainder of the Work.

If concrete fails to meet the strength requirements of this specification, the Engineer may order the Contractor to have a testing laboratory, acceptable to the Engineer, take and test core samples of questionable concrete. The Engineer may order all low-strength concrete removed and replaced if core strengths are below specified strengths. All costs connected with concrete coring and removal and replacement of low-strength concrete shall be borne by the Contractor.

Contractor shall repair all core holes at his expense.

4.03 **Slump Tests.** Project Engineer to conduct slump tests on each day's pour and on individual trucks whenever concrete consistency varies. Test failure shall be grounds for rejection of individual or batch loads.

4.04 **Air Content.** The Project Engineer to conduct air tests on each day's pour and on individual trucks as determined by the Town. Test failure shall be grounds for rejection of entire batch until satisfactory tests are obtained.

END OF SECTION
1.00 GENERAL

1.01 Scope. These specifications cover the furnishing of all labor, material, services, supplies and equipment required in conjunction with or properly incidental to the pre-stressing of concrete by the post-tensioning method as shown on the Drawings and as specified herein.

1.02 Related Work Specified Elsewhere.

Section 03200 - Concrete Reinforcement
Section 03300 - Cast-in-Place Concrete

Drawings and general provisions of the contract apply to work specified in this section, as well as all codes and standards referenced.

1.03 Terms Defined. Post-tensioning shall refer to a method of pre-stressing concrete in which the post-tensioning tendon is tensioned after concrete has been placed and cured to the minimum specified strength.

A. Tendon - The complete assembly consisting of anchorage, pre-stressing steel and sheathing. The tendon imparts pre-stressing forces to the concrete.

B. Bonded Tendons - Tendons which are bonded to the concrete through grouting or other approved means and, therefore, are not free to move relative to the concrete.

C. Anchorage - The means by which the pre-stressing force is permanently transmitted from the pre-stressing steel to the concrete.

D. Pre-stressing Steel - That element of a post-tensioning tendon, which is elongated and anchored to provide the necessary permanent pre-stressing force.

E. Sheathing - Enclosure around the pre-stressing steel to avoid temporary bond between the pre-stressing steel and the surrounding concrete.

1.04 Quality Assurance.

A. Materials and Procedures - The following post-tensioning materials and design procedure specifications apply and are part of this specification:

i) ASTM A416.
ii) PTI "Tentative Specification for Post-Tensioning Materials".
iii) ACI 301. "Specifications for Structural Concrete for Buildings".
iv) ACI 344, "Design and Construction of Circular Pre-stressed Concrete Structures with Circumferential Tendons".
B. **Post-Tensioning Supplier/Installer - Qualifications** - Post-tensioning concrete work specified in this section shall be performed only by an Installer having not less than five (5) years experience in post-tensioning work and who has successfully completed at least ten (10) installations of nature and magnitude similar to this project.

Work to be completed under immediate and continual control of Installer's Superintendent with adequate previous experience. The Superintendent shall be an employee of the post-tensioning system supplier. The Superintendent's résumé is required. Installer's Superintendent shall supervise the placement of the mild steel reinforcement.

The Installer of the post-tensioning system shall own and furnish all equipment necessary to stress bonded and unbonded strands and tendons and pumps to grout bonded tendons.

C. **Safety** - Observe strict safety precautions during execution of the work. Do not allow anyone to stand behind the jacks while tendons are tensioned.

1.05 **Submittals.**

A. **Shop Drawings** - Shop Drawings showing complete details of tendon profile, anchorage components and stressing procedures, including anticipated friction and wobble coefficients shall be submitted for approval by the Engineer. Detailed computations indicating the minimum forces required, the specified pre-stressing losses, the final working stress and the stressing sequence shall be submitted with the shop drawings before commencing fabrication or installation of any post-tensioning materials. Once approved, no changes or deviations from shop drawings shall be permitted without the approval of the Engineer.

B. **Data Reports and Tests** - Tensioning procedures, jack clearances, stressing sequence, initial tensioning forces, gage pressures and strand elongation.

Certified mill reports on the pre-stressing steel used shall be submitted to the Engineer and shall show the ultimate strength, the modulus of elasticity and percent elongation at rupture. These values shall conform to latest revisions of ASTM A416.

Amount of slip expected in seating anchorage devices, friction wobble coefficient, and friction curvature coefficient expected for tendons. If requested, submit test data sustaining expected coefficients.

Field reports of elongation and tension applied for each tendon and each stressing operation are to be compiled and submitted to the Engineer. A representative of the Owner's testing agency will observe all stressing operations and check the stressing records prior submission to the Engineer.
1.06 **Submittals.**

A. **Shop Drawings** - Shop drawings showing complete details of tendon profile, anchorage components and stressing procedures, including anticipated friction and wobble coefficients shall be submitted for approval by the Engineer.

Detailed computations indicating the minimum forces required, the specified prestressing losses, the final working stress and the stressing sequence shall be submitted with the shop drawings before commencing fabrication or installation of any post-tensioning materials. Once approved, no changes or deviations from shop drawings shall be permitted without the approval of the Engineer.

B. **Data Reports and Tests** - Tensioning procedures, jack clearances, stressing sequence, initial tensioning forces, gage pressures and strand elongation.

Certified mill reports on the pre-stressing steel used shall be submitted to the Engineer and shall show the ultimate strength, the modulus of elasticity and percent elongation at rupture. These values shall conform to latest revisions of ASTM A416.

Amount of slip expected in seating anchorage devices, friction wobble coefficient, and friction curvature coefficient expected for tendons. If requested, submit test data substantiating expected coefficients.

Field reports of elongation and tension applied for each tendon and each stressing operation are to be compiled and submitted to the Engineer. A representative of Owner's testing agency will observe all stressing operations and check the stressing records prior to submission to the Engineer.

1.06 **Delivery, Handling and Storage.** Deliver post-tensioning steel in prefabricated coils, tagged and marked. Use metal tags indicating location, length and other information corresponding to placement drawings.

Store post-tensioning steel off the ground and in a manner to prevent rust, damage and accumulation of dirt.

2.00 **MATERIALS**

The post-tensioning system shall be as manufactured by VSL Corporation. Specifically, CP+, PT-Plus and BSLAB+ systems. Alternate post-tensioning systems or methods may be approved, provided the following information is submitted to the Engineer and approved for use at least ten (10) days prior to bid date:

A. Complete description of the post-tensioning system and method proposed for use. Such descriptions shall include tendon size, block-out dimensions, tendon layout and design calculations as required to fully substantiate any deviations from the method shown on the contract Drawings.

B. Test reports as required under Section 105 (B) of these specifications.

C. Evidence that the post-tensioning system proposed has been successfully used on
projects of similar magnitude for the past five (5) years.

D. A complete description of the corrosion protection aspects of the proposed system which shall be equivalent to those of the VSL system, specifically the VSL CP+, PT-Plus and VSLAB+ systems.

2.01 Pre-stressing Steel/Strand. Pre-stressing steel shall be uncoated seven-wire, low-relaxation strand for pre-stressed concrete manufactured in accordance with ASTM A415, Grade 270.

2.02 Bonded Tendons.

A. Anchorages. The anchorages shall develop at least 90 percent of the minimum specified ultimate strength of the pre-stressing steel, tested in an unbonded state without exceeding anticipated set. The anchorage shall be so arranged that the pre-stressing force of the tendon may be verified prior to removal of the stressing equipment.

B. Unbonded Tendons.

i) Anchorages - The anchorages of unbonded tendons shall develop the minimum specified ultimate strength of the pre-stressing steel. Elongation under ultimate load of the tendon shall not be less than two percent (2%) measured in a minimum gauge length of 10 feet.

C. Sheathing - Unbonded Strand. Coat strands to protect them permanently against corrosion and rust. Strand shall be completely shop-coated with a non-volatile, low-friction mineral oil based grease with a rust-preventing additive, having a uniform viscosity under temperature ranges of 20°F to 120°F. The sheathing shall be high-density polyethylene or polypropylene at least 60 mil thickness. Provide continuous coating that will remain ductile and free from cracks without becoming fluid over anticipated range of temperatures, chemically stable and non-reactive to cement and material used for sheathing.

The sheathing for the unbonded strand shall have tensile strength and water resistance sufficient to resist irreparable damage and deterioration during transport, storage at the job site and installation. The sheathing shall prevent the intrusion of cement paste and the escape of the coating material. The sheathing shall be extruded polyethylene or polypropylene tube. Damage in the sheathing shall be repaired through the use of waterproof tape approved by the Engineer.

D. Ducts - Bonded Tendons. Duct material for bonded tendons shall be high-density polyethylene, according to ASTM D3350 cell classification 324420C, or polypropylene with a specific gravity of 0.90 to 0.91. Grout ports shall be provided at each anchorage and at intervals not to exceed 150 feet. Duct shall be capable of transferring 40% of the specified tensile strength of the tendon within a length not exceeding 45 duct diameters. Ducts, including couplers shall be watertight. Ducts shall be coupled in a manner, which is leak-tight without the use of tape. The inside diameter of ducts for grouted horizontal tendons shall be 59 millimeters.
The outside dimensions for ducts for grouted vertical tendons shall be 43 millimeters by 106 millimeters.

Ducts shall have grout openings at each end. All grout openings or vents should include provisions for preventing grout leakage. Drain holes shall be provided at low points if the tendon is to be placed, stressed or grouted in freezing climate.

E. **Anchorages.** All anchorages shall meet the minimum requirements as set forth in the "Guide Specification for Pot-Tensioning Materials" as prepared by the Post-tensioning Institute.

The load from the anchoring device shall be uniformly distributed to the concrete by means of approved devices. Such approved devices shall conform to the following requirements:

i) Provide anchor plates of sufficient size to keep concrete bearing stresses within allowable limit of ACI 318 for the specified concrete strength at stressing. Enclose splices in housings long enough to permit necessary movements.

F. **Grout Materials for Stressing Pockets.** Stressing pockets shall be filled with non-metallic, non-shrink grout, Master Builders Master-Flo 713, Five Star or equivalent. Apply bonding agent to all interior surfaces.

i) Bonding Agent for Grout Stress Pockets.


G. **Grout Materials for Grouting of Bonded Tendons.**

i) Portland Cement - Portland cement should conform to one of the following: Specifications for Portland Cement ASTM C150, Type I, II or III. Cement used for grouting should be fresh and should not contain any lumps or other indication or hydration or "pack set".

ii) Water - The water used in the grout should be potable, clean and free of injurious quantities of substances known to be harmful to Portland Cement or pre-stressing steel.

iii) Admixtures - Use CELEBEX 209, manufactured by CELITE, Inc., or approved equal. An equal shall impart the properties of low water content, good flowability, minimum bleed and controlled expansion. Its formulation should contain no chemicals in quantities that may have harmful effect on the pre-stressing steel or cement. Admixtures containing chlorides, fluorides, sulfides and nitrates shall not be used.
All admixtures shall be used in accordance with the instructions of the manufacturer.

2.03 Design Criteria.

A. Strand. Base selection on required working forces indicating and per project requirements. Profile control points shown on the Drawings are based on 0.5 inch diameter strand.

B. Concrete. To determine effective pre-stress, consider sources of loss of pre-stress in accordance with requirements of ACI 318. Other losses to be provided for, depend upon methods, system, type of pre-stressing steel enclosures and anchorage and sequence of stressing. Submit calculations showing all losses.

2.04 Manufacture. Post-tensioning tendons shall be fabricated in accordance with detailed ship drawings as approved by the Engineer.

Precaution shall be taken to prevent rust through prolonged exposure of the pre-stressing steel. Contractor shall coordinate deliveries and provide storage to keep exposure of strands to corrosion to a minimum.

Remove and replace strands having broken wires and/or strands showing fabrication effects. Tag pre-stressing steel with assigned heat number.

2.05 Equipment.

A. Fabricating and Placing. All equipment used for fabricating, handling and placing tendons shall be such that it does not damage or deteriorate the pre-stressing steel or the anchorages.

B. Stressing. All hydraulic jacks shall be equipped with calibrated hydraulic pressure gauges to permit the stress in the pre-stressing steel to be computed at any time. A calibration chart shall accompany each jack-pump-gauge unit. If inconsistencies between the measured elongation and the jack gauges reading occur, the jack and gauge shall be re-calibrated. An agreement of with +5% shall be satisfactory. Check jack chucks for uneven wear before each use and replace if such wear is evident.

C. Tendon Grouting. The grout pump shall be capable of producing an outlet pressure of at lat 150 psi. The pumping pressure at the tendon inlet shall not exceed 250 psi. The grouting equipment shall be capable of continually grouting the largest tendon on the project in nor more than 20 minutes.

3.00 EXECUTION

3.01 Placing.

A. Installation. - All post-tensioning shall be under the immediate control of a person experienced in this type of work. He shall exercise close check and rigid control of all operations as necessary for full compliance with all requirements.
Post tensioning strands have priority over the other reinforcement, conduit and embedded items for location.

Location of pre-stressing tendons in the field must be in accordance with the approved shop drawings. Any changes due to interference with other grades must be approved by the Engineer and the shop drawings must be revised by the Contractor and reissued.

B. **Profile.** Set post-tensioning strands to parabolic profile and to control points shown on Drawings. Dimensions locating this profile apply to center of gravity of strand. Low points of strands are at mid-span unless otherwise noted.

Provide suitable plastic or epoxy coated horizontal and vertical spacers and/or chairs as required to hold strands in true position and in required profile. Placing tolerance: $\pm 0.125$ inch in vertical direction for members less than 12 inches in depth, and $\pm 0.25$ inch for members 12 inches and greater in depth.

C. **Fabrication.** Fabricate all strands in a given pour full length without splices or couplers unless called for on erection drawings accepted by the Engineer.

D. **Horizontal Deviation.** Strands shall clear openings and drains by at least six (6) inches. Slight deviations in spacing of strands and anchorages is permitted where required to avoid openings and inserts which are specifically located on the Drawings.

Keep horizontal plane deviations to a radius of curvature of not less than 25 feet.

E. **Blockouts/Sleeves/Openings.** Provide block-outs or sleeves prior to the concrete pour to the concrete pour for all openings required by Mechanical and Electrical Contractors through pre-stressed slabs. Any openings not provided for, shall be located to miss pre-stressing tendons as shown on approved shop drawings and locations shall be submitted for approval prior to cutting any opening.

F. **Concrete Placement.** Concrete shall be placed in such a manner as to ensure that alignment of post-tensioning sheathing or tendons remains unchanged.

Special provision shall be made to ensure proper vibration of concrete around tendon bearing plates.

Where the end of a post-tensioning assembly will not be covered by concrete, the anchoring devices shall be recessed so that the ends of the pre-stressing steel and all part of the anchoring devices will be at least two (2) inches inside of the end surface of the members, unless a greater embedment is shown on the Drawings. Following post-tensioning, the recesses shall be filled with non-metallic, non-shrink grout and finished flush.

G. **Drilled Inserts.** Drilled insets not exceeding 1¼" at top and 3/4" bottom (drilled depth) may be installed in the top or bottom of pre-stressed slabs provided.
i) All inserts in the bottom of slabs or in the top of slabs near columns shall be spaced midway between pre-stressing tendons, as shown on approved shop drawings.

All other items requiring anchorage to the pre-stressed slabs or pre-stressed walls shall be provided for with embedded items prior to the concrete pour. Any items not provided for and requiring drilled depth greater than 3/4" shall be located to miss tendons by a minimum of two (2) inches laterally and shall be shown on shop drawings and submitted to the Structural Engineer for approval prior to drilling.

3.02 Stressing.

A. Concrete Strength. Do not commence tensioning until concrete has reached a strength of at least the following:

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>STRENGTH (psi)</th>
<th>STRESSING PERCENTAGE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade slab</td>
<td>2000</td>
<td>50</td>
</tr>
<tr>
<td>Grade slab</td>
<td>3500</td>
<td>100</td>
</tr>
<tr>
<td>All other P.T. Concrete</td>
<td>4500</td>
<td>100</td>
</tr>
</tbody>
</table>

Concrete strength shall be as evidenced by test results of field cured cylinders. Stressing shall not proceed without the approval of the Engineer. Perform testing by approved independent testing laboratory in accordance with ANSI/ASTM C31. Minimum of three field-cured cylinders are required for each break. See Section 03300 for compressive strength requirements.
B. **Wall Stressing Sequence.** Wall tendons shall be stressed in the following sequence:

<table>
<thead>
<tr>
<th>STAGE</th>
<th>PILASTER</th>
<th>SEQUENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>A1R, A3R, A5R, A1L, A3L, A5L</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>B1R, B3R, B5R, B1L, B3L, B5L</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>B1R, B3R, B5R, B1L, B3L, B5L</td>
</tr>
</tbody>
</table>

C. **Tendon Position.** If tendons move out of their designed positions during concreting operations, adjust tendons to their correct position.

D. **Records.** Keep records of elongation and tension applied to each tendon and submit them to the Engineering promptly upon completion of each slab.

E. **Procedure.** At the time of stressing, check individual strand to establish procedure for ensuring uniform results.

F. **Recheck.** Engineer shall have the right to order a recheck at any time it appears that design stresses are not being attained.

G. **Sheathing Check.** Do no tensioning unless the stressing steel is reasonably free and unbonded in enclosure. All tears and holes in the enclosure shall be repaired before concreting begins.

H. **Record Review.** Do not cut or cover strand ends until tensioning records have been received and reviewed by the Engineer and his permission is given to proceed.

I. **Forces.** Forces shown on Drawings are the least force in a given tendon considering all force losses at any given location, unless otherwise noted.

J. **Multiple Tendons.** Tendons composed of multiple strands or bars in a given sheath should be tensioned simultaneously unless the effects or interferences between the elements are considered.
3.03 **Grouting of Stressing Pockets.** Coat exposed post-tensioning recesses with an approved bonding agent and then fill flush with specified grout. Perform this work as soon as practical after tendon elongation review and acceptance by the Engineer.

4.00 **BONDED TENDONS**

4.01 **General.** Prior to grouting, conduit shall be made free of water, dirt and other foreign substances. Grouting shall ensure complete filling of voids between wires or strand and conduit and end anchorages. Temperature of members at time of grouting, and for 48 hours thereafter, must be 45º F or above. Grouting of conduit shall not begin until 6 to 24 hours after stressing AND shall not begin until the elongation records have been review and accepted by the Engineer. Conduit shall be completely filled from one end with grout under pressure not less than 50 psi as read on gage connected to the inflow end. A vacuum shall be provided at the outflow end of the conduit. Care shall be exercised to ensure a continuous flow of grout.

A. **Admixtures.** Approved admixtures may be used to increase workability and to reduce shrinkage. See Section 2.02. G.(iii) of this specification.

B. **Mixing of the Grout.**
   i) Water should be added to the mixer first, followed by Portland Cement and admixtures, or as required by the admixture manufacturer.
   ii) Mixing should be of such duration as to obtain a uniform thoroughly blended grout, without excessive temperature increase or loss of expansive properties of the admixture. The grout shall be continuously agitated until it is pumped.
   iii) Proportions of materials shall be as detailed in the plans. The water content shall be the minimum necessary for proper placement, and when Type I and II cement is used should not exceed a water-cement ratio of 0.45 (approximately five (5) gallons of water per sack of cement).

The water content required for Type II cement should be established for a particular brand based on tests.

The pumpability of the grout may be determined by the Engineer in accordance with the U.S. Corps of Engineers Methods CRD-C79 (see Page 149). When this method is used, the afflux time of the grout sample immediately after the mixing should be not less than 11 seconds. The flow cone test does not apply to grout that incorporates a thixotropic additive.

C. **Grouting.**
   i) Flushing of ducts shall be optional as accepted by the Engineer. Water used for flushing ducts may contain slack-lime (calcium hydroxide) or quicklime (calcium oxide) in the amount of 0.1 lbs/gallon.
   ii) Injection of the grout. All grout and high pint vent openings should be open
when grouting starts. Grout should be to flow from the first vent after the
inlet pipe until any residual flushing water or entrapped air has been
removed, at which time the vent should be capped or otherwise closed.
Remaining vents should be closed in sequence in the same manner.

The pumping pressure at the tendon inlet should not exceed 250 psi. If the
actual grouting pressure exceeds the maximum recommended pumping
pressure, grout may be injected at any vent that has been, or is ready to
be, capped provided a one-way flow of grout is maintained. If this
procedure is used, then the vent, which is to be used for injection should
be fitted with a positive shut-off.

When the one-way flow of grout cannot be maintained as outlined 2.00 and
2.04 above, the grout shall be immediately flushed out of the duct and with
water. Grout should be pumped through the duct and continuously wasted
at the outlet pipe until no visible slugs of water or air are injected and the
afflux time of the ejected grout should not be less than the injected grout.
To ensure that the tendon remains filled with grout, the outlet and/or inlet
should be closed. Plugs, caps or valves thus required should not be
removed or opened until the grout has set.

iii) In temperatures below 32º F, ducts should be kept free of water to avoid
freezing damage.

Concrete temperature - The temperature of the concrete should be 45º F
or higher from the time of grouting until job cured two-inch cubes of grout
reach a minimum compressive strength of 800 psi.

Grout temperature - Grout should not be above 85º F during mixing or
pumping. If necessary, the mixing water shall be cooled.

4.00 MEASUREMENT AND BASIS OF PAYMENT.

See Bid Schedule.

End of Section
SECTION 03700
DISINFECTING AND TESTING OF RESERVOIR

1.00 GENERAL

1.01 Scope. Furnish all labor, equipment, materials necessary to clean, disinfect and test the circular reservoir.

1.02 Related Work Specified Elsewhere.

   Section 03300 - Cast-in-Place Concrete

2.00 MATERIALS

2.01 Materials. Water clean and free of deleterious substances. Calcium hypochlorite containing 65 percent chlorine. Contractor shall verify this material specification with the Colorado Department of Public Health & Environment.

3.00 EXECUTION

3.01 Preparation. After construction of the reservoir has been completed, and before backfilling, the inside of the roof, walls and base slab shall be broom-cleaned. The floor shall be squeegeed of curing water and washed with clean water. After the brooming and the removal of all debris, all cracks and joints shall be properly sealed in accordance with provisions of Section 03300.

   Completely hose down the interior surface of the reservoir with water under pressure and drain the wash water from the reservoir.

3.02 Disinfecting. Use calcium containing 65 percent chlorine. Dissolve one pound of this compound to 75 gallons of water. The entire inside of the reservoir shall be thoroughly wetted with water and, while wet, the chlorine solution shall be sprayed evenly at the rate of one gallon per 150 square feet over the floor, walls, column, ceiling and miscellaneous metal.

   The spraying shall be done so that no areas shall be occupied after spraying, this, the ladder must be sprayed as the sprayer is climbing the ladder. All persons in the tank must be equipped with oxygen masks during the spraying operation. The time use of the mask must be carefully observed. Other protection devices may be used, but any device must protect everyone inside the tank.

3.03 Testing. After the reservoir has been cleaned and disinfected, the tank shall be filled to the overflow and allowed to stand for at least 72 hours. During the first 72 hours, the surface of the water may drop, and shall be continually refilled to the overflow.

   The water level elevation shall be determined by using a surveyor's level and level rod; after a lapse of another 72 hours, the water level shall again be determined in the same manner as the initial reading was determined. If, during the 72 hours, the water level has dripped more than 0.20 inches, the reservoir will not be considered sufficiently watertight.
If the test fails to meet the above requirements, the reservoir shall be drained, repaired, disinfected, and again tested for watertightness.

For the second test, and any other tests thereafter, the Contractor will be charged for all water used at the cost of water to be established by the Engineer.

Damp spots on the exterior wall areas or the wall faces shall not be permitted. Damp spots are defined as spots where moisture can be picked up on a dry hand. Damp spot areas shall be cleaned and repaired. See Section 03300.

3.04 Bacteriological Examination. After the system has been thoroughly flushed, take samples from representative points in the system in sterile bottle and submit to proper authorities as directed for bacteriological examination. If their report is unsatisfactory, repeat the disinfecting procedure until satisfactory results are obtained.

4.00 MEASUREMENT AND BASIS OF PAYMENT.

See Bid Schedule.

End of Section
SECTION 04200

MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Work to be completed under this section shall include all labor, equipment, plant, and materials necessary to furnish and install all masonry units, together with all miscellaneous and appurtenant items required for installation and/or furnished by other trades, as shown on the Plans and as specified herein.

1.02 REFERENCE STANDARDS


1.03 SUBMITALS

A. Descriptive literature and catalogue cuts on masonry units, reinforcing steel and insulation.

1.04 PROTECTION OF WORK

A. Contractor responsible for protection of all work prior to acceptance. Exposed insulation or cells shall be covered to prevent moisture or dirt intrusion.

1.05 STORAGE OF MATERIALS

A. Materials shall be stored in a dry place and in a manner to prevent damage or intrusion of foreign matter. Materials showing evidence of water or other damage are subject to rejection.

B. Concrete masonry units shall be protected against wetting prior to use. During freezing weather, all masonry units shall be protected with tarpaulin or other suitable material. Concrete masonry units shall be stored under covers that will permit circulation of air and prevent excessive moisture absorption.

C. Cement, lime and air-settling mortars shall be stored in watertight sheds with elevated floors.

D. Reinforcement shall be protected from the elements; immediately before placing, reinforcement shall be free from loose rust, ice or other foreign coatings that will destroy or reduce the bond.
E. Deliver packaged material in original manufacturer's containers.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS (CMU)

A. Units shall conform to ASTM C90 specifications. All units shall be Type I. Units below grade or exposed to weather shall be Grade N. Other units may be Grade S. Crushing strength, f'm = 1900 psi.

B. Units shall be in modular sizes with standard 8" width or 4" width as required. Corner units shall have square external corners.

C. Jamb units at windows, bond beam units and other special units shall match the approved samples for the type of construction and locations designated.

D. Units shall not contain iron spots or other substances that will strain plaster or paint.

2.02 JOINT REINFORCEMENT

A. Steel reinforcement for use in horizontal bed joints of concrete masonry units and other locations as hereinafter specified shall be prefabricated truss design type formed of zinc-coated cold drawn steel wire conforming to ASTM A82 and A116 of Class 3 coating. Side wire shall be formed of 9 gauge rod; cross rods shall be of 9 gauge, smooth or deformed wire, butt welded to side wires in the same plane at contact points. Special formed pieces shall be provided at corners and wall intersections.

B. Reinforcing shall be of proper widths for the wall thicknesses shown.

C. Reinforcing shall be Standard Type Dur-O-Wall, Rewal, or approved equal.

D. Unless otherwise noted on the plans, reinforcement in masonry walls shall be installed in the first and second bed joints above lintels, below sill at openings and below bond beams around the entire top of the perimeter walls of the building. Elsewhere, reinforcing shall be installed in bed joints at 16" vertical intervals. Side rods shall be lapped horizontally a minimum of 6". Joint reinforcement embedded in horizontal mortar joints shall have not less than 5/8" mortar coverage from the exposed face.

2.03 REINFORCED STEEL

A. Reinforcing steel shall be deformed bars conforming to "Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement" (ASTM A615) and shall be Grade 60.

2.04 MORTAR AND GROUT

A. Shall conform to the property requirements of ASTM C476. Proportion the mix to meet strength and other requirements. Mortar shall be Type S minimum grout compressive strength shall be 2000 psi.
B. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
1. Pigments shall not exceed 10 percent of Portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement by weight.
3. Application: Use pigmented mortar for exposed mortar joints with the following units: Integral color CMUs.

2.05 PORTLAND CEMENT

A. All cement shall be Portland Cement Type II or V conforming to "Standard Specifications for Portland Cement" (ASTM C 150).

2.06 INSULATION

A. Loose fill insulation not permitted.
B. Foamed-In-Place masonry insulation see Section 07214.

2.07 MASONRY CEMENT

A. Cement shall conform to ASTM Specification C91. Cement shall be gray.

2.08 LIME

A. Hydrated lime shall be Type S conforming to ASTM Specification C207. Quicklime shall conform to ASTM Specification C5; it shall be slaked in accordance with the manufacturer's directions.

2.09 LIME PUTTY

A. Putty shall be a stiff mixture of lime and water. Keep putty moist until used. Putty made from quicklime shall be slaked and allowed to soak at least 24 hours before using. Putty made from Type S hydrated lime may be used immediately after mixing.

2.10 SAND

A. Sand shall conform to ASTM Specification C144 except that sand for mortar in 1/4 inch wide joints shall pass a No. 16 sieve.

2.11 MIXING WATER

A. Water shall be clean and potable.

2.12 COARSE AGGREGATE FOR MASONRY GROUT

A. Aggregate shall conform to ASTM Specification C404.
PART 3 EXECUTION

3.01 MIXING MORTAR

A. Mix all cementitious materials and sand in a mechanical batch mixer for a minimum of 5 minutes.

B. Adjust the consistency of the mortar to the satisfaction of the mason, but add only as much water as is compatible with convenience in using the mortar.

C. If the mortar begins to stiffen from evaporation or from absorption of a part of the mixing water, re-temper the mortar immediately by adding water and remix the mortar.

D. All mortar shall be used within 2 1/2 hours of the initial mixing. It shall not be used after it has begun to set.

3.02 OTHER TRADES

A. Other trades shall be consulted and provisions made such that the installation of their work is permitted in a manner to avoid butting and patching.

B. Install, by way of example, anchor bolts, bearing plates, pipe and conduit openings and sleeves, HVAC openings and other knockouts required by other trades. Provide minimum 7-day notice to Owner, Engineer and other trades prior to requiring materials or detailing information.

C. Build in work specified under other sections, as necessary and as the work progresses in accordance with requirements or other trades. Masonry contractor not responsible for installation of materials running within walls such as concealed conduit and piping.

3.03 LAYING MASONRY UNITS

A. All units shall be set plumb and true to line. All units shall be laid with level horizontal joints. Units shall be laid in "running bond" unless otherwise shown.

B. All interior masonry partitions unless otherwise shown shall terminate ½-inch from structural ceilings and a ½-inch thick by 8-inch wide expansion joint material installed thereon.

C. Where electric conduit, outlet and switch boxes occur, units shall be ground and cut before building in service. Work shall be coordinated with electrical subcontractor. Cutting of all units exposed in finished work shall be done with an approved type of power saw. Work must also be coordinated with plumbing subcontractor where plumbing occurs in masonry partitions.

D. Masonry units shall be reinforced horizontally with continuous joint reinforcement placed not to exceed 16" on center vertically in exterior walls and in non-load bearing partitions.

E. Bond each course at corners in a masonry bond and at intersections with metal ties, anchors or joint reinforcement spaced as above.

F. Partitions of all units that abut exterior walls, columns and other partitions shall be bonded in or be anchored thereto once every 16 inches in height. Where anchors are used they shall
be 1/8 x 1-inch zinc coated steel anchors with ends turned up 2 inches and extending 4 inches into wall and not less than 8 inches onto partitions; or anchors may be of type to fit the slats in concrete.

G. Interior joints of all masonry construction shall match existing. Exterior joints of all masonry construction shall be "concave".

3.04 SPECIAL REQUIREMENTS

A. Masonry shall not be laid when the temperature of the outside air is below 40 degrees F, unless suitable means as approved by the Engineer are provided to heat materials, protect work from cold and frost and ensure that mortar will harden without freezing. (No anti-freeze ingredient shall be used in the mortar).

B. The facing material shall be protected against staining and tops of walls kept covered with non-staining waterproof coverings when work is not in progress. When work is resumed, top surface of work shall be cleaned of all loose mortar and in drying weather thoroughly wet except for concrete masonry units.

C. Where fresh masonry joins masonry that is partially set or totally set, clean the exposed surface of the set masonry and wet it lightly so as to obtain the best possible bond with the new work. Remove all loose brick and mortar. If it is necessary to "stop off" a horizontal run of masonry, this shall be permitted only with the Engineer's approval.

D. All reinforced hollow unit masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Walls and webs forming such cells to be filled shall be full bedded in mortar to prevent leakage of grout. All head (or end) joints shall be solidly filled with mortar for a distance of the longitudinal face shells. Bond shall be provided by lapping units in successive vertical courses or by equivalent mechanical anchorage.

E. Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than 2 inches by 3 inches.

F. All cells containing reinforcement shall be filled solidly with grout. Grout shall be poured in lifts of 8 feet maximum height. All grout shall be consolidated at time of pouring by puddling or vibrating and then reconsolidated by again puddling later, before plasticity is lost.

G. When total grout pour exceeds 8 feet in height, the grout shall be placed in 4-foot lifts and special inspection during grout shall be required. Minimum cell dimension shall be 3 inches.

H. When the grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout 1½ -inches below the top of the uppermost unit.

I. Steel in lintels shall be set in beds of mortar. Spaces around jambs and heads of metal door bucks and frames shall be filled solidly with mortar.

J. Bond beams or concrete caps along the top of the walls shall be provided with the necessary and required bearing plates, anchor bolts, expansion joint filler, etc. and welds and connections of the pre-cast concrete components to the walls shall be made by the contractor under this section.
K. All mortar smears and mortar chucks shall be cleaned from all exposed surfaces or surfaces to receive paint. Point all joints as directed by Engineer removing joint material sufficient to allow uniform joint after repair. Receive approval of finished wall.

END OF SECTION
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