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PART I - GENERAL CONDITIONS

SECTION 1.

DEFINITIONS AND ABBREVIATIONS

1.1. DEFINITIONS

Wherever used in the Contract Documents, the following terms shall have the meanings indicated which shall be applicable to both the singular and plural thereof;

Addendum - Written or graphic instruments issued prior to the execution of the Contract Agreement which modify or interpret the Contract Documents, drawings and specifications, by additions, deletions, clarifications or corrections.

Bid Documents - The part of the Contract Documents which advise and instruct prospective Bidders of the Work and forms to be submitted that insure their consideration for award of contract, consisting of Advertisement for Bids, Information for Bidders, Special Conditions, Addendum, Bid Bond, Bid Proposal, Bid Schedule and Project Drawings.

Bid Proposal - The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

Bid Schedule - That part of the Bid Proposal which lists the items and the Owner's estimated quantities of the Work for which the Bidder agrees to perform, as required by the Contract Documents, for payment at the lump sum or unit price he has caused to be inserted therein.

Bidder - Any individual, partnership, corporation, company, or other legal entity submitting a Bid Proposal for the Work.

Bonds - Bid or Performance and Payment Bond, and other instruments of security, furnished by the Contractor and his surety in accordance with the Contract Documents.

Calendar Day - A mean solar day of 24 hours, beginning at a mean midnight within a specified time zone and on a specific day of the year.

Change Order - A written order to the Contractor authorizing an addition, deletion or revision in the Work within the general scope of the Contract Documents, or authorizing an adjustment in the Contract Price or Contract Time.

Claim - A demand by either party to the Contract Agreement for something due or believed to be due from the other, attributed to the performance of the Work required by the Contract Documents which is open to challenge.

Contract Agreement - A part of the Contract Documents, signed by the Owner and the Contractor, representing the entire and integrated agreement between the parties hereto and supersedes all prior negotiations, representations, or agreements, either written or oral, including the Bid Documents. The Contract Agreement may be amended or modified only by a Change Order.

Contractor - An individual, partnership, corporation, company, or other legal entity who has executed the Contract Agreement and in so doing is responsible to the Owner for the performance of the Work in accordance with the Contract Documents.

Contract Documents - The Contract in its entirety, which includes Advertisement for Bids, Information for Bidders, Special Conditions, Addendum, Bid Bond, Bid Proposal, Bid Schedule, Project Drawings, Notice of

Award, Contract Agreement, Performance and Payment Bond, Notice to Proceed, General Conditions, Change Order, Method of Measurement and Payment, and the City of Rifle "Standard Specifications and Drawings for Design and Construction."

Contract Price - The total monies payable to the Contractor under the terms and conditions of the Contract Documents.

Contract Time - The number of consecutive calendar days stated in the Contract Documents for the completion of Work, including Saturdays, Sundays and Holidays, commencing in accordance with the Notice to Proceed.

Drawings - The part of the Contract Documents which shows the characteristics and scope of the Work to be performed and which have been prepared or approved by the Engineer.

Engineer - The City Engineer or his authorized representative, firm or corporation appointed or retained by the Owner and named as such in the Contract Documents.

Extra Work - Additional labor, material, equipment or incidentals required to complete the Work within the general scope of the Contract Documents, but not therein provided for, authorized by the Engineer in the form of a Change Order.

Field Order - A written order effecting a change in the Work not involving an adjustment in the Contract Price or an extension of the Contract Time, issued by the Engineer to the Contractor during construction.

Inspector - A technical agent, firm or corporation appointed or retained by the Owner and acting under the direction of the Engineer, to insure the Work is performed in accordance with the Contract Documents.

Laboratory - A testing facility, belonging to or designated by the Owner, to investigate, test, report and assure the quality of materials and equipment being incorporated in the Work conforms to that specified in the Contract Documents.

Liquidated Damages - The amount of United States currency stated in the Bid Proposal which the Contractor agrees to pay the Owner for his failure to complete the Work in accordance with the Contract Documents, within the Contract Time.

Major Item - Any item or unit of the Work, required by the Contract Documents, having a monetary value of 8% or more of the total Contract Price.

Measurement and Payment - A part of the Contract Documents briefly outlining the items of work, specified in the Bid Proposal, and the method to be used to determine the quantity to be paid for after installation and acceptance.

Modifications - A change in the requirements of the City of Rifle "Standard Specifications and Drawings for Design and Construction" as specified in the Special Conditions or by Addendum to the Bid Documents; or a change to the Contract Agreement accomplished through Change Order, a Written Notice or a Field Order from the Engineer or Owner.

Notice of Award - The Written Notice of the acceptance of the Bid Proposal from the Owner to the successful Bidder.

Notice to Proceed - Written Notice issued by the Owner to the Contractor authorizing him to proceed with the Work and establishing the dates of commencement and completion of the Work.

Owner - The City of Rifle, Colorado, a municipal corporation acting through its Mayor and City Council, for whom the Work is to be performed.

Project - The total construction of the Work, designed by the Engineer, of which the Work performed under the Contract Documents may be the whole or a part.

Project Engineer - The authorized representative of the Engineer and Owner who is assigned to the project site or any part thereof.

Proposal - See Bid Proposal.

Shop Drawings - All drawings, diagrams, illustrations, brochures, schedules and other data which are prepared by the Contractor, a Subcontractor, manufacturer, supplier or distributor, which illustrate how specific portions of the Work shall be fabricated or installed.

Special Conditions - A part of the Bid Documents, covering conditions peculiar to the Work on the Project, which modify and take precedence over the City of Rifle "Standard Specifications and Drawings for Design and Construction."

Specifications - A part of the Contract Documents consisting of the Special Conditions and City "Standard Specifications and Drawings for Design and Construction", which are written descriptions of a technical nature describing nature of materials, equipment, construction systems, standards and workmanship.

Standard Specifications and Drawings for Design and Construction - The General Specifications contained in the Contract Documents.

Subcontractor - An individual, partnership or corporation having a direct contract with the Contractor or with any other Subcontractor for the performance of a part of the Work at the site.

Substantial Completion - That date as certified by the Engineer when the construction of the Project or as specified part thereof is sufficiently completed, in accordance with the Contract Documents, so that the Project or specified part can be utilized for the purposes for which it is intended.

Supplemental Agreement - A negotiated agreement constituting a modification of the original Contract Documents and covering the performance of Work beyond its general scope.

Supplemental General Conditions - Modifications to the General Conditions required by a Federal Agency for participation in the project and approved by the agency in writing prior to inclusion in the Contract Documents.

Suppliers - Any person, supplier or organization who supplies materials or equipment for the Work, including that fabricated to a special design, but who does not perform labor at the site.

Warranty Letter - A Written Notice from the Engineer to the Contractor placing the project or a portion thereof under warranty for a period of one year from the date the project or a portion thereof was put in service, or from the date of final acceptance, whichever occurs first.

Work - The furnishing of all labor, material, equipment and incidentals necessary to produce the construction required by the Contract Documents, and all materials and equipment incorporated or to be incorporated in the project.

Working Day - Any day, exclusive of Saturdays, Sundays, and Holidays, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed, for a major part of the daylight hours, with the normal working force.

Written Notice - Any notice to any party of the Contract Agreement relative to any part of the Contract Agreement in writing and considered delivered and the service thereof completed, when posted by certified or registered mail to the said party at his last given address, or delivered in person to said party or his authorized representative on the Work.

1.2. ABBREVIATIONS

Whenever the following abbreviations are used in these specifications, standard details or on the plans, they are to be construed the same as the respective expressions represented.

AASHTO	American Association of State Highway & Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AGC	Associated General Contractors of America, Inc.
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APA	American Plywood Association
APHA	American Public Health Association
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing Materials
AWSC	American Welding Society Code
AWWA	American Water Works Association
CDOT	Colorado Department of Transportation
IEEE	Institute of Electrical and Electronic Engineers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCPI	National Clay Pipe Institute
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NIC	Not in Contract
SAE	Society of Automotive Engineers
UL	Underwriter's Laboratories, Inc.
USC&GS	United States Coast and Geodetic Survey
USGS	United States Geological Survey

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PART I - GENERAL CONDITIONS

SECTION 2.

SCOPE AND CONTROL OF THE WORK

2.1. ADDITIONAL INSTRUCTIONS, MODIFICATIONS AND DETAIL DRAWINGS

The engineer may, during the duration of the contract agreement and in accordance with Sections 2-16, 2-17, and 2-18 of these General Conditions, furnish the contractor written instructions, modifications or detail drawings necessary to illustrate changes in the work.

The additional written instructions and detailed drawings thus supplied shall become a part of the contract documents, without invalidating the contract agreement, and the contractor shall perform the work as modified or altered.

2.2. EXECUTION, CORRELATION, INTENT, INTERPRETATION AND FURNISHING OF CONTRACT DOCUMENTS

The contract documents shall be executed in triplicate by the owner and contractor.

By executing the contract agreement the contractor represents that he has visited the sight of the work, familiarized himself with the locale, subsurface and site conditions under which the work is to be performed, and correlated his observations with the available information included with and required by the contract documents.

The contract documents are complementary and what is required by any one shall be as binding as if required by all. The intention of the documents is to include all labor, materials, equipment and incidentals necessary for the proper execution and completion of the work. It is not intended that work not covered under any heading, section, class or trade of the specifications shall be supplied unless it is required elsewhere in the contract documents or is reasonably inferable there from as being necessary to produce the intended results. Words, which have well known technical or trade meanings, are used herein in accordance with such recognized meanings. Well-known technical standards are used herein in accordance with the latest edition and revisions thereof.

Written interpretations necessary for the proper execution or progress of the work, in the form of drawings or other wise, will be issued with reasonable promptness by the engineer and in accordance with any approved schedule, upon written request from the contractor. Such interpretations shall be consistent with and reasonably inferable from the contract documents and may be effected by field order.

Unless otherwise provided in the contract documents, the contractor will be furnished, free of charge, three (3) copies of drawings and specifications necessary for the execution of the work. All drawings and specifications thus furnished shall not be reused on any other project.

2.3. SCHEDULES, REPORTS AND RECORDS

The contractor shall submit to the owner such schedule of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as the owner may request concerning work performed or to be performed.

Prior to the first partial payment estimate the contractor shall submit to the engineer schedules indicating:

A. Partial payments that he anticipates he will earn during the course of the work.

B. The order in which he proposes to carry on the work, including dates at which he will start the various parts of the work, estimated date of completion of each part; and as applicable:

1. The dates at which special detailed drawings will be required from the engineer.

2. The date that the contractor will submit shop drawings to the engineer.

3. Respective dates that manufacturing will begin, the testing and the installation of materials, supplies and equipment.

Schedules submitted by the contractor shall reflect:

C. The timely and orderly completion of:

1. Specific portions of the work as called for in the Special Conditions.

2. The work in accordance with allowed contract time.

D. The inability to perform work on Saturdays, Sundays, holidays or between the hours of 7:00 p.m. and 7:00 a.m. on any working day, without written permission from the engineer.

E. The safety, adequacy and efficiency of his plant equipment, tools, labor and methods of performing the work.

F. The availability of materials, equipment and incidentals to be incorporated in the work.

G. Maintenance and control of traffic.

2.4. DRAWINGS, SPECIFICATIONS, CONFLICTS AND DISCREPANCIES

The intent of the drawings and specifications is that the contractor shall furnish all labor, materials, tools, equipment, incidentals and transportation necessary for the proper execution of the work in accordance with the contract documents to complete the project in an acceptable manner, ready for use, occupancy or operation by the owner.

In case of conflict between the drawings and specifications, the specifications shall govern. Figured dimensions on drawings shall govern over scale dimensions, detailed drawings shall govern over General Drawings and Special Conditions shall govern over Standard Specifications.

Any discrepancies between the drawings and specifications and site conditions; or any inconsistencies, errors, omissions or ambiguities in the drawings or specifications; or any errors or omissions in the layout as given by survey points and instructions shall be immediately reported to the engineer, in writing, who shall promptly verify and correct such inconsistencies or ambiguities in writing. Work performed by the contractor after such discovery, until authorized or corrected by the engineer, shall be done at the contractor's risk.

2.5. SHOP DRAWINGS AND MATERIAL SAMPLES

The contractor shall provide shop drawings, in triplicate, as may be necessary for the prosecution of the work (i.e. vault piping, electrical systems, reinforcing, non-detailed items, etc.) as required by the contract documents. The engineer shall promptly review all shop drawings. The engineer's approval of any shop drawing shall not release the contractor from responsibility for deviations from the contract documents. The approval of any shop drawing, which substantially deviates, from the requirement of the contract documents shall be evidenced by a Change Order.

When submitted for the engineer's review, shop drawings shall bear the contractor's certification that he has reviewed, calculated non-detailed dimensions, checked and approved the shop drawings and that they are in conformance with the requirements of the contract documents.

Portions of the work requiring a shop drawing or material sample submission shall not begin until the shop drawing or submission has been approved by the engineer. A copy of each approved shop drawing and each approved material sample shall be kept in good order by the contractor at the site and shall be available to the engineer.

2.6. MATERIALS, SERVICES, AND FACILITIES

It is understood that, except as otherwise specifically stated in the contract documents, the contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, supervision, temporary construction of any nature, and all other services and facilities of any nature whatsoever necessary to execute, complete and deliver the work within the specified time.

Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the work. Stored materials and equipment to be incorporated in the work shall be located so as to facilitate prompt inspection.

Manufactured articles, materials and equipment shall be fabricated, furnished, applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer or in accordance with the latest revision to or edition of well known technical standards (i.e. ASTM, AWWA, Colorado Department of Transportation, etc.) referred to in the Specifications or Special Conditions.

Materials, supplies and equipment shall be in accordance with samples submitted by the contractor and approved by the engineer.

Materials, supplies or equipment to be incorporated into the work shall not be purchased by the contractor or the subcontractor subject to a chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller.

2.7. INSPECTION AND TESTING

All materials and equipment used in the construction of the project shall be subject to adequate inspection and testing in accordance with generally accepted standards and as required by the contract documents.

The owner shall provide technical personnel, acting under the supervision of the engineer, for the inspection and testing of the work in progress to ascertain that the completed work complies in all respects with the requirements of the contract documents.

If the contract documents, laws, ordinances, rules, regulations or orders of any public authority having jurisdiction require any work to specifically be inspected, tested, or approved by someone other than the contractor, the contractor will give the engineer timely notice of readiness. The contractor will then furnish the engineer the required certificates of inspection, testing or approval.

Neither observations by the engineer nor inspections, tests or approvals by any person shall relieve the contractor from his obligations to perform the work in accordance with the requirements of the contract documents.

The engineer and his representative will at all times have access to the work whenever it is in preparation or in progress. In addition, authorized representatives and agents of any participating federal or state agency shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The contractor will provide proper facilities for such access and observation of the work and also for any inspection thereof.

If any work is covered contrary to instructions or without approval or consent from the engineer, it must if required by the engineer, be uncovered for his examination and properly restored at the contractor's expense.

If any work has been covered which the engineer has not specifically requested to observe prior to its being covered, or if the engineer considers it necessary or advisable that covered work be inspected or tested by others, the contractor, at the engineer's request, will uncover, expose or otherwise make available for observation, inspection or testing as the engineer may require, that portion of the work in question, furnishing all necessary labor, materials, tools and equipment. If it is found that such work is defective, the contractor will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction. If, however, such work is not found to be defective, the contractor will be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate Change Order shall be issued.

2.8. SUBSTITUTIONS

Whenever a material, article or piece of equipment is identified on the drawings or specifications by reference to brand name or catalog number, it shall be understood that this is referenced for the purpose of defining the performance or other salient requirements and that other products of equal capacities, quality and function shall be considered. The contractor may request, in writing, the substitution of a material, article, or piece of equipment of equal substance and function for those referred to in the contract documents by reference to brand name or catalog number, and if, in the opinion of the engineer, such material, article, or piece of equipment is of equal substance and function to that specified, the engineer may approve its substitution and use by the contractor. Any cost differential shall be deductible from the contract price and the contract documents shall be appropriately modified by Change Order. The contractor warrants that if substitutes are approved, no major changes in the function or general design of the project will result. Incidental changes or extra component parts required to accommodate the substitute will be made by the contractor without a change in the contract price or contract time.

2.9. PATENTS

The contractor shall pay all applicable royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and save the owner harmless from loss on account thereof, except that the owner shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified by the owner; notwithstanding anything above to the contrary, if the contractor has reason to believe that the design, process or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information, in writing, to the engineer.

2.10. SURVEYS

The owner shall furnish, at no cost to the contractor, field electronic horizontal and vertical control data at only two control points at each site of the work at the owner's choice of location of control points. From the information provided by the owner, the contractor shall be required to make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pile locations and other working points, lines, elevations and cut sheets.

The contractor shall carefully preserve benchmarks, reference points and stakes and, in case of willful or careless destruction, he shall be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance.

The contractor shall notify the engineer, in writing, forty-eight hours in advance, of the time and place at which he will require lines and grades in order to perform the Work or obtain measurements for record and payment.

2.11. LICENSES, PERMITS, AND REGULATIONS

All contractors and subcontractors performing work on the project shall have a current City of Rifle Municipal or Building Contractor's License, whichever is applicable to their trade. Permits and licenses of a temporary nature necessary for the prosecution of the work shall be secured and paid for by the contractor. Permits, licenses, and easements for permanent structures or permanent changes in existing facilities shall be secured and paid for by the owner, unless otherwise specified. The contractor shall give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the contractor observes that the Contract Documents are at variance therewith, he shall promptly notify the engineer in writing, and any necessary changes shall be adjusted as provided in the Contract Documents for changes in the work.

2.12. PROTECTION OF WORK, EMPLOYEES, PUBLIC AND PROPERTY

The contractor will be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. He will take all necessary precautions for the safety of, and will provide the necessary protection to prevent damage, injury or loss to all employees on the Work and the public who may be affected thereby, all the work and all the materials or equipment to be incorporated therein, whether in storage on or off the site, and other property at the site or adjacent thereto, including pedestrian and vehicular traffic, trees, shrubs, lawns, fences, walks, pavements, roadways, structures and utilities, shown or not shown on the plans which are not designated for removal, relocation or replacement in the course of construction.

The contractor will comply with all applicable laws, ordinances, rules, regulations and order of any private or public body having jurisdiction. He will notify owners and users of adjacent utilities when prosecution of the work may affect them. He shall keep adjacent highways, streets and private access open to traffic and free of dirt and litter resulting from handling operations. He shall take reasonable precautions to protect private property adjacent to the project from such nuisances as dust, dirt, rock and excessive noise. The contractor shall remedy all damage, injury or loss to any property caused, directly or indirectly, in whole or in part, by the contractor, any subcontractor or anyone directly or indirectly employed by any of them or anyone for whose acts any of them be liable, except such as may be due to errors in the Contract Documents, or caused by agents or employees of the owner.

2.13. EMERGENCIES

In emergencies affecting the safety of life or the work or property at the site or adjacent thereto, the contractor, without special instruction or authorization from the engineer or owner, shall act to prevent threatened damage, injury or loss.

He will give the engineer prompt written notice of any significant changes in the Work or deviations from the Contract Documents caused thereby, and a Change Order shall thereupon be issued covering the changes and deviations involved, except when the emergency is attributed to acts of the contractor in performing the Work.

2.14. LAWS, ORDINANCES, RULES, REGULATIONS, AND ORDERS

The contractor shall keep himself fully informed of, and shall comply with all applicable laws, ordinances, rules, regulations and orders of the city, county, state, federal or public bodies having jurisdiction affecting the work. He shall provide, erect and maintain all necessary, police, watchmen, flagmen, firemen, shoring, signing, traffic devices, barricades and sanitary facilities, as required by the conditions and progress of the work, and all other necessary safeguards for safety and protection, as set forth by the United States Department of Labor, Occupational Safety and Health Administration.

The contractor must conform to the rules and regulations of the Industrial Commission of Colorado. Prior to starting excavation the contractor shall obtain from the Commission and file with the engineer a copy of his "Notice of Intent to Excavate."

The contractor shall comply with the requirements of CRS 8 -17-101 (1985 Supp.) by employing not less than 80 percent Colorado residents in the several classifications of skilled and common labor employed on the project.

The contractor shall be an equal opportunity employer and adhere specifically to all the City of Rifle resolutions and ordinances pertaining thereto.

The contractor shall protect and indemnify the owner and its agents against any claim or liability arising from or based on the violations of such ordinances, regulations, or laws, caused by the negligent actions of the contractor, his agents or employees.

2.15. SUPERVISION AND DISCIPLINE BY CONTRACTOR

The contractor will supervise and direct the work. He will be solely responsible for the means, methods, techniques, sequences and procedures of construction. The contractor will employ and maintain on the work a qualified supervisor or superintendent who shall have been designated in writing by the contractor as the contractor's representative at the site. The supervisor shall have full authority to act on behalf of the contractor and all communications given to the supervisor shall be as binding as if given to the contractor. The supervisor shall be present on the site at all times as required to perform adequate supervision and coordination of the work.

The contractor shall at all times enforce strict discipline and good order among his employees and shall avoid employing on the project anyone unskilled in the work assigned.

2.16. CHANGES IN THE WORK

At any time during the progress of the work, the owner, through its city manager, may order alterations or changes in the plans, specifications, character or quantity of work, without invalidating the contract agreement. When the total arithmetic dollar value of all such changes, both additive and deductive, does not exceed 25 percent of the contract price, bid unit or lump sum prices, where applicable, shall be used. Should the dollar value of the changes exceed 25 percent of the contract price, the value of the changes over 25 percent shall be based on negotiated unit or lump sum prices, where applicable.

The engineer, also, may at any time, by issuing a Field Order, make changes in the details of the work, the contractor shall proceed with the performance of any changes in the work so ordered by the engineer unless the contractor believes that such Field Order entitles him to a change in contract price or time, or both, in which event he shall give the engineer written notice thereof within fifteen days after the receipt of the ordered change, and the contractor shall not execute such changes pending the receipt of an executed Change Order or further instruction from the owner.

2.17. CHANGES IN CONTRACT PRICE

The contract price may be changed only by a Change Order. The value of any work covered by a Change Order or of any claim for increase or decrease in the contract price shall be determined by one or more of the following methods in the order of precedence listed below.

A. Contract Unit Prices. If a change is ordered in an item of work covered by a contract unit or lump sum price, then an adjustment in the contract price will be made based upon the increase or decrease in quantity of the contract unit or lump sum price.

B. Agreed Prices. Adjustments in contract price for changes ordered that are not covered by contract unit or lump sum price or exceed the limitation in Section 2.16, will be determined by agreement between contractor and owner. If unable to reach agreement, the owner may direct the contractor to proceed on the basis of extra work in accordance with Paragraph C.

C. Extra Work. When the price for extra work cannot be agreed upon, the owner will pay for the extra work based on the accumulation of costs as provided herein below.

1. Daily Reports by Contractor. At the close of each working day, the contractor shall submit a daily report to the engineer, together with applicable delivery tickets, listing all labor, materials, and equipment for that day, and for other services and expenditures when authorized. An attempt shall be made to reconcile the report daily, and it shall be signed by the engineer and the contractor. In the event of disagreement, pertinent notes shall be entered by each party to explain points which cannot be resolved immediately. Each party shall retain a signed copy of the report. Reports by subcontractors or others shall be submitted through the contractor.

a. Labor. The report shall show the names of workers, classifications, and hours worked.

b. Material. The report shall describe and list quantities of materials used.

c. Equipment. The report shall show type of equipment, size and hours of operation, including loading and transport, if applicable.

d. Other Services and Expenditures. Other services and expenditures shall be described in such detail as the engineer may require.

2. Basis for Establishing Costs.

a. Labor. The costs of labor will be the actual cost for wages for each craft or type of workers at the time the extra work is done, plus employer payments of payroll taxes and insurance, health and welfare, pension, vacation, and other direct costs resulting from federal, state or local laws, as well as assessments or benefits required by lawful collective bargaining agreements. The use of a labor classification which would increase the extra work cost will not be permitted unless the contractor establishes the necessity for such additional costs. Labor costs for equipment operators and helpers shall be reported only when such costs are not included in the invoice for equipment rental.

b. Materials. The cost of materials, or equipment to be incorporated in the work, shall be at invoice or lowest current price at which such materials are locally available and delivered to the job site in the quantities involved, plus freight and delivery.

The owner reserves the right to approve materials and sources of supply, or to supply materials to the contractor if necessary for the progress of the extra work. No markup shall be applied to any material provided by the owner.

c. Tool and Equipment Rental. No payment will be made for the use of tools which have a replacement value of $400 or less.

Regardless of ownership, the rates to be used in determining equipment rental costs shall not exceed rates approved or authorized by the Colorado Department of Transportation at the time the extra work is performed. (Dataquest-Rental Rate Blue Book)

The rental rates paid shall include the cost of fuel, oil, lubrication, supplies, small tools, necessary attachments, repairs and maintenance of any kind, depreciation, storage, insurance and all incidentals.

Necessary loading and transportation costs for equipment used in performing the extra work shall be included.

If equipment is used intermittently and, when not in use, could be returned to its rental source at less expense to the owner than holding it at the work site, it shall be returned, unless the contractor elects to keep it at the work site at no expense to the owner.

The reported rental time for equipment already at the job site shall be the duration of its use on the extra work, commencing at the time it is first put into actual operation on the extra work.

d. Other Items. The owner may authorize other items, which may be required on the extra work. Such items include labor, services, material and equipment which are different in their nature from those required for the work and which are of a type not ordinarily available from the contractor or any of the subcontractors.

Invoices covering all such items in detail shall be submitted with the request for payment.

e. Invoices. Vendors' invoices for material, equipment rental, and other expenditures, shall be submitted with the request for payment. If the request for payment is not substantiated by invoices or other documentation, the engineer may establish the cost of the item involved at the lowest price which was current at the time of the report.

3. Markup.

a. Work by Contractor. The following percentage shall be added to the contractor's costs and shall constitute the markup for all overhead and profits:

Labor (1.32 x certified payroll)	15
Materials	15
Equipment Rental	15
Other Items and Expenditures	15

To the sum of the costs and markups provided for in this subsection, one percent shall be added as compensation for bond and liability insurance.

b. Work by Subcontractor. When all or any part of the extra work is performed by a subcontractor, the markup established herein shall be applied to the subcontractor's actual cost of such work, to which a markup of five percent on the subcontracted portion of the extra work may be added by the contractor.

4. Any other cause which, in the opinion of the engineer, entitles the contractor to additional time, including but not restricted to acts of the public enemy, acts of any government in either its sovereign or any applicable contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and unforeseeable severe abnormal weather.

2.18. CHANGES IN CONTRACT TIME

The contract time may be changed only by a Change Order. The contractor shall notify the engineer promptly and in writing of any occurrence or conditions which, in the contractor's opinion, entitle him to an extension or reduction in contract time. Such notice shall be submitted in ample time to permit full investigation and evaluation of the contractor's claim. Failure to provide such notice shall constitute a waiver by the contractor of any claim. The engineer shall acknowledge the contractor's notice within seven days of its receipt.

Changes in contract time for the completion of the work shall be stipulated by Change Order:

A. When changes in the work occur.

B. When work is suspended by the owner.

C. For unforeseeable causes beyond the control and without the fault or negligence of the contractor, his subcontractor or supplier and which were not the result of their fault or negligence.

D. When delays in the progress of the work caused by:

1. Any act or neglect of the owner, his employees or agents.

2. Other contractors employed by the owner.

3. Any delay in furnishing of drawings, information or return of shop drawings by the engineer.

4. Any other cause which, in the opinion of the engineer, entitles the contractor to additional time, including but not restricted to acts of the public enemy, acts of any government in either its sovereign or any applicable contractual capacity, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and unforeseeable severe abnormal weather.

2.19. TIME FOR COMPLETION AND LIQUIDATED DAMAGES

The date of beginning and the time for completion of the work are essential conditions of the contract documents and the work embraced shall be commenced on the date specified in the Notice to Proceed.

The contractor will proceed with the work at such rate of progress to insure full completion within the contract time. It is expressly understood and agreed, by and between the contractor and the owner, that the contract time for the completion of the work described herein is a reasonable time, taking into consideration the average climatic and economic conditions and other factors prevailing in the locality of the work.

A daily charge will be made against the contractor for each working day, including free time, that any work shall remain uncompleted after elapse of contract time. This daily charge, determined by the original contract amount for the project from the table herein below, will be deducted from any money due the contractor. This deduction will not be considered a penalty but as liquidated damages.

The schedule of liquidated damages set forth below is an amount, agreed to by the contractor and the City of Rifle, as reasonably representing additional construction engineering costs incurred by the City if the contractor fails to complete performance within the contract time.

The schedule of liquidated damages will be:

Original Contract Amount		Daily Charge
From More than	To and Including	
$ 0	$ 25,000	$ 270
25,000	50,000	465
50,000	100,000	540
100,000	500,000	950

500,000	1,000,000	1,250
1,000,000	2,000,000	1,400
2,000,000	4,000,000	1,750
4,000,000	8,000,000	1,970
8,000,000	10,000,000	2,050

Over $10,000,000 - daily charge will increase by $100 increments for each $2,000,000 over $10,000,000.

Permitting the contractor to continue and finish the work or any part thereof after elapse of contract time will not operate as a waiver on the part of the City of any of its rights under the contract.

Any deduction assessed as liquidated damages under this section shall not relieve the contractor from liability for any damages or costs resulting from delays to other contractors on the project or other projects caused by a failure of the assessed contractor to complete the work according to contract times.

The contractor shall not be charged with liquidated damages or any excess cost when the delay in completion of the work is due to the following and the contractor has promptly given written notice of such delay to the owner or engineer.

A. To any preference, priority or allocation order duly issued by the owner.

B. To unforeseeable causes beyond the control and without the fault or negligence of the contractor, including but not restricted to, acts of God, or of the public enemy, acts of the owner, acts of another contractor in the performance of a contract with the owner, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes and unforeseeable severe abnormal weather.

The owner shall have the right to deduct the amount of liquidated damages from any monies due or to become due to the contractor, or to sue for and recover compensation for damages for non-performance of the work, from the contractor and his surety, as stipulated in the contract documents.

2.20. CORRECTION OF WORK

The contractor shall promptly remove from the premises all material and work condemned by the engineer for failing to comply with the contract documents, whether incorporated in the construction or not, and the contractor shall promptly replace and re-execute the work in accordance with the contract documents and without expense to the owner and shall bear the expense of making good all work and material of other contractors destroyed or damaged by such removal or replacement.

All removal and replacement Work shall be done at the contractor's expense. If the contractor does not take action to remove such condemned work and materials within ten days after receipt of written notice, the owner may remove such work and store the materials at the expense of the contractor.

2.21. SUBSURFACE CONDITIONS

The contractor shall promptly, and before such conditions are disturbed, except in the event of an emergency, which jeopardizes the safety of the project and/or persons thereon, notify

the owner in writing of:

A. Subsurface or latent physical conditions at the site differing materially from those indicated in the contract documents.

B. Previously unknown physical or other conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract documents.

The engineer shall promptly investigate the conditions, and if he finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or in the time required for, performance of the work, an equitable adjustment shall be made and the contract documents shall be modified by a Change Order. Any claim of the contractor for adjustment hereunder shall not be all wed unless he has given the required written notice; provided that the engineer may, if he determines the facts so justify, consider and adjust any such claims asserted before the date of final payment.

2.22. SUSPENSION, DELAY OR INTERRUPTION OF WORK

The owner may, at any time and without cause, suspend the work or any portion thereof for a period of not more than ninety calendar days or such further time as agreed upon by the contractor, by written notice to the contractor and the engineer which notice shall fix the date on which work shall be resumed. The contractor will resume that work on the date so fixed. The contractor will be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to any suspension.

If the performance of all or any portion of the work is suspended, delayed or interrupted as a result of a failure of the owner or engineer to act within the time specified in the contract documents, or if no time is specified, within a reasonable time, an adjustment in the contract price or an extension of the contract time, or both, shall be made by Change Order to compensate the contractor for the costs and delays necessarily caused by the failure of the owner or engineer.

2.23. OWNER'S RIGHT TO TERMINATE OR ABANDON WORK

If the contractor is adjudged bankrupt or insolvent, or if he makes a general assignment for the benefit of his creditors, or if a trustee or receiver is appointed for the contractor or for any of his property, or if he files a petition to take advantage of any debtor's act, or to reorganize under the bankruptcy or applicable laws, or if he repeatedly fails to supply sufficient skilled workmen or suitable materials or equipment, or if he repeatedly fails to make prompt payments to subcontractors or for labor, materials or equipment or if he disregards laws, ordinances, rules, regulations or orders of any public body having jurisdiction of the work or if he disregards the authority of the engineer, or if he otherwise violates any provision of the contract documents, then the owner may, without prejudice to any other right or remedy and after giving the contractor and his surety a minimum of ten days from delivery of a written notice, terminate the services of the contractor and take possession of the project and of all materials, equipment, tools, construction equipment and machinery thereon owned by the contractor, and finish the work by whatever method he may deem expedient. In such case the contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price exceeds the direct and indirect costs of completing the project, including compensation for additional professional services, such excess shall be paid to the contractor. If such costs exceed such unpaid balance, the contractor will pay the difference to the owner. Such costs incurred by the owner will be determined by the engineer and incorporated in a Change Order.

Where the contractor's services have been so terminated by the owner, said termination shall not affect any right of the owner against the contractor then existing or which may thereafter accrue. Any retention or payment of monies by the owner due the contractor will not release the contractor from compliance with the contract documents.

After ten calendar days from delivery of a written notice to the contractor, the owner may, without cause and without prejudice to any other right or remedy, elect to abandon the project and terminate the contract. In such case, the contractor shall promptly remove all of his equipment, temporary facilities and supplies from the premise, clean up the project and contiguous properties. Otherwise, the owner shall perform such housekeeping at the expense of the contractor. However, the contractor shall be paid for all work executed and any expense sustained plus reasonable profits as a result of such action by the owner.

2.24. CONTRACTOR'S RIGHT TO TERMINATE OR STOP WORK

If, through no act or fault of the contractor, the work is suspended for a period of more than ninety calendar days by the owner or under an order of court or other public authority, or the engineer fails to act on any request for payment within thirty calendar days after it is submitted, or the owner fails to pay the contractor substantially the sum approved by the engineer within thirty calendar days of its approval and presentation, then the contractor may, after ten calendar days from delivery of a written notice to the owner and the engineer, terminate the contract and recover from the owner payment for all work executed and all expenses sustained. In addition and in lieu of terminating the contract, if the engineer has failed to act on a request for payment or if the owner has failed to make any payment as aforesaid, the contractor may upon ten calendar days notice to the owner and the engineer stop the work until he has been paid all amounts then due, in which event and upon resumption of the work, Change Orders shall be issued for adjusting the contract price or extending the contract time, or both, to compensate for the costs and delays attributable to the stoppage of the work.

2.25. SUBCONTRACTING

The contractor may utilize the services of subcontractors on those parts of the work which, under normal contracting practices, are performed by specialty subcontractors.

The contractor shall not award work to subcontractor(s), in excess of fifty percent of the total contract price, without prior written approval of the owner.

The contractor shall be fully responsible to the owner for the acts and omissions of his subcontractors, and of persons either directly or indirectly employed by them, as he is for the acts and omissions of persons directly employed by him.

The contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the contractor by the terms of the contract documents insofar as applicable to the work of subcontractors and to give the contractor the same power as regards terminating any subcontract that the owner may exercise over the contractor under any provision of the contract documents.

Nothing contained in this contract shall create any contractual relation between any subcontractor and the owner.

2.26. CONTRACT SECURITY

The contractor shall, within seven calendar days after the receipt of the Notice of Award, furnish the owner with a Performance and Payment Bond in the penal sum of the total contract price, conditioned upon the performance by the contractor of all Change Orders, undertakings, covenants, terms, conditions and agreements of the contract documents, and upon the prompt payment by the contractor to all persons supplying labor, equipment and materials in the prosecution of the work provided by the contract documents. Such bond shall be executed by the contractor and a corporate bonding company licensed to transact such business in the State of Colorado and listed in the most recent revision of "Surety Companies Acceptable on Federal Bonds" as published in the U.S. Treasury Department Circular No. 570. The expense of the bond shall be borne by the contractor. If at any time a surety on any such Bond is declared a bankrupt or loses its right to do business in the State of Colorado, or is disapproved by the owner, the contractor shall, within ten calendar days after notice from the owner to do so, substitute an acceptable bond (or bonds) in such form and sum and signed by such other surety or sureties as may be satisfactory to the owner. The premiums on such bond shall be paid by the contractor. No further partial payments shall be deemed due nor shall be made until the new surety or sureties shall have furnished an acceptable bond to the owner.

2.27. PARTIAL COMPLETION AND OCCUPANCY

At any time during the performance of the work that a portion of the permanent construction has been satisfactorily completed, in accordance with the contract documents, which is not required for the operation of the contractor but is needed or required by the owner, the engineer shall issue to the contractor a written notice of partial completion, and thereupon or at any time thereafter, the owner may take over, occupy, operate and use that portion of the construction therein described.

The notification of partial completion shall in no way be construed to constitute an extension in contract time for the completion of all the work or as a waiver of the right of the owner to require the fulfillment of all the terms of the contract documents.

If such prior use should cause an increase in the cost of, or in the time required for, performance of the Work, as determined by the engineer, an equitable adjustment to the contractor shall be made and the contract documents modified by a Change Order.

2.28. MEASUREMENT OF QUANTITIES FOR PAYMENT

Measurement for pay items in the contract shall be as defined in the Measurement and Payment Section of the City of Rifle Standard Specifications for Design and Construction or as modified in the Special Conditions. The methods of measurement and computation to be used in determination of quantities; of work performed, of materials to be furnished and/or installed; will be those methods generally recognized as conforming to good engineering practice.

Sundry items, which are incident to or required in the construction of the work, but are not included as items in the Bid Schedule, shall be considered an integral part of the work to be performed. All labor, materials, etc., required for such items shall be furnished and installed, and the costs shall be included in the applicable contract unit price or lump sum amount bid.

2.29. SCOPE OF PAYMENT

Payment to the contractor will be made only for the actual quantities of contract items constructed and installed in accordance with the plans and specifications.

Payment made at the contract unit price or lump sum amount bid shall be full compensation for furnishing all labor, materials, equipment, appurtenances, taxes, insurance, permits and incidentals necessary to complete the work as shown on the plans and as required by the Specifications. Each item, fixture, piece of equipment, etc., shall be complete in place, operational and accepted.

No additional payment, over the amount bid, will be made for related work to any item unless specifically called for in the contract. Neither will payment be made for materials wasted, rejected or placed outside of plan limit lines.

2.30. PARTIAL PAYMENT AND CERTIFIED TAX REPORTS

The engineer, on or about the twenty-fifth day of the month in which work on the project is performed, shall prepare for contractor's approval, a partial payment estimate of the work performed and materials placed in accordance with the contract documents.

Not more than eighty (80) percent of the cost of materials and equipment delivered and suitably stored at or near the project site, but not incorporated in the work may be included in an estimate; provided however, the contractor furnishes invoices and supportive data establishing title in the name of the owner, to the engineer.

The amount to be retained from partial payments will be ten percent of the value of completed work, exclusive of mobilization and payment for materials on hand. When the retainment on contracts exceeding $80,000 in value has reached five percent of the amount of the contract, no further retainment will be made. Amount of retainment will be held until such time as final payment is made with the following provision: When ninety-seven and one-half percent of the work has been completed, the engineer may, at his discretion and

The amount to be retained from partial payments will be ten percent of the value of completed work, exclusive of mobilization and payment for materials on hand. When fifty percent of the work required by contracts exceeding $150,000. has been performed, no further retainment will be made if in the opinion of the City, satisfactory progress is being made on the work. Amount of retainment will be held until such time as final payment is made with the following provision: When ninety-seven and one-half percent of the work has been completed, the engineer may, at his discretion and with the consent of the Surety, reduce the retained amount to twice the value of the work remaining to be done. Any amount retained under this provision shall be subject to the requirements of Colorado Revised Statute § 24-91-103.

Earnings so retained on contracts exceeding $150,000. in value may be withdrawn by the contractor provided the contractor provides the City with an irrevocable letter of credit in a form and from a financial institution acceptable to the owner. Any amounts so retained by the owner under this provision shall be subject to Colorado Revised Statute. § 24-91-105.

The contractor upon receipt of each partial payment estimate shall either indicate his approval by signing and returning a copy to the engineer, or return the estimate unsigned and indicate in writing his reason for refusing payment.

The owner, within fifteen- (15) days of presentation to the engineer of an approved partial payment estimate, shall pay the contractor the amount due thereon.

Upon receipt from the contractor of an approved designated semifinal estimate, as prepared by the engineer:

A. The contractor shall, in writing, request the engineer to make a semifinal inspection in preparation for final acceptance of the work by the owner.

B. The contractor shall prepare and furnish the engineer certified city and county sales and use tax reports covering the equipment and materials incorporated in the work.

The engineer, upon receipt of written request for semifinal inspection, shall promptly make said inspection of the work and issue to the contractor a written notice advising him of any deficiencies, corrective measures or clean up that he must complete prior to preparation of the final payment request.

All work covered by partial payment made shall thereupon become the sole property of the owner, but this provision shall not be construed as relieving the contractor of the sole responsibility for the care and protection of the work upon which payments have been made or the restoration of any damaged work, or as a waiver of the right of the owner to require the fulfillment of all terms of the contract documents.

2.31. FINAL PAYMENT REQUEST, ACCEPTANCE AND RELEASE

Upon completion of the work, cleanup of the project site, the engineer's receipt from the contractor in triplicate of certified tax receipts, the engineer, within ten calendar days thereafter shall:

A. Prepare a final payment request, for contractor's approval, showing the total value of the work completed in accordance with the contract documents and as modified by any Change Orders, less the value of:

1. Partial payments previously made by the owner to the contractor.

2. Retention of any claims, on file with the owner, against the contractor

3. Estimated costs of completing any incomplete or unsatisfactory items of the work.

4. Payments advanced by the owner, to subcontractors, material and equipment suppliers or others which are known by the contractor to have been made but not previously accounted for.

5. Liquidated damages not previously paid to the owner by the contractor.

B. Advise the owner and contractor by written notice that:

1. The work has been inspected and accepted by him under the conditions of the contract documents.

2. The work, effective the date of the notice, is placed under warranty, at the contractor's expense, for a period of one year.

3. The entire balance shown on the final payment request, as prepared by the engineer, is due and payable within thirty calendar days from date of approval thereof by the contractor.

Upon approving the final payment request, as prepared by the engineer, the contractor by such act, indemnifies and saves the owner and his agents harmless from all claims growing out of the lawful demands of subcontractors, laborers, workmen, mechanics, material men and furnishers of machinery and parts thereof, equipment, tools, and all supplies incurred in the furtherance of the performance of the work. The contractor shall, at the owner's request, furnish satisfactory evidence that all obligations of the nature designated above have been paid, discharged or waived. If the contractor fails to do so, the owner may, after having notified the contractor, either pay unpaid bills or withhold from the contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged, in accordance with the terms of the contract documents, but in no event shall the provisions of this sentence be construed to impose any obligations upon the owner to either the contractor, his surety, or any third party. In paying any unpaid bills of the contractor, any payment so made by the owner shall be considered as a payment made under the contract documents by the owner to the contractor and the owner shall not be liable to the contractor for any such payments made in good faith.

The acceptance by the contractor of final payment shall be and shall operate as a release to the owner of all claims and all liability to the contractor other than claims in stated amounts as may be specifically excepted by the contractor for all things done or furnished in connection with this work and for every act and neglect of the owner and others relating to or arising out of this work. Any payment, however, final or otherwise, shall not release the contractor or his sureties from the warranty period or any other obligations under the contract documents or the Performance and Payment Bond.

In the event the owner fails to make final payment as herein provided, there shall be added daily interest at the rate of six percent per annum, commencing on the first day after said payment is due and continuing until the payment is delivered or mailed to the contractor.

2.32. INSURANCE

The contractor shall at its own expense keep in full force and effect during the term of this contract insurance as follows:

The contractor shall secure and maintain statutory workmen's compensation.

The contractor agrees to secure, at his own cost, a policy or policies of insurance sufficient to insure against the liability assumed by the contractor pursuant to the provisions of paragraph 2.36 of these General Conditions. The contractor's insurer must be rated "B+" or better, according to Best's Key Rating Guide and must be admitted to do business in the State of Colorado. The contractor shall provide the owner with a certificate of insurance from a properly qualified representative of the insurer, that any policy purchased pursuant to this contract complies with the conditions required by this contract. The certificate of insurance must show current name and address of the insured(s) named in the policy. The contractor shall not commence any work under this contract, and shall not allow any subcontractor or any officer, employee, or agent of the contractor or any subcontractor to commence any work under this contract, until any such certification has been received and approved by the owner.

The contractor shall not be relieved of any liability assumed pursuant to the foregoing paragraph by reason if its failure to secure insurance as required by this contract or by reason of its failure to secure insurance in sufficient amounts, of sufficient durations, or of sufficient types to cover such liability. The required policy shall meet the following conditions:

A. The policy limits shall be as follows:

1. The limit for an injury to one person in any single occurrence shall be no less than $1,000,000, and the limit for an injury to two or more persons in any single occurrence shall be no less than $2,000,000. Costs of defense shall not be included within such limits or, if they are so included, the minimum limits shall be $1,000,000 combined single limits.

2. The general aggregate limit shall be unlimited or at least $2,000,000.

B. The policy shall include the owner as an additional insured. The parties hereto understand and agree that the owner is relying on and does not waive or intend to waive by this contract, any provision hereof, including the provisions of this paragraph, the monetary limitations (presently $1,000,000 per person and $2,000,000 per occurrence) or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, C.R.S. 24-10-101, et seq., as from time to time amended, or otherwise available to the owner.

C. The insurer shall give the owner notification of any cancellation or termination by refusal to renew the policy or any change in coverage of the policy in the manner provided by law. If no such notification is provided by law, the insurer shall give the owner at least thirty (30) days prior written notification of any cancellation or termination by refusal to renew the policy or of any change in coverage of the policy, unless cancellation or termination is for non-payment of premium, in which case, the industry standard of ten (10) days prior written notification shall apply.

D. The contractor shall be solely responsible for any deductible losses under the policy.

E. If the policy is a claims made policy, the policy shall provide the contractor the right to purchase, upon cancellation or termination by refusal to renew the policy, an

extended reporting period of not less than two years. The contractor agrees to purchase such an extended reporting period should the policy be cancelled or terminated.

F. If the policy is a claims made policy, the policy shall give the owner the right to purchase the extended reporting period described in paragraph E above if the contractor fails to purchase such an extended reporting period as required by this contract. The owner's exercise of such right shall not relieve the contractor of any liability for its failure to purchase such an extended reporting period as required by this contract.

G. If the policy is a claims made policy, the retroactive date of any renewal of such policy shall be no later than the date this contract is signed by the parties hereto.

H. If the contractor purchases a subsequent claims made policy in place of any prior policy, the retroactive date of such subsequent policy shall be no later than the date the contract is signed by the parties hereto.

The contractor shall secure and maintain, at his own expense, if applicable or called for in the Special Conditions, the following insurance coverage:

Fire, extended coverage and vandalism insurance on the project to the full insurable value thereof for the benefit of the owner, the contractor and subcontractors.

"All Risk" type builder's risk insurance for work to be performed. Unless otherwise authorized by the owner, the amount shall not be less than the contract price totaled in the Bid Proposal. The policy shall cover not less than the losses due to fire, explosion, hail, lightning, vandalism, malicious mischief, wind, collapse, riot, aircraft and smoke during the contract time and until the work is accepted by the owner. The policy shall name as the insured the contractor, the owner and their designated agents.

Special Comprehensive General Bodily Injury and Property Damage for the period of time that work being performed is encroaching on property owned or controlled by individuals, partnerships or corporations such as irrigation companies and railroads, state or federal agencies, and to limits set forth in their permit. The policy shall be issued to the permittee and name as the insured the contractor, the owner and their designated agents.

The contractor must comply with the owner's requirements for filing certificates of insurance, as determined by the Risk Management Division. A certificate of insurance acceptable to the Risk Management Division must be provided at the time the contract is executed by the parties hereto unless both parties arrange otherwise. The contractor is responsible for submitting certificate(s) of insurance, subject to the insurance requirements described above, for all subcontractors. All certificates of insurance are subject to periodic verification and approval by the owner.

2.33. SEPARATE CONTRACTS

The owner reserves the right to let other contracts in connection with this project, or contiguous thereto. The contractor shall afford other contractors, utility companies or owner's forces reasonable opportunity for the introduction and storage of their materials and the execution of their work, and shall properly connect and coordinate his work with theirs. If the proper execution or results of any part of the contractor's work depends upon the work of any

other contractor, the contractor shall inspect and promptly report to the engineer any defects in such work that render it unsuitable for such proper execution and results.

If the performance of additional work by other contractors, utility companies or the owner is not noted in the contract documents prior to the execution of the contract, written notice thereof shall be given to the contractor by the engineer, prior to starting any such additional work. If the contractor believes that the performance of such additional work by the owner or others entitles him to a change in contract price or time, or both, he may, by written notice to the engineer, request a Change Order as provided under Changes in the Work.

2.34. HOUSEKEEPING AND CLEANUP

At all times during the progress of the work the contractor, at his expense, shall maintain the site, storage yard, adjacent properties, both public and private, policed and free of litter or trash. All material and equipment to be incorporated in the work shall be stored in a neat appearing manner and protected from damage or the elements until accepted in accordance with the contract documents.

Prior to final payment, the contractor, at his expense, shall remove from the project site and from contiguous private and public property, all temporary structures, equipment, rubbish and waste materials resulting from his operations. He shall clean up, police around and over all facilities that the owner will acquire maintenance thereof.

Disposal areas for waste material, from the contractor's operation, shall be those areas that comply in every way with local ordinances and are approved by the engineer.

2.35. ASSIGNMENT

Neither the contractor nor the owner shall sell, transfer, sublet as a whole, or otherwise dispose of the contract or any portion thereof without the written consent of the other and its surety; nor shall the contractor assign any monies due or to become due to him thereunder, except to a bank or financial institution acceptable to the owner.

2.36. INDEMNIFICATION

The contractor agrees to indemnify and hold harmless the owner, its officers, employees, insurers, and self-insurance pool, from and against all liability, claims and demands on account of personal injuries, including without limitation worker compensation claims and death claims, or property loss or damage, or any other loss of any kind whatsoever, which arises out of or are in any manner connected with this contract, whether or not such injury, loss, or damage is caused by, or is claimed to be caused by, the act, omission, negligence or other fault of the contractor, any employees of the contractor, or any other person or entity; or by accident; or by any other cause. Nothing herein is intended to constitute a covenant, promise, or agreement to indemnify and hold harmless the owner from any liability or damages directly caused by or attributable to the owner's own negligence. The contractor agrees to investigate, handle, respond to, provide defense for, and defend against, any liability, claims, or demands arising from, connected with, or related to the contract at the sole expense of the contractor regardless of whether the liability, claim, or demand is related to the owner's own negligence and the contractor further agrees to bear all other costs and expenses, related thereto, including court costs and attorney fees, whether or not the claim or claims alleged are groundless, false, or fraudulent. Nothing herein is intended to be, or may be construed as, a waiver or the immunities, protections, or limitations on damages provided

to The City of Rifle by the Colorado Governmental Immunity Act, C.R.S.. 24-10-101 through 24-10-120, as it may from time to time be amended.

2.37. ENGINEER'S STATUS AND DECISIONS

The engineer shall act as the owner's representative during the construction period. He shall decide questions which arise in the execution of the work. He shall perform technical inspections in the field, in laboratories, at factories, at sources of supply and wherever he feels the necessity to determine the quality and acceptability of material and equipment furnished and work performed. He shall reject all material, equipment and work which fails to conform to the specifications. He shall stop the performance of the work whenever such stoppage may be necessary to insure the proper execution of the contract documents. He shall determine the quantity of work to be paid for and prepare all partial payments, estimates and the final payment request for submittal to the owner after obtaining the contractor's approval thereof.

The engineer will not be responsible for the construction means, controls, techniques, sequences, procedures or construction safety.

The engineer shall, within a reasonable time after presentation, make decisions by written notice on all claims of the owner or the contractor on all matters relating to the execution and progress of the work or the interpretation of the contract documents.

2.38. LAND, RIGHTS-OF-WAY, EASEMENTS AND ENCROACHMENTS

Prior to issuance of Notice to Proceed, the owner shall obtain all land and rights-of-way necessary for carrying out and for the completion of the work to be performed pursuant to the contract documents, unless otherwise stated in the Special Conditions or mutually agreed to.

The owner shall indicate on the drawings or provide to the contractor information which delineates and describes the lands owned, rights-of-way and easements acquired, and encroachments over lands upon which the work is to be performed.

Delays in furnishing land for the work by the owner may be deemed proper cause for a change in the contract price, contract time, or both.

The contractor shall provide, at his own expense and without liability to the owner, any additional land and access thereto that the contractor may desire for temporary construction facilities, or for storage of materials and equipment.

2.39. GUARANTY AND WARRANTY

The contractor shall guarantee all material and equipment incorporated in, and warrant all workmanship on, the project for a period of one year from the date of written notice of acceptance of the project or portions thereof. The contractor shall within forty-eight hours after notification from the owner, subsequently verified by written notice, make all needed repairs and corrections which develop or result from defective workmanship, materials or equipment.

In the event the contractor should fail to make such repairs, adjustments, or performs other necessary work required to correct any deficiencies, the owner may do so and charge the contractor the cost thereby incurred. The Performance and Payment Bond shall remain in full force and effect through the guarantee and warranty period.

2.40. TAXES

The contractor will pay all applicable sales, use and other similar taxes required by the laws of the State of Colorado. When taxes are due, the developers, other responsible parties, and/or their subcontractors, prior to requesting final warranty on their project shall furnish the engineer, in triplicate on the City form, certified receipts of sales, use and other similar taxes, required by law, paid on all materials and equipment incorporated in or used in the performance of the work.

Notwithstanding the above, the contractor shall obtain from the Colorado Department of Revenue a Certification of Exemption indicating, where applicable, that the contractor's purchase of construction or building materials is for use in the building, erection, alteration or repair of public works owned and used by the City of Rifle, in its governmental capacity. The contractor shall file with the engineer a certified copy of the Certification of Exemption, prior to commencing Work.

Where a project is exempt from such tax, the amount of such tax shall not be included in any bid proposal submitted to the City.

2.41. DESIGNING AND PERFORMING WORK WITHOUT A CONTRACT AGREEMENT

All property owners, individuals, partnerships or corporations which engage in the subdividing or improving of land, or in the design or construction of the Work, ultimately to be maintained, operated, occupied or owned by the City of Rifle, other than those directly contracting with the City, shall adhere to this Public Works Manual, Design and Construction of Public Improvements to which these General Conditions are a part.

No portion of the work shall be performed until the engineer has approved the drawings pertaining there to, and then only by a contractor that is licensed and bonded to the City of Rifle.

Those who are responsible for, or cause the work to be performed, and those who actually perform the work, will be considered, for purposes of these General Conditions and Standard Specifications, as having executed a contract agreement, as contractor, with the City of Rifle as owner, even though no agreement exists. As such, they shall comply with all the technical and performance provisions of these Specifications, be subject to inspection and the directives of the engineer.

2.42. CLOSEOUT

To close out a project or development, several items need to be taken into account by the Contractor, Engineer and by the Owner. Several of these items may have been initiated prior to or during the work.

The Contractor of the work shall notify the Engineer and the Owner in writing that he has reached “Substantial Completion” and include a list of work yet to be completed or corrected. If requested by the Engineer, closeout of areas or portions of work may be allowed by the Owner.

The Engineer, along with the Owner’s representative, shall inspect the work to determine if it is substantially complete. If it is substantially complete, a “Certificate of Substantial Completion” will be issued by the Engineer along with a “Punch List” of items to be completed or corrected, to the Contractor and the Owner.

The Contractor shall complete and/or correct the items listed on the punch list, or any other item that becomes known, and again notifies the Engineer and Owner in writing that the work is ready for final inspection. At this time, the Contractor may submit his application for final payment to the Engineer.

The Engineer along with the Owner’s representative will make a final inspection. If the work is found acceptable and complete to the satisfaction of the Owner, a meeting will be scheduled to finalize all other items due. Should the Contractor fail to complete and/or correct all punch list items required by the Owner, the Contractor shall pay for additional “Final Inspections” by the Engineer at the Engineer’s current rates. If the Contractor has any question with regard to any items found on the punch list, he shall request clarification from the Engineer prior to final inspection.

Prior to release of final payment, a meeting (referred to in the previous paragraph) shall be held to collect from the Contractor and/or the Engineer, for the Owner, the following items:

1. Outside Inspection Certificates, as applicable,
2. Materials Certificates of Compliance,
3. Equipment and Material guarantees,
4. Contractors one-year (or longer, if required) guarantee or warranty using Owner forms,
5. Operation & Maintenance Manuals and Parts list, as applicable,
6. Receipts for Materials delivered to the Owner,
7. Miscellaneous Keys, Tools, etc.
8. Final Application for Payment,
9. Consent of Surety to Final Payment,
10. Contractor’s Affidavit of Release of Liens,
11. Project Record Drawings (As-Builts),
12. Quitclaim deed from developer conveying any interest it has in the public improvements to the Owner using Owner format,
13. Bill of Sale conveying all public improvements to the Owner free and clear of liens and encumbrances using Owner format,

14. Final Payment Amount,
15. Contractor acknowledgement of Date of Warranty, and
16. All other documentation.

And the Owner will provide to the Engineer:

1. Public Works Director Certification that the work has been constructed in conformance with the plans and specifications.
2. A letter informing the financier to release the Letter of Credit.

Inspection certificates shall be submitted (Number 1, in the list above) from any State or Other governing body having jurisdiction, such as State electrical certification that the work is in strict conformance with applicable codes.

The Contractor shall remedy any defects due to faulty materials or workmanship and pay for damage to other work resulting there from, for a period of one year (or longer, if required) in accordance with Section 2.39 herein. A written warranty based on the provisions of Section 2.39 shall be provided to the Owner, dated as agreed with the Owner, properly signed and notarized and addressed to the Owner.

All keys to doors, panels or switches, special tools required for equipment and spare parts or supplies, as applicable, shall be accounted for and turned over to the Owner.

The Owner, will initiate action to advertise in the local newspaper regarding final payment to the Contractor and determining the date for payment.

Project Record Drawings (As-Builts) shall consist of one blackline copy of the completed project work with changes clearly marked and clouded and a CD-ROM. The CD-ROM disk shall include the marked up sheets in individual PDF format files and the electronic line work in the latest AutoCad drawing format. The electronic line work should be supplied such that all improvements are located on the Rifle grid i.e. UTM Z13 in metric (meter) scale. All drawings (electronic and hardcopy) should be clearly and neatly marked “RECORD DRAWING” in ½” block letters in the lower right quadrant of the sheet.

Item 14, above, shall be broken down into 1) cost of water system per individual street (including pipe, fittings, valves, services, hydrants, etc.), 2) sewer system (including pipe, services, manholes, etc.) per individual street, 3) storm drain and culvert system per individual street (including pipe, inlets, boxes, flared ends, manholes, etc.) and 4) individual street costs (including signals, signs, striping, asphalt, road base, curb, gutter sidewalk, grading, etc.).

2.43. RIGHTS AND REMEDIES

The duties and obligations imposed by the Contract Documents and the rights and remedies available there under shall be in addition to and not as a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law, including but not limited to tort remedies. The Contractor agrees that the economic loss rule as set forth in the Town of Alma v. Azco Construction, Inc., 10 p.3d 1256 (Colo. 2000) shall not serve as a limitation on the Owner’s right to pursue tort remedies in addition to other remedies it may have against the Contractor. Such rights and remedies shall survive the acceptance of the Work or any termination of the Contract Documents. Contractor further specifically waives all provisions of Chapter 8 of Article 20 of Title 13, Colorado Revised Statues,

regarding defects in the Work under the Contract. In the event any portion of this provision is deemed un-enforceable by a court of competent jurisdiction, the remaining portions of this provision shall survive.

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PART I - GENERAL CONDITIONS

SECTION 3.

MEASUREMENT AND BASIS OF PAYMENT

3.1. GENERAL

All work completed under the contract will be measured in place by the engineer, according to United States Standards of measures, using methods generally recognized as conforming to good engineering practices and as specified herein.

Quantities of the units of work in place will be measured and payment computed, based on the following:

Measurement	Payment Units
Count	Lump sum, each
Linear (Horizontal or Vertical)	Inch, feet, yard, mile
Area (Horizontal or Vertical Plane)	Square: feet, yard or acre
Volume	Cubic: feet, yard
Weight (Avoirdupois)	Pounds, 2000 lb. ton
Liquid	U.S. Gallon
Haul	Ton mile, yard mile
Equipment	Hour

Payment made and accepted by the contractor shall be full payment for furnishing all materials and performing all work under the contract in a complete and acceptable manner and for all risk, loss, damage, or expense of whatever character arising out of the nature of the work or the prosecution thereof.

Work or materials for which there are pay items and which are to be paid separately will be included in the approximate quantities listed in the Bid Schedule. Work or materials that are essential to the project but for which there are no pay items, will not be measured and paid for separately but shall be included in the project work.

3.2. CLEARING AND GRUBBING

Measurement: (Acres) (Lump Sum) The quantity of clearing and grubbing shall be measured in acres or fraction thereof acceptably cleared and/or grubbed including scalping and shrub removal, within the project limits. No measurement will be made when the Bid Schedule calls for clearing and grubbing on a lump sum basis.

Payment: The accepted areas will be paid for at the contract unit price or lump sum amount bid. When the Bid Schedule does not contain an item for clearing and grubbing, the work will not be paid for directly, but will be considered as a subsidiary obligation of the contractor under other contract items.

Trees, plants, structures, etc. that are not to be removed shall be fully protected from injury by the contractor at his expense.

3.3. TRANSPLANTING PLANTS, SHRUBS, TREES

Measurement: (Each) - The quantity of transplanting to be measured will be the actual number of plants of the various types transplanted and accepted in their final location and in healthy condition at the end of the 90 day maintenance period.

Payment: The accepted quantities of the various plants transplanted, as specified in the Bid Schedule, will be paid for at the contract unit price bid. No separate measurement or payment will be made for digging, balling, spraying, debudding, pruning, transporting, fertilizing, watering and maintaining, but shall be included in the work.

3.4. DEMOLITION

Measurement: (Each) - Demolition will be measured as the number of locations where structures have been raised or removed and area properly graded and accepted.

Payment: Accepted areas on which demolition has been performed will be paid for at the contract amount bid for the specified location. No separate measurement or payment will be made for: clearing and grubbing, removal of buildings, foundation, basement slabs, cesspool, privies, buried fuel and septic tanks, wells, well casing, slabs on grade; disconnect and protection of public utilities or improvements; hauling and disposal of rubble, furnishing, hauling, placing, compacting fill and grading the area to drain; protection of facilities designated to remain, but shall be included in the work.

3.5. REMOVAL OF STRUCTURES OR OBSTRUCTIONS TO SALVAGE OR WASTE

Items: Buildings and foundations; bridges, culverts and other drainage structures; concrete curb, gutter, sidewalk, crosspans and pavement; manholes, fence, pipe, valves, meters, traffic devices, etc.

Measurement: (Each) (Lump Sum) (Linear Feet) (Square Feet) (Square Yard) - Measurement will be made for removal for salvage or waste according to the unit specified in the Bid Schedule. Only count will be made of items removed on a lump sum basis.

Payment: The accepted quantities will be paid for at the contract unit price bid for each of items removed for salvage or waste specified in the Bid Schedule. No separate measurement or payment will be made for sawing, removing, hauling and disposal, excavation and subsequent backfill to finish grade, but shall be included in the work.

The contract unit price bid shall also include the salvage of materials removed, their custody, preservation, storage and disposal as specified in the contract documents.

3.6. RESET, RELOCATE, RECONNECT, ADJUST

Items: Barricade, fence, gate, mailbox, manhole barrel, cover, cone, flat top, ring or steps; pipe, pole, structures; sewer service; traffic devices; water meters, services and valves.

Measurement: (Each) (Lineal Feet) (Square Yards) - The quantity to be measured shall be the actual number, length or area of the various items removed, stored, reconnected, relocated, adjusted and reset to service, when specified on the Bid Schedule.

Payment: The accepted quantities of item reset to service will be paid for at the applicable contract unit price bid. No separate measurement or payment will be made for work related materials necessary to reset the item to service; such as posts, hardware, wire, mailbox,

excavation, backfill, concrete, rewiring, bedding, joint material, collars, connecting bands; but shall be included in the work.

3.7. FLOW CONTROL, SPECIAL FITTINGS AND MEASURING DEVICES OR SYSTEMS

Items: Meters, pumps, special fittings and valves; flumes, drain and head gates; recorders, totalizers, telemetry and electrical systems.

NOTE: Fire hydrants are excluded.

Measurement: (Each) - The actual number of the various devices or systems specified in the Bid Schedule installed and accepted.

Payment: The accepted number of flow control, special fittings and measuring devices or systems will be paid for at the contract unit price bid. No separate payment will be made for excavation, dewatering, bedding, in line fittings and connectors, supports, riser guides and extension, valve box with covers, backfill, grading, mounting brackets, electrical conduit, wire etc., but shall be included in the work.

3.8. FIRE HYDRANTS

Measurement: (Each) - Actual number of five (5) inch three-way fire hydrants installed to grade.

Payment: The accepted number of fire hydrants will be paid for at the contract unit price bid. No separate measurement or payment will be made for excavation, dewatering, six (6) inch flanged gate valve with box and cover at main, hydrant extensions, bedding, six (6) inch PVC CL-200 lateral pipe, gravel underdrain, tie rods, shackle, tape wrapping, concrete anchor block, backfill, grading, etc., but shall be included in the work.

3.9. PIPING IN VAULTS

Measurement: (Lump Sum) - No separate measurement will be made of Piping installed in vaults or within three (3) feet of the vault exterior surface.

NOTE: In line valves, meters, telemetry and electrical systems will be measured and paid for separately as called for in the Bid Schedule.

Payment: - Accepted in vault piping will be paid for at the contract unit price bid. No separate measurement or payment will be made for the various types, sizes or length of pipe and fittings required, tie-rods, corporation stop, gauges, pipe and device supports, structural steel, steel plates, hardware, gaskets, tubing, insulating and joint bonding material, tape wrapping, gasket and outlet sealants, vents, conduit, etc., but shall be included in the work.

3.10. CASING PIPE - JACKING OR BORING

Measurement: (Lineal Feet) The quantity of casing pipe, according to the type and size called for in the Bid Schedule, will be measured along the pipe centerline between the limits designated on the plans or as directed.

Payment: Accepted quantity of casing pipe will be paid for at the contract unit price bid. No separate measurement or payment will be made for special insurance, excavation, pit sheeting and shoring, dewatering, pressure grouting, skids, chucks, stulls, stringing and anchoring carrier pipe, furnishing and installing sand in voids between the carrier and casing pipe, bulkheads, backfill, disposal of surplus material, etc., but shall be included in the work.

NOTE: The length of carrier pipe will be paid for separately under the applicable contract unit price bid for pipe, installed through the casing.

3.11. PIPE LINES

Items: Drainage, sanitary sewer and water lines; sanitary and water service lines; irrigation, siphon, underdrain and vent lines.

NOTE: Fire hydrant laterals and flared end treatments are excluded.

Measurement: (Lineal Feet) - Pipe of the various types, classes and sizes called for in the Bid Schedule will be measured by the lineal foot along the in place pipe centerline, between points of connection with existing facilities or extremities specified on the plans.

NOTE: Deduction in measured quantities will be made for piping in vaults and pipe at manholes and structures where the concrete inverts are cast in place and shaped. No deduction in measured length will be made for in line fittings and valves.

Payment: - Accepted quantities of pipe will be paid for at the contract unit price bid. No separate measurement or payment will be made for excavation, dewatering, trench stabilization, bedding, in line fittings and connectors, tape wrapping, gasket and joint materials, all thread ties, tied joints and concrete anchor blocks, clay trench and inversion plugs, backfill, disposal of surplus materials, etc., but shall be included in the work.

3.12. CATHODIC PROTECTION DEVICES AND SYSTEMS

Items: Anode Field, Conductors, Controller, Deepwell Anode System, Rectifier, Submerged Anode System, Test Station.

Measurement: (Each) (Lump Sum) - Cathodic protection will be measured by the actual number of the various devices and/or systems, specified on the Bid Schedule, installed.

Payment: Accepted quantities of the cathodic protection devices and systems will be paid for at the contract unit price bid. No separate measurement or payment will be made for excavation, drilling, dewatering, caldwell thermite bonding, insulating, ridged conduit, wire, reference electrodes, ground rod, junction box, backfill, energizing, testing, training owner's personnel in operating the system, retesting, etc., but shall be included in the work.

3.13. CONNECTS TO EXISTING FACILITY

Items: Inlet, manhole, and pipe connections.

Measurement: (Each) - The quantity to be measured shall be the actual number of connections made between a new installation and an existing facility.

Payment: Accepted number of connections made to an existing facility will be paid for at the contract unit price bid. No separate measurement or payment will be made for connecting to water taps made by City crews, excavation, dewatering, tapping, cutting, chipping, drilling; furnish and installing; fittings, tie-rods, anchor blocks, tape wrapping, jointing material, gasket sealants, reshaping manhole inverts, backfill, etc., but shall be included in the work.

3.14. CHLORINATION, EXFILTRATION AND PRESSURE TESTS

Items: Drainage, sanitary sewer and water lines.

Measurement: (Each) - The quantity of exfiltration tests shall be the number of pipe stretches tested between two (2) adjacent manholes on sanitary and storm sewer lines, or the number of stretches of water main tested between the line extremities as shown on the plans. No count will be made of lateral connections to immediate adjacent valves or service lines extending from the main.

Payment: Accepted exfiltration tests will be paid for at the contract unit price bid. No separate measurement or payment will be made for chlorination and flushing of water lines, exfiltration testing of each manhole with water, retesting when prior tests have failed, furnishing and connecting approved; bulkheads, connectors, tubing, piping, compressor, pump, water, volumetric and pressure gauges, etc., to test water lines at 150 psig or sewer lines to 3.5 psig; but shall be included in the work.

3.15. PIPELINE INSPECTION AND/OR CLEANING

Items: Root removal, scouring, t.v. inspection.

Measurement: (Lineal Foot) - The actual number of lineal feet of pipe requiring root removal, inspected and/or scoured, measured along the pipe centerline between consecutive manholes, to the limits specified in the contract documents or as directed.

Payment: Accepted quantities of line inspected and/or scoured, as called for in the Bid Schedule, will be paid for at the contract unit price bid. No separate measurement or payment will be made for flow diversion or control; equipment set ups, film, traffic control, collecting data and reporting location of line failures; removal and offsite disposal of purged solids; repair of service lines damaged in performing the work etc., but shall be included in the work.

3.16. PIPE JOINT REHABILITATION

Items: Joint testing, joint sealing, proof testing.

Measurement: (Each) - The actual number of pipe joints tested and/or sealed of the various pipe sizes called for in the Bid Schedule.

Payment: Accepted quantities of joints tested and/or sealed will be paid for at the contract unit price bid. No separate measurement or payment will be made for flow diversion or control, equipment set ups, retests of joints sealed, traffic control, etc., but shall be included in the work.

3.17. PIPE POINT REPAIR

Measurement: (Each) - The actual number of point repairs made, in which thirteen and one-half (13 1/2) feet or less of new equivalent size pipe is installed.

Payment: Accepted quantities of point repairs made, of the various sizes of pipe specified in the Bid Schedule, will be paid for at the contract unit price bid. No separate measurement or payment will be made for mobilization, traffic control, excavation, trench shoring, dewatering, flow diversion or control, service line reconnects, watertight couplings or fittings, locating and protecting other utilities, bedding and backfill placement and compaction, disposal of waste and surplus materials, etc., but shall be included in the work.

3.18. PIPE SLIPLINER

Items: Access pits, service reconnects, sliplining.

Measurement: (Lineal Feet) (Each) In place slipliner, of the various thickness and sizes called for in the contract documents, will be measured along the pipe centerline, between points of reconnects. Measurement of the access pits and service line reconnects will be the actual number of access pits for insertion and/or service connections made to the in place liner pipe.

Payment: The accepted number of lineal feet of slipliner pipe installed and/or the number of designated access pits or service reconnects made will be paid for at the respective contract unit price bid therefore. No separate measurement or payment will be made for mobilization, traffic control, excavation, manhole rehabilitation, flow diversion and/or control, shoring, power, thermal jointing, cement stabilized sand, circle seal clamps, sealing at manholes, saddles, gaskets, backfill, disposal of surplus material, restoration of property, etc., but shall be included in the work.

3.19. TRENCH RESURFACING

Items Base course, asphalt grading C, class A concrete

Measurement: (Square Yard) (Ton) The quantity of the trench resurfacing material specified in the contract documents will be measured as the number of surface square yards or tons placed over the pipe centerline within the following limits:
Minimum thickness shall be six (6) inches unless otherwise specified. Maximum width shall not exceed three (3) feet plus the outside diameter of the pipe "barrel" in feet, and then only where applicable.

Payment: Accepted quantities of trench resurfacing will be paid for at the respective contract unit price bid. No separate measurement or payment will be made for wetting and compacting trench backfill, subgrade densification and shaping, vertical trueing of existing surface along each side of the trench, placing materials outside the established prism limits, tacking existing surface edges, traffic control, etc., but shall be included in the work.

3.20. SELECT MATERIALS FOR BEDDING, BACKFILL, ETC.

Items: Bed course, filter media, select and/or structural backfill, special backfill

Measurement: (Cubic Yard) - Measurement of select materials called for in the Bid Schedule shall be computed between horizontal and vertical neat lines and planes.

A. Circular Conduits: Calculated volume between:

1. Vertical planes perpendicular to the conduit centerline between stations shown on the drawings or as directed; and between;

2. Vertical planes each side and parallel with the conduit centerline. The spacing between the planes shall not exceed two (2) feet plus the outside diameter of the conduit in feet, and between;

3. Two (2) horizontal planes, one (1) being one (1) foot above and parallel with the outside crown of the conduit and one at base course subgrade or at finish grade, whichever is the lower in elevation.

B. Bedding Material: Calculated volume of material lying within the prism shown on the plans. Except no measurement will be made for trench rock stabilization or conduit bedding material installed below a horizontal plane located one (1) foot above the conduit crown centerline.

C. Bridges and Irregular Shaped Structures: Calculated volume to vertical neat lines one and one-half (1 1/2) feet outside and parallel to the outline of the foundation plan and between horizontal planes at elevation limits shown on the drawings or as directed.

Payment: Accepted quantities of select materials will be paid for at the contract unit price bid for the items as they appear in the Bid Schedule. No separate measurement or payment will be made for material royalties, haul, dewatering, compaction, etc., but shall be included in the work.

NOTE: Cost of trench dewatering, disposal of surplus material, trench stabilization, conduit bedding below and to the elevation specified in the contract documents shall be in the contract unit price bid for the conduit or pipe in place.

3.21. CONCRETE-FLATWORK

Items: Crosspans, curbs, gutters, pavement, sidewalk, slabs on grade, median.

Measurement: (Square Yard) (Lineal Feet) - Concrete flatwork will be measured as the actual number of square yards or lineal feet of exposed surface concrete placed to the thickness, shape and length specified in the contract documents.

Payment: Accepted quantities of concrete flatwork will be paid for at the contract unit price bid for the applicable type of concrete flatwork specified in the Bid Schedule. No separate measurement or payment will be made for base course material, fine grading, expansion joint, reinforcing steel, dowels, tie bar, joint filler, etc., but shall be included in the work.

3.22. CONCRETE-STRUCTURAL

Items: Bridges, box culverts, catch basins, cut off walls, diversion structures, head and wing walls, inlets, vaults

Measurement: (Cubic Yard) (Each) - Bulk structural concrete will be measured by the cubic yard in accordance with the neat line dimensions called for in the contract documents. Deductions in the bulk measurement will be made for voids, wherein the volume of concrete displaced exceeds one (1) cubic foot. No deduction will be made for the volume of reinforcing steel contained therein.

Minor structures such as catch basins, diversion structures, cut off walls, etc., may be measured as the actual number installed, when so specified in the Bid Schedule.

Payment: The accepted quantity of structural concrete and or structures cast in place will be paid at the contract unit price bid. No separate measurement or payment will be made for structural excavation, dewatering, foundation stabilization, forming, embedded frames, grates, access covers, reinforcing or structural steel, colored concrete, etc. but shall be included in the work.

NOTE: Deck concrete within plan limits for curb, gutter, sidewalk and transitions shall be included in the contract unit price bid, when basins and inlets are to be paid for on the per each basis.

3.23. CONCRETE-MISCELLANEOUS

Items: Anchor blocks, pipe encasement.

Measurement: (Lineal Feet) (Cubic Yard) - The quantity of anchor block concrete will be computed as the volume of concrete placed between end bulk heads. Set perpendicular to the pipe and between two (2) vertical planes; one (1) which clears the pipe springline by the lessor of one half the pipe outside diameter or twelve (12) inches, and one (1) passing through the pipe centerline, less the concrete volume displaced by one half the pipe end area. Pipe encasement will be measured along the pipe centerline, between bulkheads and neat lines specified in the contract documents, or as directed.

Payment: Accepted quantities of miscellaneous concrete will be paid for at the contract unit price bid, in accordance with the various items called for in the Bid Schedule. No separate measurement or payment will be made for excavation, dewatering, bulkheads, reinforcing steel, curing, frost protection, etc., but shall be included in the work.

3.24. CONCRETE - PRECAST

Items: - Box culverts, catch basins, inlets, pre-stressed members, manholes, vaults, flared end sections

Measurement: (Each) - Actual number of precast structures of the various sizes and shapes specified in the contract documents.

Payment: Accepted quantities of precast structures will be paid for at the contract unit price bid. No separate measurement or payment will be made for excavation, dewatering, rock stabilization, shaped inverts or bases, eccentric cones, flat top covers, joint and outlet gasket or sealants, exterior drop pipe and fittings, concrete cast outs, steps, leveling rings, sump pit frame and grate; vent and sump piping; access frames and covers, backfill, etc., but shall be included in the work.

NOTE: Concrete curb, gutter, sidewalk and transitions cast in place shall be included in the contract unit price bid for catch basin and inlet.

3.25. REINFORCING STEEL - PLAIN OR EPOXY COATED

Measurement: (Pounds) Reinforcing steel will be measured by computing the unit weight of steel called for on the plans. Exceptions will be made for design revisions or proven error in excess of two (2) percent of the quantities specified in the Bid Schedule.

Payment: Accepted quantities of reinforcing steel will be paid for at the contract unit price bid. No allowance will be made for supports, clips, wire or other material used to anchor the reinforcement in place, but shall be included in the work.

3.26. STRUCTURAL MEMBERS

Items: Steel, timber.

Measurement: (Thousand feet board measure) (Pound) - Timber will be measured by the (TFBM); steel will be measured by computing the unit weight of material actually incorporated in the work.

Payment: Accepted quantities of structural timber or steel will be paid for at the contract unit price bid. No separate measurement or payment will be made for structural excavation, hardware, bolts, rivets, alloys, plates, galvanizing, epoxy coating, castings, welding, fabricating, bearing devices, connectors, rollers, drain pipe, waterproofing membrane, damproofing, water stops, painting, structural backfill, etc., but shall be included in the work.

3.27. RAILING

Items: Hand rail, guardrail, end anchors.

Measurement: (Lineal Feet) (Each) - Railing of the various sizes and types called for in the Bid Schedule will be measured along the centerline of the railing between ends, including transitions. Guardrail end anchors will be measured as the actual number installed and accepted.

Payment: Accepted quantities of railing and end anchors will be paid for at the contract unit price bid for the type specified. No separate measurement or payment will be made for guardrail terminal sections, concrete, reinforcing steel, anchor bolts, hardware, cable, rod, nuts, washers, posts, etc., but shall be included in the work.

3.28. MISCELLANEOUS

Items: - Access cover and frame, embedded items, flared end sections, grate and frame, tied joints, manhole steps, reshape manhole inverts, trash guards, meter pits, meters, etc.

Measurement: (Each) - The quantity of miscellaneous items to be measured will be the actual number, of the various types and sizes of miscellaneous items called for on the plans or specified in the contract documents, installed.

Payment: Accepted quantities of miscellaneous items will be paid for at the contract unit price bid for each of the various items that appear in the Bid Schedule. No separate measurement or payment will be made for subsidiary items essential to making the items functional as intended, but shall be included in the work.

3.29. DRILLED CAISSONS

Measurement: (Linear Foot) - Drilled caissons will be measured by the linear foot from ground line or elevation shown on the plans to the bottom of the hole as drilled.

Payment: Accepted quantities of the various diameters of caisson specified in the Bid Schedule will be paid for at the respective contract unit price bid. No separate measurement or payment will be made for dewatering, furnishing and placing reinforcing steel, Class "A" concrete, splicing, etc., but shall be included in the work.

3.30. PILING

Items: Sheet, steel, timber.

Measurement: (Square Feet) (Linear Feet) - Number of facial square feet of sheet piling or the lineal feet of steel and timber piling installed, to cut off elevation.

Payment: Accepted quantities of piling will be paid for at the contract unit price bid for each of the various types specified in the Bid Schedule. Payment made shall be full compensation for furnishing and driving piling including splicing, cut offs not used, drilling holes to facilitate driving, capping, pile shoes, jetting, blasting, painting exposed surfaces, etc., but shall be included in the work.

3.31. CRIB OR BIN WALL

Items: Steel, concrete, timber.

Measurement: (Square feet) - Crib walls of the various types and design specified in the Bid Schedule will be measured by the number of square feet of facial area which parallels the centerline of the roadway or channel.

Payment: Accepted quantities of the various types specified in the Bid Schedule will be paid for at the contract unit price bid. No separate measurement or payment will be made for excavation; furnishing and installing Class "B" concrete, reinforcing steel; furnishing placing and compacting backfill, etc., but shall be included in the work.

3.32. FENCE AND GATES

Measurement: (Lineal Feet) (Each) - Fence will be measured along the base of the fence between end post of each continuous run of fence but excluding gate openings. Gates will be measured by the actual number of the various sizes or types installed.

Payment: Accepted quantities of fence and gates will be paid for at the contract unit price bid for the various types and sizes called for in the Bid Schedule. No separate measurement or payment will be made for clearing and grubbing, grading along the alignment; line, end, corner and line brace posts; braces, guyes, concrete, painting and cut surface treatment of wood posts cut in the field, but shall be included in the work.

3.33. EXCAVATION, EMBANKMENT AND/OR BORROW

Items: Borrow, embankment, excavation, muck, rock, unclassified.

Measurement: (Lump Sum) (Cubic Yard) - Measurement for excavation, embankment and/or borrow will be made according to the unit specified on the Bid Schedule. No measurement will be made when the item is specified as lump sum.

When payment is specified on a volume basis, all except excavation, stripping and borrow shall be measured in its original position by cross-sectioning the area excavated. Volume will then be computed from the cross-section measurements by the average end area method. Embankment material, when called for on a volume basis, will be measured in its final compacted position without allowances being made for stripping or subsidence due to compaction of the base of fills.

Payment: The accepted quantities of excavation, embankment, or borrow, called for on the Bid Schedule, will be paid for at the contract unit price bid. Payment made shall be full compensation for royalties on material, excavation, haul, rehandling from stockpile, wetting, compacting, shaping and disposal of surplus material.

3.34. SUBGRADE TREATMENT

Items: Heating and scarifying bituminous surface, reconditioning subgrade, treatment at the base of cuts and fills.

Measurement: (Square Yard) - Subgrade treatment will be measured by the square yard of existing surface area treated and reconditioned.

Payment: The accepted quantities of the various type of treatment, called for in the Bid Schedule, will be paid for at the contract unit price bid. No separate measurement or payment will be made for scarifying, wetting, rolling, blading, shaping, finishing and maintenance of the finished surface prior to acceptance, but shall be included in the work.

3.35. SOIL STERILIZATION

Measurement: (Lump Sum) (Square Yards) - The quantity of soil sterilization shall be the actual number of area surface square yards treated as specified in the contract documents. No measurement will be made when the item in the Bid Schedule is specified as lump sum.

Payment: Accepted quantities of soil sterilization will be paid for at the contract unit price bid. Water will not be measured and paid for separately but shall be included in the work.

3.36. FABRIC MATERIALS

Items: Filter, geotextile, geogrid, impervious.
Measurement: (Square Yard) - Fabric will be measured as the number of surface square yards covered.

Payment: Accepted quantities of the various types of fabric specified in the Bid Schedule will be paid for at the contract unit price bid. No separate measurement or payment will be made for overlap, securing pins, vinyl bonding, bituminous tack coat, etc., but shall be included in the work.

3.37. AGGREGATES AND ASPHALT MATERIALS

Items: Base course, cover coats, foundation drains, gravel underdrains, patching, pit run, plant mix asphalts, seal coats, special backfill, treated base.

Measurement: (Ton) (Square Yards) - Measurement of aggregates and asphalt materials shall be the actual tons, evidenced by certified weight tickets, of the various types, grades or classes of materials, or placed in the work or the number of surface square yards when specified on the Bid Schedule.

Payment: The accepted quantities of materials will be paid for at the contract unit price bid. No separate measurement or payment will be made for barricading, traffic control, disposal of waste materials, subgrade preparation, hauling, placing, wetting, rolling, shaping, compacting, etc., but shall be included in the work.

3.38. LIQUID AGENTS FOR ASPHALT SURFACE TREATMENT

Items: Emulsions, prime coat, rejuvenating agents, tack coat.

Measurement: (Gallon) - Liquid agents for asphalt surface treatment will be measured as the actual number of gallons sprayed in place. The pay quantity for emulsified asphalt and/or rejuvenating agent shall be the number of gallons of concentrate before dilution and mixing with water.

Payment: The accepted quantities of the various liquid agents will be paid for at the contract unit price bid. No separate measurement or payment will be made for traffic control, blotter materials, or water used as diluent, but shall be included in the work.

3.39. COLD MILLING

Measurement: (Square Yards/Vertical Inch) - Cold milling will be measured as the actual number of square yards of surface area milled to an average depth of one inch, or fraction thereof.

EXAMPLE: A milled section twenty-seven (27) feet long, uniformly tapered from two and one quarter (2 1/4) inches below the gutter lip line and which daylights with the existing asphalt surface eight (8) feet and perpendicular therefrom will be measured as: (27 ft. x 8 ft./9 ft./sq. yd.) (2-1/4 in./2) = 27. 0 square yards.

Payment: The accepted quantities will be paid for at the contract unit price per square yard per inch of depth bid. No separate measurement or payment will be made for traffic control, disposal of milled materials, maintenance of milled surface, prior to resurfacing etc., but shall be included in the work.

3.40. SLOPE AND DITCH PAVING

Items: Bituminous, concrete, dry or grouted rubble.

Measurement: (Cubic Yards) (Ton) - Bituminous slope and ditch paving will be measured by the number of tons in place and accepted. Measurement of the various other types will be by the cubic yard based on dimensions shown on the plans, as directed or measured by the average end area method.

Payment: Accepted quantities of the various types of slope paving specified in the Bid Schedule will be paid for at the contract unit price bid. No separate measurement or payment will be made for excavation, haul, mortar or concrete used for grout, top coat, etc., but shall be included in the work.

3.41. EROSION CONTROL MATERIALS

Items: Rip rap, gabions, slope mattresses.

Measurement: (Cubic Yard) Number of cubic yards computed from dimensions shown on the plans, as directed or measured by the average end area method.

Payment: Accepted quantities of the various sizes and/or types of erosion control items specified in the Bid Schedule, will be paid for at the contract unit price bid. No separate measurement or payment will be made for excavation, toe or cut off walls, shaping subgrade, sand cement grout, filler rock, etc., but shall be included in the work.

3.42. HAULING

Measurement: (Cubic Yard Mile) (Ton Mile) - Haul shall be the product obtained by multiplying the number of units of material removed; from its original center of volume or mass position; by the mean distance in miles or fraction thereof to its center of placement volume or mass.

Payment: The quantity of haul measured as provided above will be paid for at the contract unit price bid. Unless specifically specified in the Bid Schedule, no separate payment will be made for haul but shall be included in the various items of the work.

3.43. EQUIPMENT RENTAL

Items: Backhoe, Dragline, Dozer, Front End Loader, Lo-Boy, Patrol Pump, Roller, Truck, etc.

Measurement: (Hour) - The quantity to be measured will be the number of hours or fraction thereof that the Bid Schedule specified piece of equipment is used, as directed.

Payment: The actual number of hours the specified piece of equipment is used will be paid for at the contract hourly rate bid. No measurement or payment will be made for labor, mobilization, time equipment is mechanically inoperative, attachments, piping, discharge lines, channelization, excavation, backfill, grading, etc., but shall be included in the work.

NOTE: Hourly rates shall not exceed the hourly rates recognized by the Colorado Department of Transportation plus 1.35 times the operator's hourly rate.

3.44. MUD JACKING

Measurement: (Square Yard) - The quantity to be measured will be the number of superficial square yards or fraction thereof, of concrete mud jacked to grade between construction joints.

Payment: The accepted quantity of surface area will be paid for at the contract unit price bid. No separate measurement or payment will be made for drilling and plugging of holes, dewatering, soil cement materials, etc., but shall be included in the work.

3.45. PAINTING

Items: Pavement marking with paint, thermoplastic or tape; steel, wood and concrete structures

Measurement: (Lineal Feet) (Square Feet) (Each) - The quantity to be measured shall be the actual exposed length or surface area of marking or painting installed. Painting of structures will be the actual number of the various types and sizes thereof, specified in the Bid Schedule, and no measurement of the surface area will be made.

Payment: Accepted quantities of pavement marking, and structure painting will be paid for at the contract unit price bid. No separate measurement or payment will be made for traffic

control, dewatering, sand or grit blasting, protection of existing cathodic protection systems, protection of adjoining properties during blasting and/or painting, site restoration, disposal of surplus materials, etc., but shall be included in the work.

3.46. TRAFFIC CONTROL

Measurement: (Lump Sum) - No separate measurement will be made for maintaining and channelizing traffic as required by the latest revision of the "Manual on Uniform Traffic Control Devices for Streets and Highways" and the Colorado Division of Transportation supplement thereto.

Payment: Payment of the contract amount bid will be paid as follows:

25% will be paid upon the first utilization of traffic control devices or flag persons.

75% balance will be prorated and paid according to the percent of the original contract amount approved for payment, but subject to retainage.

Payments made shall be full compensation for: furnishing, erecting, maintaining, moving, removing and disposing of temporary control devices; providing traffic control management, flagging and pilot car operation.

3.47. TRAFFIC CONTROL DEVICES

Measurement: (Each) Traffic control devices will be measured by the actual number of the various types specified on the Bid Schedule, installed.

Payment: Accepted quantities of traffic control devices will be paid for at the contract unit price bid. No separate measurement or payment will be made for excavation, concrete footings, pedestals, posts, structural frame members, sign panels, mounting brackets, backing angles, hardware, lighting fixtures, electrical equipment, lamps, switch boxes, photo-electric controls, controllers, conduit, wiring, cable, cabinets, faces, loop detectors, magnetometer detectors, sensors, amplifiers, mast arms, cable, painting, messages, pavement cutting and sawing, backfill, asphalt replacement, electrical hookup between power source and switch, etc., but shall be included in the work.

3.48. PROJECT FACILITIES

Items: Field office, laboratory, sanitary.

Measurement: (Each) The number of facilities complete with utilities furnished, as called for in the contract documents.

Payment: Payment at the contract amount bid will be paid for project facilities furnished and maintained throughout the duration of the project, as follows: Fifty- (50) percent upon first utilization, fifty (50) percent balance will be prorated and paid according to the percent of the original contract amount approved for payment, but subject to retainage. Restoration of the field facility areas will not be paid for separately, but shall be included in the cost of the item.

3.49. MOBILIZATION

Measurement: (Lump Sum) - No measurement for mobilization will be made.

Payment: Partial payments, subject to contract retainage, for mobilization will be made each month as the work progress as follows:

Original Contract Amount* Earned**	Mobilization Contract Amount Bid Payable
5%	25%
10%	50% (Less Prev. Payment)
25%	60% (Less Prev. Payment)
75%	100% (Less Prev. Payment)

*Original contract amount less contract amount bid for mobilization
**Payment for materials on hand will not be included as a percent of original contract earned until said materials on hand have been incorporated into the work and accepted for item payment.

3.50. PARK FACILITIES

Items: - Benches, buildings, comfort stations, drinking fountain, flagpole, lighting, playground equipment, picnic tables, trash receptacles, shelters, signs

Measurement: (Each) - The quantity of park facilities shall be the actual number of the various units, specified in the Bid Schedule, installed and accepted.

Payment: The accepted quantities will be paid for at the contract unit price bid. No separate measurement or payment will be made for excavation, backfill, permanent or temporary utilities, barricades, masonry, specialty items, doors, frames, windows, hardware, ceramic tile, roofing, flashing, insulation, carpentry, timber, glass, glazing, painting, special coating, plumbing, drainage, fixtures, heating, ventilating, electrical work, etc., but shall be included in the work.

3.51. SPRINKLER AND IRRIGATION SYSTEMS

Items: Irrigation pipe and fittings, power conduit and control wire, sprinkler heads, swivels and backflow prevention devices, pressure reducing and drain valves, manual and/or automatic control valves and controllers, meters, pits, quick couplers, strainers, in line valves and boxes.

Measurement: (Each) (Lineal Feet) - The quantities to be measured will be the actual number of the various units; and/or the lineal feet of electrical and sprinkler pipe, including fittings; installed and accepted.

Payment: The accepted quantities will be paid for at the contract amount or unit price bid, for the various items and types that appear in the Bid Schedule. No separate measurement or payment will be made for excavation, concrete, anchor or thrust blocks, sump aggregate, water, backfill, etc., but shall be included in the work.

3.52. TOPSOIL

Measurement: (Cubic Yards) On site stripped topsoil shall be measured in the stockpile, by the average end area method. Imported topsoil shall be measured by the average end area method in its original location or by a pre-determined and agreed to hauling unit bed volume count delivered to the site.

Payment: Accepted quantities of topsoil will be paid for at the contract unit price bid. No separate measurement or payment will be made for hauling, screening or removal of oversize rock and debris, subgrade preparation, placing, shaping, etc., but shall be included in the work.

3.53. LAWN SOD AND SEEDING

Measurement: (Square Yard) (Acre) - The quantity of lawn sod and/or seeding will be measured as the number of square yards or acres of surface area, providing acceptable growth.

Payment: Accepted quantities of lawn sod or seeding will be paid for at the contract unit price bid. No separate measurement or payment will be made for grading, tilling, seeding, drilling, fertilizing, mulching, placing sod, watering, maintaining, mowing, etc., but shall be included in the work.

3.54. PLANTING TREES, SHRUBS

Measurement: (Each) - The quantity of planting to be measured will be the number of plants, of the types and sizes specified in the Bid Schedule, planted and accepted.

Payment: The accepted quantities of plants will be paid for at the contract unit price bid. No separate measurement or payment will be made for handling, pruning, anchor stakes, soil conditioners, fertilizer, excavation, backfill, mulching, irrigating, seasonal spraying, maintenance and/or replacement until accepted, but shall be included in the work.

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 5.

DEMOLITION, SITE PREPARATION, EXCAVATION AND EMBANKMENT

5.1. GENERAL

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.

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

5.1.1. Local Laws, Ordinances and Code - The contractor shall be licensed with and bonded to the City of Rifle and shall comply with all current federal, state and local laws, codes and ordinances pertaining to demolition, wrecking, clearing and grubbing operations.

5.1.2. Protection of Public Improvements - The contractor will be held responsible to insure the protection of all existing public improvements such as fire hydrants, street lights, traffic lights, parking meters, traffic signs, catch basins, manholes, valves, survey monuments, overhead utility lines and poles, and any existing underground sprinkler or utility lines which may be damaged during the execution of the 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 City representative.

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 City representative to provide permanent access. Existing driveways shall be resurfaced with the then existing type of surfacing, whenever surfaces are destroyed.

Work shall include sawcutting or proper preparation of remaining materials, which are to be re-constructed. Materials left in place shall be protected from damage during construction. Contractor shall be responsible to maintain or repair materials left in place.

5.1.3. Disconnection of Existing Utilities - 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.

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

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

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

5.1.4. Equipment Operated On Streets - The contractor shall be permitted to operate only pneumatic-tired equipment over any paved surface and shall be responsible for any damage to street surface resulting from his operations.

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

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 compete. Repair/replacement of paving surface shall be determined by City Engineer or City Representative for the project.

5.2. DEMOLITION, CLEARING AND GRUBBING

The contractor shall remove from the site, or within the limits of construction, all obstructions specified in the special conditions or noted on the plans.

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

5.2.2. Trees and Shrubs - Trees not impeding demolition of structures or performance of the work will not be removed except as designated. Trees and shrubbery designated for removal will include stumps and roots to 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.

Trees scheduled to remain shall be carefully protected from damage during performance of the work. Any damage due to the contractor's operations shall be repaired by suitable tree surgery methods. Damaged trees shall be replaced, as approved by the City at the contractor's expense.

5.2.3. Cesspools, Privies, Buried Fuel and Septic Tanks - 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.

Underground motor fuel storage tanks shall be excavated and removed under the direction and in the presence of a representative from the Rifle Fire Protection District. 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.

5.2.4. 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.

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

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

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

5.2.8. 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.

5.2.9. Filling and Grading - Depressions resulting from the removal of structures, basement walls, footings, buried tanks etc., shall be filled and compacted with clean fill materials so as to eliminate hazards of cave-in, accumulation and ponding of water. Under no circumstances shall organic building material, broken concrete or asphalt be considered as approved fill material.

Immediately following demolition and removal of rubbish from the site, the contractor shall grade the entire contract area by filling, compacting, and leveling the site to existing adjacent grades. Grading and cleanup of the site must be complete and acceptable before any consideration will be given to making final payment for the work.

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

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

5.2.11. Disposal - 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 City Engineer.

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.

5.3. EXCAVATION

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

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

All excavations shall be made to subgrade elevations and shall be true to grade. Material below subgrade elevation in cuts shall not be loosened by plowing or other methods during the progress of the work except with the approval of the 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 material with satisfactory material and thoroughly compact same at his own expense.

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.

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

5.4. EMBANKMENT

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.

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 $\forall$ 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 $\forall$ 2% of optimum moisture content and compacted to the relative compaction specified. Rollers shall be of a tamping type conforming to CDOT standards.

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.

5.4.1. Compaction - 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.

Soil Classification (AASHO M-145)	AASHO T-99 Minimum Relative Compaction	AASHO T-180 Minimum Relative Compaction
A-1	100	95
A-3	100	95
A-2-4	100	95
A-2-5	100	95
All Others	95	90

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

5.4.2. Subgrade for Slabs on Grade and Paving - 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.

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 recompacted to requirements for density and moisture at contractor's expense.

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.

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

Concurrently with the rolling or tamping operations, the materials shall be wetted by uniformly sprinkling each layer or course of material being placed, to $\forall$ 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.

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

5.5. HOUSEKEEPING, RESTORATION AND CLEANUP

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

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

5.5.2. Concrete Curb, Gutter and Valley Gutter - The contractor shall replace in like kind all curb and gutter and valley gutter that are damaged during construction. The replacement shall be of equal or better quality than found. No separate payment will be made for replacing curb and gutter and valley gutter removed for the installation of a pipe line.

5.5.3. 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 treatments shall be done in accordance with the forestry regulations of the authority having jurisdiction and at contractor's expense.

5.5.4. Surface Restoration - The City 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.

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

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

A. Unsurfaced Areas: The general grade and condition of all unsurfaced areas shall be restored to nearly as practicable to the grade and condition immediately prior to construction. Topsoil shall be removed, saved and replaced in cultivated and agricultural areas; and any excess earth shall be removed from the ROW at no additional expense to the City. All grassed areas shall be reseeded or resodded, and the contractor shall be responsible for caring for the grass until its growth is established.

B. Surfaced Areas: Roadway surface cuts shall be made in a vertical plane and in a straight line. All roadway surfacing between the surface cuts on each side of the excavations shall be removed and replaced with base 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.

C. Cleanup: Upon completion of the work, the contractor shall remove from the job site all rubbish, unused materials, concrete forms and other like material. Also, at all times during construction, the contractor shall maintain the site, partially finished structures, material stockpiles and other like areas in a reasonable state of order and cleanliness.

In the event of the contractor's failure to perform the above work, the Work may be performed by the City at the expense of the contractor.

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 10.

CONCRETE

10.1. GENERAL

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

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.

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.

10.2. MATERIALS

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

10.2.1. 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).

10.2.2. Admixtures

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

B. 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.

C. 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.

D. 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.

2. Mix Dry type, W.R. Grace & Co. Staybrite, Master Builders Colormix, or approved equal.

E. Fibrous Concrete Reinforcement: 1.5 lbs/cy of 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.

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

10.2.4. Aggregates

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

Concrete Aggregates	ASTM C-33
Unit Weight of Aggregates	ASTM C-29
Organic Impurities Colormetric	ASTM C-40
Soundness of Aggregate by Sodium Sulfate	ASTM C-88
Sieve Analysis	ASTM C-29

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:

Percentage Passing Designated Sieves and Nominal Size Designation

	COURSE			FINE
	#467	#57	#67	AASHO-M6
Sieve Size	1 1/2" to #4	1" to #4	3/4" to #4	#4 to #100
2"	100			
1 1/2"	95-100	100		
1"		95-100	100	
3/4"	35- 70		90-100	
1/2"		25- 60		
3/8"	10- 30		20- 55	100
# 4	0- 5	0- 10	0- 10	95-100
# 16		0- 5	0- 5	45- 80
# 50				10- 30
#100				2- 10

10.2.5. 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. Welded Wire Fabric shall be electrically welded wire fabric, cold-drawn wire, conforming to ASTM A-185.

C. Epoxy-coated reinforcing bars and/or welded wire fabric shall be epoxy coated by electrostatic spray methods meeting the requirements of AASHTO M-284. The coating material shall be a light colored powdered epoxy resin which will highlight rusting of untreated bar area.

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

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

10.2.6. Joint Materials

A. Non-extruding and resilient non-bituminous type conforming to ASTM D-1752 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.

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

10.3. 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.

10.3.1. Class "A" Concrete - Concrete shall have a maximum allowable water cement ratio of 0.50 by weight. The fine aggregate shall be between 34% and 38% by volume of the total aggregates and the end product shall have a minimum 28 day compressive strength of 3500 psi when tested in accordance with ASTM C-31.

10.3.2. Class "B" Concrete - Concrete shall have a maximum allowable water cement ratio of 0.63 by weight. The fine aggregates shall be between 34% and 38% by volume of the total aggregates and the end product shall have a minimum 28 day compressive strength of 3000 psi when tested in accordance with ASTM C-31.

10.3.3. Class "C" Chemcomp Concrete - Concrete shall have a minimum of 5.5 sacks of expansive shrinkage compensating cement per cu. yd. 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 4300 psi, when tested in accordance with ASTM C-31.

10.3.4. Class "S" Calcareous Aggregate Concrete - Concrete mix design for high alkalinity concrete pipe, manufactured in accordance with ASTM C-76.

Portland Type II Cement $\leq$ 5% C_3A	630 lbs.
Concrete Sand	600 lbs.
Calcareous Breeze	1775 lbs.
Calcareous 3/8" chips	1375 lbs.
Air Content	5-7%
Water Cement Ratio	0.44 (max)
Calcium Carbonate Equivalent	> 65% when tested in accordance with ASTM C-602.

10.3.5. 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:

Mix Proportion	ASTM	Per CY of Concrete	
Portland Cement	C-150	42	LBS
Sand	C-33	1,845	LBS
Aggregate #57	C-33	1,700	LBS
AA	C-260	5	OZ
Water	C-94	325	LBS

Compressive Strength: 28 day = 60 psi MAX

10.3.6. Construction - Application for the various combination of aggregate size, in combination with allowable air content and slump range, for the different classes of concrete are as shown below.

Nominal Max. Size Coarse Ag.	Air Content Range	Vib. Slump Range	Min. Cement Content	Concrete	
In.	% by. Vol.	In.	Sks./CY	Class	Typical Application
1 1/2"	4-7	1-4	6.0	A	Columns, Slabs on Grade, Reinforced Walls
	4-7	1-3	6.0	A	Grade Beams, Caissons, Rein-forced & Plain Footings
	4-7	2-3	6.0	A	Roadway Pavement
	4-7	2-4	5.0	B	Pipe Encasement, kickblocks
	4-8	1-3	0.45	F	Structural backfill Utility Trenches V-ditches
1"	5-7	1-4	6.0	A	Columns, Slabs on Grade, Reinforced Walls
	5-7	1-3	6.0	A	Reinforced & plain footings, Grade Beams, Caissons, Columns
	5-7	2-4	5.0	B	Pipe Encasement, Kickblocks
	5-7	4-6	5.5	C	Reinforced Slabs on Grade
3/4"	5-8	2-3	6.6	A	Bridge Deck
	5-8	1-3	6.0	A	Structural Slabs on Grade; Reinforced Columns, Footings, Beams and Walls
	5-8	4-6	5.5	C	Reinforced Slabs on Grade
3/8"	6-9	0	6.7	S	Sewer Pipe

10.3.7. 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 City 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.

10.4. FORM WORK

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

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.

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.

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

10.4.2. Preparation of Form Surfaces - 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.

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.

10.4.3. 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.

10.5. FABRICATION AND PLACEMENT OF EMBEDDED REINFORCEMENT

10.5.1. Fabrication Tolerance

A. Sheared length and bends, ±1".

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

10.5.2. 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".

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.

10.5.3. Reinforcement Placement - 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. Templets will be required for all column dowels.

Epoxy coated reinforcing bars and welded wire fabric shall be tied with epoxy coated tie wire that will not damage or cut the coating. Bars shall be placed on plastic supports or steel supports fully coated with plastic or epoxy. Care shall be taken to prevent coated bars from coming into contact with other steel items. The contractor shall repair all damaged coating prior to concrete placement.

Provide adequate support for welded wire fabric during placing of concrete to insure proper position of the fabric in the slab.

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.

Unless otherwise noted on the drawings, the steel shall be protected by concrete, after placement as follows:

A. 3/4" for interior slabs.

B. 1" for interior walls and formed exterior slabs.

C. 1 1/2" for beams, columns and concrete exposed to the weather or in contact with the ground.

D. 3" for concrete deposited against the ground.

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.

10.6. JOINTS

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

10.6.1. Construction Joints - 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 1/2" deep in all joints in walls and between walls and slabs.

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

When required or directed, obtain bond between hardened concrete and new concrete by:

A. Use of an epoxy bond in accordance with the applicable provision of ACI Journal, Proceedings V59 #9, September, 1962, pp. 1121-1142.

B. Use of an acceptable chemical retarder.

C. By roughening surface of old concrete in an acceptable manner such as sandblasting.

D. Provide a continuous water stop as specified.

10.6.2. Expansion Joints - Install filler in expansion joints 3/4" thick by 1/2" less than slab thickness. For floors place a 3/4" x 1/2" 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.

10.6.3. Control Joints - 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 1/4" wide and approximately 1/4 of the slab thickness in depth, unless otherwise indicated or directed.

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

10.7. 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.

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

10.7.2. 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.

10.8. CONCRETE MIXING

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

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.

10.8.1. Agitating, Mix and Discharge - Concrete shall be continuously agitated from the time water is added and then mixed for 2 1/2 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.

10.8.2. Water - Indiscriminate addition of water to increase slump is prohibited.

10.8.3. Admixtures

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

B. Powder admixtures shall be weighed 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.

10.8.4. Retempering - Mix concrete only in quantities for immediate use. Concrete which has been in the mixer 80 minutes or longer shall be discarded. Retempering of concrete will not be allowed.
Concrete arriving at the project with slump below that suitable for placing may have water added only if neither:

A. The maximum permissible water-cement ratio has not been exceeded.

B. Maximum slump has not been exceeded.

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 l 1/2 minutes. No such additions will be permitted unless specifically authorized in writing by a city representative.

10.9. WEATHER

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

10.9.1. Batch Temperature - 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.

10.9.2. Protection - Provide adequate protection against rain, sleet, snow, cold and other weather conditions.

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.

10.10. PLACING

10.10.1. 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.

10.10.2. Equipment and Labor - Assemble and provide sufficient labor and equipment for proper mixing, transporting, placement and protection of concrete until accepted by the City.

10.10.3. Conveying - 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.

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.

Use of horizontal belt conveyors discharging into a hopper and pumping or pneumatic conveying equipment such that the loss in slump does not exceed l 1/2" shall be subject to approval.

10.10.4. Depositing - 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.

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

10.10.5. Consolidation - Perform consolidation in conformance with applicable detailed

recommendation of ACI 309.

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.

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

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

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.

10.11. SURFACE DEFECTS

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

10.11.2. Defective Areas - Remove and repair all honeycombed and other defective concrete down to sound concrete.

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 1/2 parts sand by damp loose volume) using no more water than necessary for handling and placing.

10.12. FINISHING

10.12.1. Selection of Finishes - Unless otherwise shown or called for in the Special Conditions, the following finishes shall be provided:

Type Finish	Type of Surface Intended
Scratch	To receive bonded applied cementitious application
Floated	To receive water proofing membranes or terrazzo
Trowled	Walking surfaces or for reception of floor covering
Broom or Belt	Sidewalks, garage floors and ramps
Non-slip	Exterior platforms, steps, athletic courts, landings and ramps
Board Form	Concrete surfaces not exposed
Smooth Rubbed	Interior vertical and other exterior surfaces
Exposed Aggregate	Scrubbed, sandblast and tooled finishes as specified in the Special Conditions

10.12.2. Tolerances of Finish

Finish Class	Application	Minimum Slope
"A"	Roads Slopes to Drains Floors	1/8" in 10 ft. using a 10 ft. straight edge
"B"	Ramps Sidewalks	1/4" in 10 ft. using a 10 ft. straight edge
"C"	Athletic Courts	1/4" in 15 ft. using a 15 ft. straight edge.

10.12.3. 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.

10.12.4. Troweled Finish Slab - 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.

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.

10.12.5. 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.

10.13. 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.

10.13.1. Initial Curing - Immediately following finishing the contractor shall provide methods to keep the concrete continuously moist at least overnight unless otherwise specified by:

A0 Ponding or continuous sprinkling

B0 Absorptive mat or fabric kept continuously wet

C0 Sand or other covering kept continuously wet

D0 Steam vapor mist bath at a temperature not to exceed 150 degrees F.

E0 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.

10.13.2. 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.

10.13.3. 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.

10.13.4. 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.

10.13.5. 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.

10.14. 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 City, at no expense to the contractor.

10.14.1. 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.

10.14.2. Testing Provided by the City

A0 Test contractor's proposed material for compliance.

B0 Review and check test contractor's proposed mix design.

C0 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.

D0 Determine slump range of concrete as delivered in accordance with ASTM C-143.

E0 Determine air content of standard weight concrete with either ASTM method.

F0 Check batching and mixing operations.

10.15. CONTRACTOR RESPONSIBILITIES

10.15.1. Preliminary Material Samples and Mix Design - Deliver to City 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.

10.15.2. Casual Labor - Furnish such labor as is necessary to handle samples at the project or at the material source.

10.15.3. 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.

10.15.4. Certificates of Compliance - Submit the following in duplicate for each shipment, with applicable ASTM Specifications:

A0 Cement - Mill Test Certificate of Conformance.

B0 Aggregate - Certified Test Report.

C0 Reinforcing Steel - Mill Test Certificate of Conformance.

D0 Air Entraining Admixture - Certificate of Conformance.

E0 Water - Reducing Admixture - Certificate of Conformance.

10.15.5. 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 City.

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 15.

STREETS

15.1. GENERAL

Curb, gutter, crosspans, sidewalk, ramps, driveway access, street surfacing and/or rejuvenation of asphaltic concrete in public right-of-way under the jurisdiction of the City, shall be installed in accordance with approved engineered plans, these Specifications and the General Conditions of the Engineering Code of Standards and Specifications for Design and Construction of Public Improvements of the City of Rifle

Requirements for site preparation, care of topsoil, excavation, embankment and treatment of cut areas are covered in Section 5 and 20 of these Standard Specifications.

The contractor shall obtain a 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.

15.2. MATERIALS

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.

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.

15.2.1. Concrete - Class "A" concrete, as set forth in Part II Section 10 of these Standard Specifications, shall be used in the construction of curbs, gutters, sidewalks and cross pans.

15.2.2. 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 six (6) inches, whichever is the lesser.

15.2.3. 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

Sieve Designation	% by weight passing 2/3 (depth of lift) 100
Characteristics	Retained on #10 - LA abrasion - (not applicable)
Characteristics	Passing #4 - L.L. 30 max.

B. BASE COURSE

% By Weight Passing

Sieve Designation	Class 5	Class 6
2-1/2"		
2"		
1-1/2"	100	
1"	95-100	
3/4"		100
#4	30-70	30-65
#8		25-55
#200	3-15	3-12
L.A. Abrasion	50 Max	50 Max
Liquid Limit	30 Max	30 Max
Plastic Index	6 Max	6 Max

Recycled concrete meeting the above requirements can be substituted.

C. HOT PLANT MIX PAVEMENT AGGREGATE

	% By Weight Passing Application	
Sieve Designation	Grading C (2) Surfacing	Grading CX (2) Overlay
3/4"	100	-
1/2"	70-95	100
3/8"	60-88	74-95
#4	44-72 (1)	50-78 (1)
#8	30-58	32-60
#3	12-34	12-34
#200	3-9	3-9

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 retained on the #10 sieve shall have a percentage of wear, when tested in accordance with AASHTO T-96, of not more than forty-five (45).

15.2.4. Seal Coat Cover Aggregates - Aggregates for cover coat material shall be 100% crushed gray granite conforming to the following requirements:

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

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

C. When tested in accordance with AASHTO T-182, aggregate shall have a retained bituminous film above 95%.

D. Meet the following gradations.

Sieve Designation	% by Weight Passing Type II	Type III	Application LBS./SQ. YD.
1/2"	100	100	
3/8"	60-100	60-100	
#4	0-15	0-30	
#200	0-01	0- 1	20-25

15.2.5. Slurry Seal Aggregates - Aggregates shall be 100% crushed stone or gravel. The aggregates, when tested for wear by AASHTO T-96 shall show a loss of not more than thirty-five (35) percent, shall be compatible ionically with the emulsified asphalt proposed, and shall conform to the gradations specified herein below, when tested in accordance with AASHTO T-27 and T-11.

Sieve Designation	% by Weight Passing Type II	Type III	Application Lbs./Sq. Yd.
3/8"	100	100	
#4	90-100	70-90	
#8	65-90	45-70	
#16	45-70	28-50	
#30	30-50	19-34	
#50	18-30	12-25	
#100	10-21	7-18	
#200	5-15	5-15	
PI	<6	<6	15 Min.
Theoretical Asphalt Content			
% Dry Aggregate	7.5 - 13.5	6.5 - 12	

The City may consider the blending of minus three eighths (3/8) inch sharp, non-plastic pit run sand with crusher fines to provide the specified gradations. However, if approved, not less than fifty percent (50%) by weight of the particles retained on the #4 sieve shall show fractured faces, the minus #4 particles shall show a significant amount of crushed particles, and the resulting blend shall be certified as being ionically compatible with the proposed emulsion.

15.2.6. Blotting Aggregate

A. Prime blotter aggregate shall be sand or crusher fines, 100% passing the #4 sieve.

B. Rejuvenating agent blotter aggregate shall be an approved dry sand, conforming to the requirements of AASHTO M6, or crusher fines, 100% passing the #4 sieve.

15.2.7. Mineral Filler - Mineral filler shall conform to the requirements of AASHTO M-17 and shall consist of rock, dust, hydraulic cement, fly ash or other suitable mineral matter.

Slurry seal filler shall be a Portland Cement, added at the rate of 1.5 to 2.0% of the dry aggregate weight in the mix design.

15.2.8. Chemical Soil Sterilization Agents

A. Non-selective, pre and post emergent, soil toxic herbicide that is soluble in water, non-toxic to humans; when used under conditions designated by the manufacturer it shall remain active for a period of one (1) year after application.

B. Casaron-D, Trysben-200 and Hyvar-X or Hyvar-XL are considered as meeting this specification.

15.2.9. Bituminous Materials - Asphaltic cements shall conform to the requirements of AASHTO M-226 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. The spot test on both the asphaltic cement and the liquid asphalt materials shall be negative for all type and grades when performed with a napthaxylene solvent containing not more than ten (10) percent xylene by volume.

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

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.

A. Prime Coat shall be MC-70 bitumen applied at the rate of 0.25 - 0.35 gal/sq. yd. of surface area.

B. Asphaltic Cement shall be AC-10, 85-100 penetration bitumen incorporated with hot plant mix pavement aggregate at the rate determined by the Colorado Department of Transportation, when they develop the job mix formula for the pit supplying the aggregate.

In general the top three (3) inches of wearing surface shall contain between five (5) percent and six and one half (6 1/2) percent by weight of asphaltic cement. For total depth asphalt applications the asphaltic cement in the black base layer may be reduced up to one (1) percent from that required in the wearing surface, as determined by the job mix formula.

C. 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.

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

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.

E. Slurry Seal shall consist of an AC-10 base CSS-lH or CQS-lH quick setting emulsified asphalt, ionically compatible with a specified mineral aggregate, Portland Cement and potable water when all are mixed and proportioned according to the job mix formula.

NOTE: Unless specified otherwise in the Special Conditions the bidder shall include with their proposals the job-mix-formula developed by and certified to by an independent testing laboratory experienced in slurry seal design.

15.2.10. Geogrid - Geogrid soil stabilizers shall be a high-density polyethylene, conforming to the design geometry specified in the special conditions or on drawings. Tensar high strength polymer geogrids SS-1, SS-2 and SS-3 meet this specification.

15.2.11. 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.

15.2.12 Signs

Signs shall be in accordance with the Manual on Uniform Traffic Control Devices (MUTCD). Stop or Yield Signs shall be 30-inch by 30-inch size. All signs shall be mounted 7-feet to the bottom of the sign from grade below the sign. Street name signs shall be 8-gauge aluminum with white double-faced 4-inch high letters on green background without a border. Where a stop or yield sign is installed, the street name signs shall be placed above the stop or yield sign a minimum of 1-inch above and between signs. Street name signs may be purchased from Newman Traffic at 1-800-437-9770 or approved equal. All signs shall have high intensity retro reflectivity (type III) in accordance with ASTM D4956. Sign posts shall be U-channel steel, weighing 2 lbs./ft., with 2-bolt splice system breakaway devices approved by FHWA. These shall be Safety-Splice Support System, or equal. Signs shall be fastened to the U-post with two ¼ inch galvanized stove bolts, with washer (next to sign) and nut.

15.2.13 Striping Paint

Pavement marking paint shall conform to the requirements listed in the following table. All proportions are by weight. Pigment composition and vehicle composition shall not vary by more than 1.0 percent of each amount specified.

Finished Paint Pigment (White and Yellow) ……...49% to 52%

a) Pigment Composition	White	Yellow
Titanium Dioxide, ASTM D 476, Type III	27.0%	
Yellow Pigment		35.0%
Calcium Carbonate, ASTM D 1199, Type GC-II	18.0%	53.3%
Magnesium Silicate, ASTM D 605	54.3%	11.0%
Pigment Suspending Agents	0.7%	0.7%

The pigment for yellow paint shall consist of a blend of organic yellow pigment and other pigments and fillers as are necessary to result in a colorfast paint complying with all provisions of this specification. The paint shall contain no lead or other material such that the dry film could be considered a hazardous waste under EPA or CDPHE regulations.

b) Vehicle Composition	White & Yellow
Alkyd Resin Solution, AASHTO M 248, Type F	70%
VM&P Naptha, Fed. Spec. TT-N-95, Type I	
Driers, ASTM D 600 cl B, and Anti-Skinning Agent, Methanol	30%

c) Pigment Suspending Agent
Organo-montmorillonite shall be added to achieve the desired storage and stability requirements. Organo-montmorillonite shall be an organic ammonium compound of montmorillonite with a high gelling efficiency in a wide range of organic liquids. It shall be a fine creamy white powder with a maximum water content of 3.0 percent and a maximum of 5.0 percent retained on a No. 200 sieve. Organo-montmorillonite shall be prewetted with methanol or ethanol as recommended by the manufacturer.

d) Properties of Finished Paint

The paint, at the time of container filling, shall be free of skins, pigment agglomerates and foreign matter and shall meet the following requirements:

1) Fineness of grind, Hegman, minimum 2

2) Consistency, Krebs-Stormer. K.U. @ 77 degrees F 70-80

3) Drying time, a wet film of paint 380 micrometers thick, tested according to ASTM Method D 711, minutes maximum. 30

4) Reflectance. The white paint shall have a daylight 45 degree, 0 degree luminous directional reflectance of not less than 80% when compared to magnesium oxide.

5) Color. The color of the yellow paint shall match visibly color chip No. 33538 of Federal Standard 595 B. In case of dispute, the color shall be within the green and red tolerance limits when compared with the standard color chips of the Standard Yellow for Highway Signs and Markings – U.S. Department of Transportation. Washington, D.C. The manufacturer shall supply test data showing that the yellow pavement paint will retain the yellow color within these limits for a period of one year under outdoor sunlight exposure.

15.2.13.1 Paint Pigment Material Requirements

Chromium Oxide, (Green)	ASTM D 265
Magnesium Silicate	ASTM D 605
Titanium Dioxide	ASTM D 476, Class IV
Red Iron Oxide	ASTM D 3721
Black Iron Oxide	ASTM D 769
Yellow Iron Oxide	ASTM D 768

15.2.13.2 Pavement Primers

The type and application rate of epoxy resin primer shall be as recommended by the preformed plastic pavement marking manufacture. A primer application rate of zero will not be accepted. The primer material may be accepted at the job site on the basis of a manufacturer's certification.

15.2.13.3 Preformed Thermoplastic Material

a) Preformed Thermoplastic markings shall be composed of aggregates, pigments, binders and glass beads and shall conform to AASHTO designation M 249 with the exception of the relevant differences due to the material being supplied in a preformed state. The material shall be either alkyd or hydrocarbon based. Only preformed thermoplastic pavement marking material approved by the City may be used.

b) Physical Requirements

1) The material shall contain a minimum of 30% graded glass beads by weight. The beads shall be clear and transparent. Twenty percent or less shall consist of irregular, fused spheroids, or silica. The reflective index shall be at least 1.50.

2) White pigment shall be titanium dioxide to insure a color similar to Federal Highway White, Color Number 17886, conforming to Federal Standard 595. Yellow pigment shall be used to insure a color similar to Federal Highway Yellow, Color Number 13655, conforming to Federal Standard 595. Yellow pigment shall be organic and contain no lead chromate.

3) The surface of the preformed thermoplastic markings shall provide a skid resistance of 45 BPN when tested according to ASTM E 303.

4) The material shall be supplied with a minimum thickness of 125 miles.

5) The preformed thermoplastic material shall be resistant to deterioration due to exposure to sunlight, water, oil, gasoline, salt and adverse weather conditions.

15.3. Construction Practices

All work in public rights-of-way shall be constructed to the lines and grades called for on City 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. City survey crews will establish the control for City projects and controls established by developers are subject to checking by City crews.

Bituminous materials and aggregates conforming to the material section of these specifications, shall be blended to the proportions of the job mix formula, spread, finished and compacted in place, utilizing equipment and procedure methods as set forth in Sections 401.01 through 401.20 of the Colorado Department of Transportation Standard Specifications and these specifications.

15.3.1. Site Preparation, Excavation, and Embankment - (See Part II, Section 5 of the A Engineering Code of Standards and Specifications for Design & Construction of Public Improvements of the City of Rifle.)

15.3.2. Curb, Gutters, Sidewalks and Crosspans - 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 City of Rifle Standard Detail Drawings. Preparation of subgrade shall be in accordance with the requirements of Part II Section 5 of these Standard Specifications. Forming, concrete placing, finishing and cutting shall conform with the requirements set forth in Part II Section 10.

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 6" x 6" / 10-10 welded wire fabric and/or reinforcing or 1.5 pounds of fibermesh per cubic yard of concrete as called for in the Standard Drawings.

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.

Premolded expansion joint filler 1/4" to 1/2" 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.

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.

15.3.3. Soil Sterilization - Bituminous parking lots, bicycle trails and walkway subgrades shall be sterilized to prevent plant growth. All surface vegetation, within the limits of the paving shall be removed within three (3) days prior to treating the soil with a sterilant. Soil sterilants shall be applied in accordance with all Colorado statutes, ordinances or codes pertaining to the use and application of fungicides, insecticides, herbicides, or other agricultural chemicals and the manufacturer's recommendation. Sterilants shall not be applied when the ambient temperature is below seventy (70) degrees Fahrenheit.

Care shall be exercised to prevent powder, spray or vapor drift which may damage gardens, shrubs or trees in the vicinity of the areas being treated. Soil sterilants shall not be used where they may contaminate water used for irrigation or drinking purposes. The contractor will be held responsible for any damage to plant growth outside the designated treatment areas where such damage is attributable to carelessness or improper application of the soil sterilant.

15.3.4. Aggregate Base Course - 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.

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.

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 1/2" for Class 1 or 1/4" for Class 5 or Class 6 base course. Areas that do not conform with these tolerances shall be reworked.

15.3.5. Asphaltic Concrete Job Mix Formula - The job mix formula developed by the Colorado Department of Transportation on the aggregates to be incorporated in the asphaltic concrete surface must be submitted to the City of Rifle Public Works Director for approval prior to commencing the work.

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

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

15.3.6. Manhole and Utility Box Adjustments - Manholes, valve and survey range boxes shall be adjusted to ± 1/4" of finish grade before the surface course of asphaltic cement 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.

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.

On streets that are being overlaid with asphaltic concrete the contractor shall adjust the valve and range boxes by screwing the adjustable rings upward to finish grade, prior to final rolling. In the case of manhole rings the contractor shall vertically and uniformally cut the existing asphalt mat eight (8)inches from the ring and remove the mat and base to a depth of six (6) inches below finish grade.

Rings shall then be removed and the existing mortar and brick courses adjusted and pointed to provide the required subgrade for resetting the rings, free of pressure points. Once the ring is reset to finish grade the collar (eight (8) inch) x six (6) inch void between the mat and

the ring) shall be filled with Class "A" concrete, compacted, finished cured and protected from traffic for a period of seven (7) calendar days.

15.3.7. Bituminous Prime or Tack Coating - 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 Section 15.2.9, paragraphs A and C of these Specifications.

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 sixty (60) degrees Fahrenheit.

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.

15.3.8. 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.

15.3.9. Flexible Pavement - 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.

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 or SS-lH bituminous material prior to placing asphaltic concrete adjacent thereto.

Asphaltic concrete, to provide in place compacted thickness of four (4) inches or less, shall be placed and struck off by means of bituminous pavers. Use of spreader boxes to place the bituminous mixture shall be limited to asphaltic sidewalks or trails, trench patching and the bulbs of cul-de-sacs. Black base bituminous mixtures, whose in place compacted thickness is to be greater than four (4) inches and less than seven and one half (7 1/2) 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.

Along the lip lines of gutters and crosspans sufficient bituminous material shall be deposited so that, after compacting, the wearing surface will remain not less than 1/8" nor more than 1/4" above the concrete. For median curb wearing surface will be from 1/4" to 1/2" below concrete.

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 generally be located as follows:

A. For two lane roadways - at the center line of the pavement and at the outside edge of the traveled lanes.

B. For roadways of more than two lanes - at the lane lines and at the outside edge of the travel lanes.

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

PLACEMENT TEMPERATURE LIMITATIONS

	WEARING SURFACE	BLACK BASE
Minimum Compacted Layer Thickness	Minimum Placement Air and Surface Temperature	Minimum Placement Air and Surface Temperature
1" or less	60°F	50°F
>1" to 3"	50°F	40°F
>3"		30°F

Asphaltic 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.

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 centerline, each trip overlapping one-half (1/2) of the roller width, gradually progressing to the crown of the street. Rolling shall be continued until all roller marks are eliminated and a minimum density of ninety-five (95) percent of a laboratory specimen made in the proportions of the job mix formula has been obtained.

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.

Variation between any two (2) contacts with the surface shall not exceed 3/16" in ten (10) feet. All lumps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material as directed.

15.3.10. Parking Lots, Trails and Walkways - 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.

Asphaltic concrete Grading C or CX shall be placed and compacted to a minimum compacted thickness of four (4) inches for bicycle trails and walkways, and a density of ninety-five (95) percent of a laboratory specimen made in proportion to the job mix formula. Compaction shall be uniform and accomplished by means of City 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.

15.3.11. Street Patching - Areas in streets designated to be patched shall have the broken asphalt and subgrade materials removed to a depth of six (6) inches and disposed of. The patch subgrade shall then be stabilized with 1 1/2" rock as directed, or compacted and fine graded. 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.

15.3.12. Slurry Sealing - The mixing unit shall be truck mounted in combination with departmentalized material storage. It shall be capable of accurately proportioning aggregate, emulsified asphalt, Portland Cement and water, according to the job mix formula. Material shall be dispensed individually by means of controls designed and calibrated especially for the type of material being handled.

The unit shall store sufficient water and be equipped with a pressurized nozzle type spray bar system so that it can simultaneously spray the street surface immediately ahead of the distribution box during lay down. The mixing unit shall discharge a uniform mix to the distributor on a continuous flow basis.

The speed of the mixing unit and distributor box shall be odometer controlled simultaneously with the flow of the mix so that not less than fifteen (15) pounds of aggregate, at optimum moisture content, is deposited per square yard of exposed slurry surface area. Slurry sealing shall proceed at an average rate of not less than 1000 square yards of surface area per hour.

The distributor box shall be equipped with a steering device maintained clean and free from mix build up at all times. It shall have flexible seals in contact with the existing pavement surface to prevent loss of material and at the same time strike off the slurry mixture to the designated thickness and width. It shall be adjustable so as to control slurry thickness, loss and width within the limits specified at all times, regardless of street grade and crown changes. A burlap drag may be required to obtain the desired texture of the seal surface.

Hand operated squeegees and tools shall be available at all times for proper jointing edging and spreading of materials in areas inaccessible to the distributor box.

Consistency of the slurry mixture shall be such that the material does not run into the gutters or run longitudinally or transversely on the street. Slurry operations shall be curtailed early enough in the day to allow sufficient curing so the area is suitable for use by traffic before dark. Immediately following the application of the slurry seal and during the curing period the contractor shall clean up the work area and blot all runs.

Slurry operations shall be undertaken only during clear weather and at temperatures of sixty (60) degrees Fahrenheit or greater. Work operations shall proceed in such a manner so as to provide two-way traffic on all streets at all times. The contractor shall schedule and coordinate the work with the City Traffic, Police and Fire Agencies. At all times he shall provide the barricades, signs, cones, flagmen, detours, etc., that the various agencies may require to assure safe vehicle movement. The contractor shall be responsible to furnish and place "NO PARKING" signs in sufficient time and quantity in advance of his operation to clear the work area. The City Representative will acquire police assistance for parked car removal as required, to hold work delays to a minimum.

15.3.13. Geogrid - Subgrade Stabilization - 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 City representative.

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.

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.

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.

15.3.14. Geotextile Fabric Pavement Systems - 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 holes 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.

The approved surface to be overlayed shall then be given a tack coat of AC-10 asphalt cement, applied at the rate of 0.20 to 0.25 gallons per square yard, and immediately covered thereafter with the geotextile fabric.

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.

Fabric shall be installed to within zero (0) to six (6) inches of gutter lip lines or crosspans. 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.

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 1/2 inches. Use of fabric at locations where a potential for shoving exists, such as turning lanes and stopping intersections, is not recommended.

15.3.15. Cold Milling, Asphalt Surfaces - 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 1/4 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.

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 1/2 to 8

feet wide and zero to 2 1/2 inches in depth, per pass. Milled edges shall be vertical and true with the alignment of each pass of the equipment.

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 proceeding the resurfacing operation. Leaving of abrupt vertical edges that will impede traffic will not be allowed.

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 1/2 to 8 feet from and perpendicular to the gutter flow line.

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

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

15.3.16. Overlay Surface Treatment - 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.

Cleaned areas to be leveled shall be tack coated, at the rate of 0.10 gallon per square yard with a 1:1 diluted CS-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 CX hot bituminous asphalt concrete.

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 AC-10 asphaltic concrete, applied at the rate recommended by the supplier.

Plant mix asphaltic concrete conforming to the Colorado Department of Transportation Grading CX shall be placed to an average compacted yield of 1 1/2", 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.

15.3.17. Roadway Striping and Marking

Furnishing and applying pavement striping and marking shall be in accordance with these specifications, Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) and in conformity to the lines, dimensions, patterns, locations and details shown on the plans or established by the City.

All pavement markings shall be placed in accordance with the following requirements.

a) When pavement marking locations and details are not provided, the contractor shall submit a layout of existing conditions with the proposed marking plan to the City for approval or modification.

b) Final pavement markings and striping shall be placed within two weeks after final surfacing is completed.
c) Striping shall be done when the air and pavement temperature is at least 40 degrees F. The pavement surface shall be clean and dry. Weather conditions shall be conductive to satisfactory results.

Equipment shall be capable of painting a reasonably clean-edge stripe of the designated width within plus or minus ¼ inch and shall have a bead dispenser directly behind, synchronized with the paint applicator. For centerlines and lane lines, an automatic skip control shall be used that will paint a stripe with a gap. Machines having multiple applicators shall be used for centerlines with no passing zones or double lines. In areas where machines are not practical, suitable hand-operated equipment shall be used. Stripes shall be protected until dry.

Paint and beads shall be applied within the following limits:

	Application Rate or Coverage per gallon of paint	
	Minimum	Maximum
Paint:	100 sq. ft.	110 sq. ft.
Beads:	5 lbs. 13 oz.	6 lbs. 3 oz.

d) Preformed thermoplastic pavement markings shall consist or a resilient white or yellow product with glass beads uniformly distributed throughout the entire cross sectional area. Legends and symbols shall be capable of being affixed to bituminous pavements by heating.

The markings shall conform to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. The material shall have resealing characteristics with the capability of fusing with itself and previously applied thermoplastic markings under normal use.

The preformed markings shall be packaged in a protective plastic film with cardboard stiffeners where necessary to prevent damage in transit. The carton in which the material is packed shall be clearly labeled for ease of identification.

Application, air and pavement temperatures shall be as recommended by the manufacturer. The materials shall be applied using a heating method specifically recommended by the manufacturer. The contractor shall provide the City with a copy of the manufacturer's installation recommendations prior to beginning the work. The pavement shall be dry, clean and free from debris. Markings may be installed on top of existing thermoplastic markings after all loose materials have been removed. Marking shall not be installed over other types of existing markings without first removing the existing markings to a depth that insures removal of the adhesive backing of the existing material. Marking shall not be installed over striping or marking paint without first removing entirely the existing paint.

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 20.

EXCAVATION, BEDDING, AND BACKFILL FOR PIPELINES

20.1. GENERAL

Piping for storm drainage, irrigation lines, sanitary sewers, water systems, service lines and laterals, to be installed in easements or public right-of-way, under the jurisdiction of the City, shall be excavated, bedded, backfilled and the trench resurfaced in accordance with approved engineered plans, and the City of Rifle Engineering Code of Standards and Specifications for the Design and Construction of Public Improvements.

The contractor performing the work shall be properly licensed with the City, obtain all permits, and give twenty-four (24) hours written notice to the Public Works Department Engineering Division, setting forth the time construction is to commence or when work is to be resumed following a delay. The contractor shall maintain a complete set of approved drawings and specifications, covering the work being performed, on the project at all times.

20.2. MATERIALS

Materials, other than pipe and fittings, which are to be placed within the trench limits and below finished grade, shall conform to the minimum standards hereinafter referred to.

Specifications and detailed recommendations for acceptable Practices set forth by the American Society for Testing Materials (ASTM), the American Association of State Highway Transportation Officials (AASHTO) and the Colorado Department of Transportation (CDOT) are made a part of these specifications.

20.2.1. Foundation Stabilizer Material - 3/4" to 1 1/2" dense, durable rock with less than fifteen (15) percent passing the #4 sieve.

20.2.2. Bedding - Free draining material meeting the specifications and gradation for the specific application set forth as follows:

BEDDING MATERIAL

BEDDING TYPE	SQUEEGEE*	AGGREGATE**	FILLER SAND***
AASHTO Spec.	Local by-product	M-43	M-6
CDOT Spec.	Local by-product	#67	
SIEVE SIZE	% PASSING SQUARE MESH SIEVE		
1 1/2"			
1"		100	
3/4"		90-100	
1/2"			
3/8"	100	20-55	100
#4	40-90	0-10	95-100
#8		0-5	
#16			45-80
#50			10-30
#100			2-10
#200	0-5		
P.I.	0	0	0
L.L.	0	0	0

*Local Platte River by-product allowed on all sizes and types of conduits
"Pipe Bedding B" is an acceptable alternative to Squeegee
**May be used in lieu of squeegee on 27" and larger conduits only
***To be used for sewer main casing pipe filler only

20.2.3. Backfill - Soils and soil aggregate mixtures classified in accordance with AASHTO M-145, Table 2, which also meets the categories hereinafter specified.

A. SPECIAL BACKFILL MATERIAL

Gravel, Stone Fragments, Sands and Silty Soils

Group Classification	A-1-a	A-1-b	A-3	A-2-4
Sieve Analysis % Passing				
#10	50 Max.			
#40	30 Max.	50 Max.	51 Min.	
#200	15 Max.	25 Max.	10 Max.	35 Max.
Characteristics of L.L.				40 Max.
Fractions (-#40 Sieve) P.I.	6 Max.	6 Max.	N.P.	10 Max.

The following is also acceptable as a **Special Backfill Material**.

CDOT Class 1 Structure Backfill Material	
Sieve Size	% Passing Square Mesh Sieve
2"	100
#4	30-100
#50	10-60
#200	5-20
P.I.	6 Max
L.L.	35 Max

B. ACCEPTABLE BACKFILL MATERIAL

Silty or Light Clayey Gravel and Sandy and Silty Soils

Group Classification	A-2-5	A-4	A-5
Sieve Analysis - % Passing			
#200	35 Max.	36 Min.	36 Min.
Characteristics of L.L.	41 Min.	40 Max.	41 Min.
Fractions (-#40 Sieve) P.I.	10 Max.	10 Max.	10 Max.

C. GENERALLY UNACCEPTABLE BACKFILL MATERIAL

Heavy Clayey Gravel and Silty, Clayey Soils

Group Classification	A-2-6	A-2-7	A-6	A-7
Sieve Analysis - % Passing				
#200	35 Max.	35 Max.	36 Min.	36 Min.
Characteristics of L.L.	40 Max.	41 Min.	40 Max.	41 Min.
Fractions (-#40 Sieve) P.I.	11 Min.	11 Min.	11 Min.	11 Min.

Note: Material in Category C above shall be disposed of and replaced with acceptable backfill material, unless specifically approved in writing by the Project Engineer for use as backfill.

20.2.4. Surfacing - See Concrete Part II Section 10 and Streets Section 15 of these Standard Specifications.

20.3. CONSTRUCTION PRACTICES

Prior to excavating in hard surfaced areas, the outer limits of the trench shall be string lined and the surfacing cut in a vertical plane by sawing, roller blade or jack hammering. Drop blades are not acceptable. Nominal trench width limits at the surface, which shall be the width used in determining the quantity of resurfacing or patching for payment, shall be three feet plus the outside diameter of the pipe, unless otherwise approved in writing by the City Engineer. During construction, should the vertical asphalt edges ravel, they shall be trued to a vertical plane to a point six (6) inches outside the limits of excavation prior to placing the resurfacing material.

20.3.1. Embankment - Depressed areas shall be raised to the proposed crown elevation of the pipe to be installed, prior to excavating the pipe trench. Preparation and placement of fill in low depressed areas shall be performed as set forth under Embankment in Section 5 of these specifications.

20.3.2. Excavation - The excavation shall be made to lines and grades shown on the plans and as established by the Project Engineer. All excavation shall be classified as “unclassified” or “rock“ excavation only. Excavation shall include materials of every description, and of whatever substance encountered, to the depths and of the areas required for the construction work. All excavation not classified as “rock excavation” as defined below shall be “unclassified”. “Unclassified” shall mean no classification will be made of the materials excavated neither as to depth, nature, composition, hardness nor degree of water content.

Surfacing materials such as concrete and asphalt shall be removed to neat lines and disposed of independently of the underlying soil; base course and gravel are to be salvaged to stockpile, protected from contamination and reused for special backfill.

Soils removed from the trench which meet the requirements for backfill materials, shall be stockpiled in a manner which will not endanger the performance of the work, obstruct sidewalks or driveways and provide the least possible interference with traffic. Soils encountered which are unacceptable for use as backfill shall be disposed of by the contractor at his expense.

At no time will trench excavation be permitted to advance ahead of the installed pipe in excess of eighty (80) feet at any one time during the performance of the work.

20.3.2a Rock Excavation – Rock excavation shall consist of igneous, metamorphic and sedimentary rock which cannot be excavated without blasting or the use of rippers, and all boulders or other detached stones each having a volume of one (1) cubic yard or more as determined by physical or visual measurement.

20.3.2b Blasting – Excavation by use of blasting shall be allowed for portions of the work which may be expedited by use of such methods. The Project Engineer may limit or prevent the use of blasting whenever, in their opinion, the blasting may harm public safety or public or private property. All blasting shall be conducted in accordance with all applicable laws, ordinances and regulations imposed by federal, state and local authorities . All trench walls shall be shored or braced prior to blasting. The contractor shall be responsible for and take special precautions to prevent damage to all adjacent structures whenever blasting is performed.

20.3.3. Wet Trench - The contractor shall provide and maintain adequate equipment to properly remove and dispose of all surface or ground water entering the trench. The use of any sanitary sewer connected to the City effluent lines to dispose of trench water will not be permitted. The trench shall be dry at all times during pipe installation and so maintained until the jointing operation is complete. It is the responsibility of the contractor to use pipe foundation stabilizer material to assist him in maintaining a dry trench.

20.3.4. Trench Depth - Where soft unstable soils, dense shale, or rock is encountered at the normal trench bottom, the contractor shall undercut and dispose of such materials, to the limits established by the Project Engineer, and backfill the void thus created with pipe foundation stabilizer material.

In dense shale or rock, the undercutting shall be not less than six (6) inches and in unstable soils to not less than twelve (12) inches below the bottom of the pipe bell and the void replaced to within six (6) inches of the pipe with the stabilizer material.

The normal trench depth shall be a minimum of six (6) inches lower than the bottom of the pipe bell, unless an additional bedding thickness is called for on the drawings. Where pipe collars, bells, or flanges protrude in excess of six (6) inches from the pipe barrel, the contractor shall hand excavate in these areas sufficiently to allow the pipe bell to rest uniformly on the bedding material. Pipe being supported by the collars, bells or flanges on natural soils will not be allowed. Unauthorized and excessive trench depths shall be filled to

bedding subgrade with foundation stabilizer material at the contractor's expense. Reuse of trench excavated soils will not be permitted in the trench until the pipe and bedding materials have been properly installed.

20.3.5. Trench Width - The allowable trench width, regardless of the type of soil encountered, the depth of excavation or method of bedding densification, shall not exceed the outside diameter of the pipe barrel plus twenty-four (24) inches or be less than the outside diameter of the pipe barrel, plus twelve (12) inches when measured at any point below the top of the pipe bell, flange or collar.

When necessary to minimize sliding or caving of the trench, it will be permissible to slope the banks from the surface to an elevation twelve (12) inches above the top of the bells, flanges or collars. Trench banks below said elevation shall be maintained in a vertical plane as stated herein above, until the pipe has been bedded and backfilled to an elevation of twelve (12) inches above the pipe barrel. Excavated material shall be piled a sufficient distance from the trench banks to avoid sliding or caving of the trench walls.

20.3.6. Unauthorized Trench Width - Where the width of the lower portion of the trench exceeds the maximum width herein above stated, the contractor, at his expense, shall furnish and install special pipe embedment or concrete encasement to protect the pipe from the additional loading. The type and quantities of special pipe embedment shall be determined by the Project Engineer, based on a pipe strength equal to the three edge bearing ultimate strength stipulated for a non-reinforced rigid pipe of comparable diameter, saturated backfill weighing 120 pounds per cubic foot and allowance for truck or other live loads where applicable.

20.3.7. Trench Supports - Whenever the sides of the trench will not stand vertically and within the limits herein above specified during the pipe installation, the contractor shall install sheeting and shoring to prevent any excessive widening or sloughing. Where excavations are made under severe water conditions, the Project Engineer, at his discretion, may require the contractor to use an approved piling instead of sheeting.

20.3.8. Surplus Excavated Material - All waste and surplus excavated materials shall be removed from the project and disposed of by the contractor.

20.4. BEDDING

All pipe, regardless of type or diameter, shall be installed on sufficient bedding material so as to provide a minimum of six (6) inches separation between the subsoil and the pipe barrel, after consolidation. See Bedding Material Paragraph 20.2.2 for types of acceptable bedding material and Standard Drawing SS-1 for pipe bedding and backfill limits.

20.4.1. Fully Embedded Pipe - Pipe twenty-four (24) inches and smaller in diameter, regardless of type, and all non-reinforced concrete, clay, asbestos cement, ductile iron, cast iron, CSP, PVC, steel, flexible and profile wall pipes, regardless of diameter, shall be enveloped with consolidated bedding material from six (6) inches below the pipe barrel, between the trench banks and to a cover above the pipe of not less than twelve (12) inches. French or perforated underdrains shall be fully embedded in the pipe foundation stabilizer material to six (6) inches each side of the underdrain pipe.

20.4.2. Partially Embedded Pipe - Prestressed concrete cylinder (PCCP) and reinforced concrete (RCP) pipes twenty-seven (27) inch and larger in diameter, need only be granularly embedded between six (6) inches below the pipe barrel to pipe springline and horizontally to adjacent trench walls.

20.4.3. Bedding Installation - Pipe bedding material shall be placed in the trench to a loose depth of seven (7) inches and then fine graded along centerline of the pipe barrel to a thickness of six (6) inches. Special precautions shall be taken to remove sufficient bedding material at the point where the pipe bell, collar or flange falls, insuring a uniform bearing of the pipe barrel throughout its length.

After the pipe is properly joined and set to line and grade, a second loose lift of bedding material, not to exceed eight (8) inches, shall be placed along each side of the pipe and then consolidated by tamping or vibration until uniform support under the pipe haunch is obtained. Additional bedding shall be carefully placed to the limits specified and then consolidated by a combination of tamping and vibrating. At all times special precautions shall be taken to prevent displacement of or damage to the pipe.

20.4.4. Densification of Bedding - Bedding material shall be compacted to 70% relative density as determined by ASTM D2049.

20.5. BACKFILL

Backfill of the trench, after the bedding material is in place and consolidated, shall be conducted in a manner to prevent damage to the pipe or its coating. When backfilling over a flexible conduit, compaction must be controlled to the extent that elongation along any axis of the pipe shall not exceed two (2) percent for steel or five (5) percent for plastic conduits.

Backfill shall be uniformly graded and free of all frozen material, clods, rocks, stones, etc. Tractor drawn tamping equipment shall not be used closer than eighteen (18) inches from rigid pipe or thirty-six (36) inches from flexible pipe.

Concrete placed in a trench to cradle or encase the pipe shall be covered with not more than thirty-six (36) inches of loosely placed backfill material and the concrete then allowed to cure for a period of five (5) days before the trench backfill is consolidated by one of the methods hereinafter described.

In areas where the trench has been sheeted, for whatever reasons, extra precautions shall be taken during backfill to solidly fill all cavities behind the sheeting when it is being abandoned in place, or to solidly fill all cavities in or adjoining the trench as the sheeting is being removed.

20.5.1. Generally Unacceptable Soils for Backfill - Soils which possess a Plastic index of twenty (20) or greater shall be disposed of and replaced with a material which meets the requirements of an acceptable or special backfill material, as specified in the Materials portion of this section of the specifications, Section 20.2.3.) In general, unacceptable backfill materials may only be used for backfilling pipelines which cross open fields and which will not be subjected to heavy loading for a period of two (2) years.

If approved in writing by the Project Engineer, backfilling with this unacceptable backfill material shall be accomplished by placing the material in loose lifts, not to exceed three (3) feet over the bedded pipe, followed by longitudinal rolling of each lift with a motor patrol, loaded truck or other rubber tired equipment until the full width of the backfill in the trench shall have been consolidated equally. Upon completion of the backfilling and compaction within the trench limits, the top of the trench shall be graded and mounded sufficiently to allow for subsidence to the level of the adjacent ground surface.

Should the total cover over the pipe be less than three (3) feet, longitudinal rolling will not be allowed. However, the trench backfill material shall be puddled with water, allowed to cure and the trench then mounded.

Backfill of this nature shall not be performed in easements across lands not owned by the City unless specific authorization in writing has been obtained from the property owners involved, which allows backfilling in the manner herein above described and which also absolves the City of all responsibility for subsidence.

20.5.2. Trenches in Streets - Soils at optimum moisture content which are placed in the manner hereinafter described and which meet the requirements set forth under the materials portion of this specification, for acceptable or special backfill material, shall be used in filling trenches which are within the limits of public thoroughfares and rights-of-way. Backfill over the consolidated bedding shall be placed in loose twelve (12) inch lifts and each lift thoroughly consolidated by wheel rolling, tamping, vibrating, or by other proposed means of compaction acceptable to the City representative, until the relative compaction, when determined in accordance with AASHO T-99 or T-180, is equal or greater than the minimum value hereinafter shown for the various classes of soil and type of compaction. Compacted backfill shall be placed to minimum depth of thirty six (36) inches over the top of the pipe before a vibratory roller or hydro hammer can be used over the pipe.

Squeegee bedding shall be consolidated by tamping, vibrating or a combination thereof, to 70% relative density as determined by ASTM D2049.

Soil Classification (AASHTO M-145)	Minimum Relative Compaction (percent)		Moisture % of optimum
	AASHTO T-99	AASHTO T-180	
A-1 through A-5	100	95	-3, +3
A-6 and A-7	95	90	-1, +3

Backfilling and compacting in lifts shall continue until the trench has been filled or the elevation of the subgrade for base course has been reached.

Consolidation shall be obtained by the use of hand tampers having a minimum weight of twenty (20) pounds and a facial area in excess of twenty-four (24) square inches or by other proposed means of compaction acceptable to the City representative. Hydro hammers or vibratory rollers shall not be used prior to placing a three (3) foot loose lift of acceptable backfill material above the twelve (12) inches of prior compacted bedding material. In cases where compacted bedding is required only to pipe springline, backfill material shall be compacted in six (6) inch lifts from springline to a depth of twelve (12) inches over the pipe crown prior to placing a three (3) foot loose lift of backfill, in preparation for vibratory rolling or hydro hammering. Large self powered or tractor drawn compactors shall not be used within thirty six (36) inches of any pipe crown or sidewalls.

20.5.3. Vibrating and Jetting - Consolidation of backfill by vibrating and jetting will only be allowed in open fields and when the backfill material has a plastic index of six (6) or less and when consolidation is obtained in the following manner:

Backfill shall be loosely placed over the consolidated bedding to within six (6) inches of finish grade and allowed to set for a period of five (5) days, providing sufficient time for the concrete encasements and mortars to become hard enough to withstand the backfill consolidation.

The loose backfill shall then be consolidated by water jetting and vibration. Water at a minimum pressure of forty (40) psi shall be injected into the backfill through a rigid pipe nozzle to within one (1) foot of the top of the pipe. If water is not available from a distribution system, the contractor shall equip a supply tank, or other water source, with a suitable pressure pump. Vibrators shall be of the immersion type of adequate power to consolidate the mass and of sufficient length to reach within one (1) foot of the top of the pipe.

Care shall be taken to use only sufficient water at each jetting point to insure permeation of the backfill and proper consolidation and not result in surface saturation. The vibrator shall not be removed from the mass until after the jet is removed. The jetting pipe nozzle and the vibrator shall be inserted in the backfill at sufficiently close intervals along the trench to insure that uniform consolidation will result.

After the jetted and vibrated backfill has settled, and the surface is dry enough to be stable, the balance of the trench shall be filled in eight (8) inch loose lifts, each lift being thoroughly compacted with vibrators and tampers. This part of the backfill shall have the proper moisture content to permit thorough compaction to the relative compaction specified in Section 20.5-2.

20.5.4 Compaction Testing – A minimum of one compaction test per every 250 feet of trench or 200 cubic yards of fill material is required. Tests will be performed by the City's soil tester on City projects. On developer projects, compaction test results shall be submitted by the contractor's soil tester. The testing shall be at varying depths and locations. Additional testing may be required around valve boxes, manholes or in questionable areas of backfill where initial tests show the compaction does not meet the compaction standards specified in Section 20.5.2 of this section of the Specifications. Additional testing may also be required if significant moisture or freezing conditions have affected the previously consolidated backfill material before permanent asphalt surfacing has been placed. The successful passing of a compaction test or tests does not constitute acceptance of the work or materials represented by the tests or any portion of the work or materials. The Contractor is solely responsible for quality control of his work. The work will only be accepted by the City upon completion and after expiration of the warranty period required in the Rifle Engineering Code of Standards and Specifications.

20.5.5. Utility Service Line Backfill - Water and sewer service stubs being installed in previously surfaced streets shall be bedded with materials as described in Section 20.2.2 and backfilled with CDOT Class 6 Road Base, Flow Fill or Flash Fill only. Road base material is to be installed in the manner described below and shall be consolidated to the relative compaction specified in Section 20.5.2 of this section of the Specifications. Base course shall be installed in consolidated lifts, not to exceed twelve (12) inches and each lift consolidated to the density required before the subsequent lift is placed in the trench. Consolidation shall be performed in the manner described in Section 20.5.2 above.

20.5.6. Street Maintenance During Construction - The maximum amount of open trench ahead of the installed pipe shall not exceed one hundred (100) linear feet. At the end of each shift, or shifts shortened for cause, the pipe trench shall be backfilled, compacted, surface graded and the trench filled to within ten (10) lineal feet of the excavated trench face. However, any liability resulting from trenches left open or improperly backfilled and maintained shall be at the contractors expense.

During the progress of the work backfilled trenches shall be maintained free of chuckholes, ruts, loose rocks and dust. Daily the contractor shall level to grade non-paved surfaces and spray thereon dust palatives or water in sufficient quantity to control dust, until such time as the trench is permanently asphalt surfaced.

Every 7-10 calendar days maximum, all unpaved trenches on the project shall be re-excavated to a depth of six (6) inches below finish grade. Asphalt edges along the trench shall be trued to a vertical plane and then asphaltic primed. Subgrade shall be leveled and recompacted. The void thus created shall then be filled with two (2) or three (3) compacted lifts of Colorado Department of Transportation Grading S bituminous asphaltic surfacing material. During winter months the initial two (2) lifts of Grading S shall not exceed a total depth of five (5) inches. The remaining one (1) inch void shall be compacted full, using CDOT Grading SX. Sufficient Grading SX material shall be used to allow feathering the finish trench surface over and onto asphalt that existed prior to construction.

In the event hot mix bituminous material is not available during winter months, the contractor shall install and maintain a temporary two (2) inch layer of cold mix asphalt atop the trench. As

soon as the hot mix plants are again producing Grading S the contractor shall re-excavate the trench and install the six (6) inch of bituminous mix as herein above outlined.

Immediately following installation of the temporary or permanent asphalt surfacing, the entire width of the asphalt surface and concrete gutters, if in place, shall be cleaned of all debris, power broomed and maintained free of rock and debris throughout the construction period.

20.5.7. Surface Restoration - Paving, curb, gutters, sidewalk, improved surfaces, or other street improvements removed, damaged or destroyed during construction shall be replaced to the same elevation and alignment, equal to and consistent with the undisturbed portions of the improvements existing prior to trench excavation. Subgrade for all restored surfaces shall be thoroughly compacted by mechanical or hand tampers weighing not less than twenty (20) pounds, by vibratory rollers or by other proposed means of compaction acceptable to the City representative.

20.5.8. Maintenance of Backfill and Surface Warranty - Backfill shall be maintained in a satisfactory condition and all areas showing signs of settlement shall be filled and maintained for a period of one (1) year following the date of final acceptance for all work performed, EXCEPT the warranty period for settlement in asphalt surfaced streets shall be for two (2) years. When the developer or contractor is notified by the City that any backfill is hazardous, he shall correct such hazardous condition at once.

20.5.9. Housekeeping Restoration and Clean Up - See Section 5 of these Standard Specifications.

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 25.

SANITARY SEWER AND STORM DRAINAGE LINES

25.1. GENERAL

Piping for sanitary sewer main, sewer service lines, storm and irrigation drainage to be installed in easements or public right-of-way under the jurisdiction of the City, shall be installed in accordance with approved engineered plans, and the City of Rifle "Engineering Code of Standards and Specifications for the Design and Construction of Public Improvements".

All excavation, bedding, backfill and surface restoration required for the installation of any pipe covered by this section of the specifications shall be performed in accordance with Section 20 of these specifications.

The contractor shall be properly licensed with the City of Rifle, obtain a permit and notify the Project Engineer in writing, twenty-four (24) hours before the planned construction is to commence or when work is to be resumed following a delay.

25.2. MATERIALS

Materials; other than bedding, backfill and trench resurfacing; which are to be placed within the trench limits, shall conform to the minimum standards hereinafter referred to.

Applicable specifications for material as set forth by the American Society for Testing Materials (ASTM), the American Association of State Highway and Transportation Officials (AASHTO) and the Colorado Department of Transportation (CDOT) are made a part of these specifications. Referenced standards are the latest edition or revision thereof.

25.2.1 Pipe - The pipe shall conform to the type indicated on the construction plans and to the specification noted in Table 25-1 of this section for the indicated type and application. All sanitary sewer mains shall be minimum eight inch (8") diameter.

25.2.2. Concrete - See Section 10 of these specifications.

25.2.3. Mortar - Freshly made uniform mix consisting of one (1) part Portland Cement, two (2) parts mortar sand and sufficient water to provide a workable paste.

TABLE 25-1
PIPE MATERIAL AND SPECIFICATION

SANITARY SEWER PIPE (NON-PRESSURE)

MATERIAL		SPECIFICATION	DIA. INCHES	NOTES
(PVC)	POLYVINYL CHLORIDE	ASTM D3034	4 - 15	(A)(B)
(PVC)	POLYVINYL CHLORIDE	ASTM F949	8 - 36	(A)(C)
(PVC)	POLYVINYL CHLORIDE	ASTM F679	18 - 27	(A)(B)(C)
(PVC)	POLYVINYL CHLORIDE	ASTM F1803	21 - 54	(A)(C)

(A) See Section 20 for Bedding Type, Limits, Gradation, and Compaction
(B) SDR-35 Minimum
(C) Minimum pipe stiffness of 46 psi

STORM SEWER PIPE (NON-PRESSURE)

MATERIAL		SPECIFICATION	DIA. INCHES	NOTES
(HDPE)	POLYETHYLENE	AASHTO M252	3 - 10	(A)(B)
(HDPE)	POLYETHYLENE	AASHTO M294	12 - 60	(A)(B)
(RCP)	REINFORCED CONCRETE ROUND CLASS III	ASTM C76,C361,C655 AASHTO M170, M242	12 -144	(A)(H)
(RCA)	REINFORCED CONCRETE ARCH	ASTM C506,C655	15 -132(E)	(A)(H)
(RCE)	REINFORCED CONCRETE ELLIP.	ASTM C507,C655	18 -144(E)	(A)(H)
(RCB)	REINFORCED CONCRETE	ASTM C789	Box	(A)(C)(H)
(RCB)	REINFORCED CONCRETE	ASTM C850	Box	(A)(D)(H)
(PVC)	POLYVINYL CHLORIDE	ASTM F949	8 - 36	(A)(I)(J)(K)
(PVC)	POLYVINYL CHLORIDE	ASTM F1803	21 - 54	(A)(I)(J)(K)
(ASP)	ALUMINIZED STEEL TYPE 2	ASTM A760,A796,A891 AASHTO M274, M36	12 - 60	(A)(G)(L)(M)

Note: Storm sewer or culvert pipe type shall be as designated on construction plans. If no designation, use of reinforced concrete pipe (RCP) shall be required.

(A) See Section 20 for Bedding Type, Limits; Gradation, and Compaction
(B) Profile Wall - Type S, 2 ft. min. bury, 10 ft. max bury, bell and spigot joint with rubber gasket as specified in ASTM D2321, AASHTO Section 18 and ASTM D3212
(C) Reinforced Box - Minimum cover 2 feet
(D) Reinforced Box - Cover less than 2 feet
(E) Equivalent round size
(G) Existing soil must be tested to verify adequate service life of pipe before use
(H) Rubber O-ring gasketed joints in accordance with ASTM C443 must be used, 1 ft. min bury, 11 ft. max bury thru 42” dia., 12 ft. max bury thru 78” dia., 13 ft. max bury thru 144” dia.
(I) Bell and spigot joints with ASTM D3212 rubber gasket
(J) Minimum pipe stiffness of 46 psi
(K) Minimum cover 2 feet or one pipe diameter (which ever is less) as determined by ASTM D2321
(L) Coupling bands shall conform to AASHTO M36 and allow the use of o-ring gaskets as required
(M) 1 ft. min bury, 16 ga., sizes 54-60 require 1.5 ft. min bury and 14 ga.

TABLE 25-1
PIPE MATERIAL AND SPECIFICATION

UNDERDRAIN PIPE

MATERIAL		SPECIFICATION	DIA. INCHES	NOTES
(PVC)	POLYVINYL CHLORIDE	ASTM D3034	6 - 8	(A)(B)
(PVC)	POLYVINYL CHLORIDE	ASTM F949	6 - 8	(A)(B)
(HDPE)	POLYETHYLENE	AASHTO M252	6 - 8	(A)(C)

(A) See Section 20 for Bedding Type, Limits; Gradation, and Compaction
(B) SDR 35 Minimum, 46 psi min. stiffness, Perforated or Solid - White Color
(C) Profile wall –Type SP, 10 ft. max bury, bell and spigot joint with ASTM D3212 rubber gasket

LINER PIPE

MATERIAL		SPECIFICATION	DIA. INCHES	NOTES
(HDPE)	POLYETHYLENE	ASTM D3350	6 - 18	(A)
(HDPE)	POLYETHYLENE	ASTM D3350	21 - 48	(B)

(A) SDR-26 Minimum
(B) RSC = 100, Grout annular void

CASING PIPE

MATERIAL		SPECIFICATION	DIA. INCHES	NOTES
(S)	STEEL	AWWA C200	18 - 36	(A)

(A) Coal Tar Epoxy Coated, Welded Joint, Grout annular void to 10 psi

JACKING PIPE

MATERIAL		SPECIFICATION	DIA. INCHES	NOTES
(RCP)	REINFORCED CONCRETE	ASTM C76,C361,C655	36 - 84	(A)(B)

(A) Joint – Rubber and Steel “R-4”
(B) Grout annular void to 10 psi

25.2.4. Manholes - Manholes for sanitary, storm and irrigation systems:

A. Bases shall be cast in place or precast using Class "A" concrete.

B. Risers, cones, bases and flat-tops shall be precast in accordance with ASTM C-478, and combined as follows:

Riser ID Ft.	Normal Top	Cone Opening
4	Eccentric Concrete (1)	24" Diameter
5	Eccentric Concrete (1)	24" Diameter
6	Flat-Top (2)	24" Diameter

1. Use flat-top when the distance between the top of the bench to the top of the manhole ring is less than six (6) feet.

2. Reduce the ID to five (5) feet approximately 6'6" above the manhole bench.

C. Interior concrete surface protective coating – The interior concrete surface of all exterior drop manholes and the adjacent upstream and downstream manholes shall be coated with one coat of 30 mil minimum thickness Sikadur 31 Hi-Mod Gel coating and two coats each 5 mil minimum thickness Sikagard 62 Epoxy coating over the Sikadur 31. Manhole base including bench and invert to be coated with two coats of Sikagard 62 Epoxy coating only. First Sikagard 62 coat shall be red color. Second coat to be gray color.

25.2.5. Adjustment Rings - Leveling course and set ring adjustment; reinforced Cl "A" concrete rings or HDPE Adjusting Rings. Maximum height of adjustment rings shall be twelve inches (12") total.

25.2.6. Rings, Covers, Grates and Frames - Gray cast iron conforming to ASTM A-48 Class 35 B (unpainted) with machined metal bearing surfaces. Inverted set rings are not allowed on sanitary manholes. In certain instances, manhole rings and covers may also be aluminum alloy A-132 and A-142 secondary furnished with positive lock down mechanisms. Aluminum rings and covers are only allowed with prior approval of the City Engineer. Covers shall be cast showing designate use (sanitary, storm, or water) and City of Rifle logo as shown in standard drawings. Storm manhole covers shall also have the "No Dumping-Drains to Creek" logo cast into them as shown in standard drawings. The following types have been approved for the application indicated.

Rings & Covers

Alloy	Sanitary Sewer	Storm Drain	Manufacturer
Cast Iron 24"	1258	1258	Deeter
Cast Iron 30"	1197	1197	Deeter
Cast Iron 24"		2018-A*	Deeter
Cast Iron 24"	R-1706	R-1706	Neenah Foundry
Cast Iron 30"	R-1798	R-1798	Neenah Foundry
Cast Iron 24"		R-1706-1S*	Neenah Foundry
Aluminum 100-24		550-31	Castings Inc.

* Slab-type for installation with "Type R" curb inlets only

Inlet Frames and Grates

Alloy	Application	Model	Manufacturer
Cast Iron	Type 13 Inlet	#13	Castings Inc.

Cast Iron	Type 13 Inlet	#13 CURB	Castings Inc.
Cast Iron	Type 13 Inlet	DBL	Castings Inc.

25.2.7. Steps - Copolymer polypropylene plastic over 1/2" diameter Grade 60 steel, PS2-PFS as manufactured by M.A. Industries, American Step Company, or equal installed on non-staggered, fifteen (15) inch vertical centers.

25.2.8. Joint Sealant for Manhole Sections, Tongue and Grooved Pipe - Preformed water repellant sealant conforming to federal specification SS-S-210A superseding Interim Federal Specification SS-S-00210 headed “Sealing Compound, Preformed Plastic for Pipe Joints”. Rub’r Nek LTM preformed gaskets as manufactured by the Henry Company or equivalent are acceptable.

25.2.9. Watertight Joint Seals for Manhole and Pipe Sections - Type M or O rubber gasket as recommended by the pipe or manhole manufacturer is required below groundwater level.

25.2.10. Chemical Joint Sealant - Acrylamide base gel grout, urethane effectiveness requirements set forth in the Environmental Protection Agency publication entitled, "Chemical Sealants for Elimination of foam grout or an approved equal. Grout shall exceed or meet the I/I". When handled and mixed in strict accordance with the manufacturer's recommendations the chemical grout sealant must: be able to react in moving water, withstand submergence in water without degration and be impervious to water penetration over the life of the grout, be flexible after curing and be able to withstand freeze-thaw and wet-dry cycles; be biodegradable and resistant to concentrations of acids, alkalis and organics found in normal sewage.

25.2.11. Reinforcing - Deformed intermediate grade 40 or 60 steel.

25.2.12. Diapers - Burlap or cotton fabric type with two (2) longitudinal metal ribbon tie anchors.

25.2.13. Plugs - Watertight compression plug as recommended by the pipe manufacturer.

25.2.14. Dead End and Wye Marker - Nine (9) gauge steel wire attached to the dead end or wye on one (1) end and extended vertically to within twelve (12) inches of finished grade and attached to the equivalent of a 2" x 4" x 24" section of timber.

25.2.15. Storm Drain Inlets

A. Curb inlets conforming to Colorado Department of Transportation Standard M-604-12.

B. Valley Inlets conforming to Colorado Department of Transportation Standard M-604-13.

C. Precast Inlets for use in (A) or (B) above are subject to the individual manufacturers obtaining written approval from the City Engineer for their specific design and fabrication procedures.

25.2.16. Transition Between Unlike Materials or Inline Size Changes - Prefabricated adaptors that are water tight, structurally sound and will provide a smooth continuous invert. Fernco or Calder flexible coupling or equivalent.

25.2.17. Concrete and Metal End Sections and Joint Fasteners - Conforming to the Colorado Department of Transportation Standard M-603-10.

25.2.18. Steel Casing for Bores - Welded steel casing pipe shall meet the requirements of AWWA C200 and shall have an inside diameter of at least twelve (12) inches greater than the outside diameter of the bell joint of the carrier pipe to be installed therein. Casing shall be coal tar epoxy coated. The minimum wall thickness of the tubing shall be:

Wall Thickness	Casing O.D.
3/8”	30" and smaller
1/2”	32”-42”

25.2.19. Jacking Pipe - Reinforced concrete pipe of the class specified in Table 25-1 and having Rubber and Steel Type R-2 joints. Joint bearing plates and longitudinal steel bars, to properly transmit the jacking thrust, shall be cast in place when specified in the special conditions.

25.2.20. Carrier Pipe Supports - Redwood skids (4" x 4" x 36") steel banded 15 to 30 degrees each side of the carrier pipe invert, at a maximum center to center spacing of twelve (12) feet.

25.2.21. Carrier Pipe Chucks - Redwood or plastic chucks banded 7 to 10 degrees each side of PVC carrier pipe crown, extended to clear the casing pipe by no more than three quarter (3/4) inch.

25.2.22. Casing Spacers and Insulators - APS Model SSI or SI with fusion bonded epoxy or PVC coating as manufactured by Advance Products and Systems, Inc., Lafayette, LA or equal, installed at a maximum center to center spacing of ten (10) feet along the carrier pipe invert with an additional spacer placed within 6” of each end of the casing pipe. Spacers shall be 8” width for carrier pipe 6” to 14” diameter, 12” width for carrier pipe 16” diameter or larger.

25.2.23. Tunnel Liner Plate - Liner plate shall be hot rolled carbon steel conforming to ASTM A-569. All plates shall be punched for bolting and fabricated as to permit complete erection from the inside of the tunnel. Two (2) inch diameter grout holes shall be tapped at the spacing and locations shown on the plans. Tapped holes shall be provided with a pipe plug screwed in place.

Plates shall be hot-dip galvanized in conformity with ASTM A-123 to provide a zinc coating of 2.5 oz. per square foot for both sides. Bolts and nuts shall conform with ASTM A-153 and be hot-dip galvanized.

25.2.24. End Seals for Casing Pipe– 1/8” thick synthetic rubber wrap around end seals with stainless steel bands shall be installed on casing pipe after carrier pipe insertion. End seals shall be APS Model AW Wrap Around End Seal as manufactured by Advance Products and Systems, Inc. Lafayette, LA or equal.

25.2.25. Sewer Service Saddles - Molded, gasketed “Wye” saddles shall be installed and manufactured to ASTM D3034, SDR 35, ASTM F679 and F1336 specifications. Saddle shall be banded to the sewer main with stainless steel straps. Saddles shall be as manufactured by GPK Products, Inc. or equal. Inserta Tee fittings by Inserta Fittings with SDR 35 gasketed bell are also allowed. Also allowed are elastomeric flexible saddles as manufactured by DFW/HPI.

25.3. INSTALLATION

The installation of pipe material and appurtenances shall be performed in accordance with the acceptable practices set forth by the American Society for Testing Materials (ASTM), the manufacturer's recommendations, these specifications and approved plans.

25.3.1. Interruption of Sanitary Service - The contractor must in writing, advise affected users twenty-four (24) hours prior to performing work on a service or collector line which will interrupt a customer's wastewater line. Contractor prepared notices shall be hand delivered to each customer or occupant. If the occupant cannot be contacted, the written notice shall be left attached to the door knob or screen.

In addition, the contractor must notify Rifle's Wastewater Collection Division (970-625-2121, ext 324) of the schedule for plugging and bypassing manholes necessary to isolate the line on which work is to be performed.

The contractor shall provide all labor, materials and equipment to properly handle and divert all sewage flow when required for construction.

If sewage backup occurs and enters buildings, private property, irrigation ditches, streams or storm drains during contractor's bypassing operations, the contractor shall be responsible for clean-up, repair, property damage and all costs and claims.

A normal outage shall be a maximum of four (4) hours and between the hours of 8:00 a.m. and 2:00 p.m. If the outage will be greater than four (4) hours, the work shall be done in a manner to minimize the inconvenience to users, such as working at night in a continuous operation until service is restored. A connection which will require an outage longer than four (4) hours shall be subject to review by the City as to the appropriate time for performing the work.

If in the process of installing a connection, there exists an industry or building in the area that cannot be out of sanitary service such as a hospital, school, etc., the contractor shall provide wastewater disposal service to them at all times during the performance of the work.

25.3.2. Excavation, Bedding and Backfill - See Section 20 of these Standard Specifications.

25.3.3. Alignment and Grade - Sanitary and storm sewers, underdrains, irrigation ditches and their appurtenances shall be constructed to the line and grade specified on the approved plans.

The grade and alignment of the pipe or ditch being installed shall be controlled by means of laser beams or offset grade stakes, set in the field by professional survey parties. The contractor shall be responsible to accurately transfer said grade and alignment to the trench and construct thereto.

25.3.4. Service Line Grades - Sanitary sewer services between the main and a point located seven (7) feet into the property or ten (10) feet behind and back of the sidewalk, whichever is the greater, shall be installed according to the following minimum grades:

Pipe Diameter	Minimum Gradient Ft./100 Ft.	Minimum Fall In./Ft.
4"	2.08'	1/4"
6"	1.04'	1/8"

25.3.5. Pipe Installation - Construction shall start at the low point in elevation or at an existing structure. Bedding and pipe shall be installed laying uphill to controlled grade and alignment. Voids shall be created by hand excavation at each pipe joint to provide room for the pipe bell or grouted diaper, and prevent beam support at the joints.

Surfaces of the joints shall be clean and dry prior to installing Rub'r Nek LTM or O-ring gasket. After the jointing material is in place, the pipe section shall be carefully pushed home using approved methods of leverage. Care shall be exercised so that there is no damage to the ends of the pipe or the joint material so that a water tight joint is assured.

Tongue and groove concrete pipe shall be set to line and grade and the joint sealed by means of Rub'r Nek LTM or O-ring gasket. Diapered and grouted joints shall not be encased by bedding material until the grout has obtained its initial set along and under the haunches and up to springline of the pipe. Once the pipe sections have been joined and adjusted to line and grade, the section shall be secured in place by tamping bedding material along and under the haunches and up to springline of the pipe.

Pipe installed shall be maintained dry and free of gravel, dirt, animals and debris. Whenever work ceases for any reason, the unfinished end of the line shall be securely closed with a temporary watertight plug. No pipe sections shall be covered with bedding or backfill material until they have been inspected by a representative of the Engineering Department.

25.3.6. Underdrains - Piped underdrains, when called for on construction drawings, shall be installed laying upgrade, the same as specified for pipe installation, except the pipe shall be encased in a free draining material (3/4" to 1 1/2" washed rock) and the vertical distance between the bells of the underdrain pipe and the carrier pipe to be installed shall not be less than six (6) inches. The lowest point on the underdrain line shall be daylighted and free draining.

Underdrain pipe joints shall be centered on each other and then covered or wrapped with an eight (8) inch strip of fifteen (15) pound roofing felt paper prior to encasement. In lieu of the above, the underdrain pipe may be entirely encased with washed rock to the top of the pipe and then a layer of Mirafi 140N or equivalent shall be installed for the full width of the trench. Squeegee may be used to encase the underdrain pipe if the underdrain pipe is wrapped with a geotextile sock.

Underdrains shall be continuous under each manhole or structure on the line. However, underdrains shall be connected to a double sweep wye with risers and threaded caps or compression plugs as shown in Drawing #SS-6 in each manhole to provide a cleanout access. Underdrain access shall be placed on opposite side of manhole steps. Underdrain access may also come into the side of the manhole thru the manhole wall where elevations dictate that the underdrain must be higher than the sanitary sewer. In these instances, no bends greater than 45 degrees will be allowed in order to pipe the cleanout into the manhole.

25.3.7. Manholes - Construct in accordance with the City of Rifle Standard Drawings. Manholes shall be placed at maximum of 400 feet intervals along the sewer main regardless of main size and at all changes in alignment, grade or at other laterals leading into the sewer main.

The maximum interior drop through any manhole shall be 0.3 ft. The main line shall be laid continuously through the manhole wherever practical and the base cast with Class "A" concrete from the pipe springline to at least eight (8) inches below the outside bottom of the pipe. The top of the base shall be shaped by sloping the manhole floor upward from the pipe springline to the manhole wall at the rate of two (2) inches per foot. Where half pipe is used or when the arch of the pipe is removed, the floor shall be finished over the exposed pipe wall

to give a free draining, smooth monolithic finish. When placing concrete under the pipe to form the base, care must be exercised to prevent flotation of the pipe.

Where there are changes in alignment, grade or other laterals leading in, the base of the manhole shall be formed and the concrete placed therein. The flowlines through the base shall be shaped to conform exactly to the lower half of the pipe to which it connects and left smooth and clean. Side branches shall be constructed with as large a radius of curvature as possible. The manhole floor shall be sloped to drain as herein above stated.

When stub-outs are required through the manhole wall or any type of structure, the bell end of the stub shall face upstream, be as close to the structure as possible and be plugged with a watertight compression seal. The barrel portion of the stub shall have Type "M" or "O" rubber gaskets around the OD of the stub placed four (4) inches back from each face of the structure wall, before dry packing and sealing in place. Where the walls of the structure are eight (8) inches or less in width, only one (1) gasket will be required.

After the manhole base concrete has been properly cured, for a period of not less than forty-eight (48) hours, the bearing area to receive a precast concrete barrel ring shall be cleaned of all laitance. Rub'r Nek LTM or equivalent shall be placed in the bearing areas and the precast section carefully lowered onto the bench so that the sealant will be forced out evenly from under the section and on all sides. Likewise, subsequent barrel sections, reducers, cones, flat-top sections and concrete riser rings installed shall be sealed. The joint between the manhole cover set ring and the cone section or riser ring it rests on shall also be sealed to prevent infiltration. Care shall be taken in setting subsequent sections to assure vertical alignment of the steps over the bench of the manhole.

Manhole cover set rings shall be set to grade in full bead of mortar over a maximum of three (3) concrete riser rings totaling no more than 12" in height above the cone or flat-top. HDPE adjusting rings are also allowed. Mortar shall be evenly placed around the exterior of the cover set ring to set the ring in place when the manhole is not in a paved area.

25.3.8 Marker Posts – When manholes are installed outside of a paved surface, a marker post shall be installed adjacent to the manhole. Marker post shall be a 5 foot tall 3 inch diameter steel post set in concrete to a depth of 2 feet. Post shall be filled with soil with a 6 inch concrete cap. Post shall be painted fire hydrant yellow.

25.3.9. Connecting to Existing Manholes - Where no existing pipe is stubbed out, the connection shall be made in such a manner that the finish work will conform as nearly as practical to that specified for a new manhole. The opening in the manhole wall shall only be made large enough to receive the new pipe barrel containing the Type "O" or "M" rubber gasket around its O.D. The existing foundation shall be chipped to the cross-section of the new pipe and a grouted smooth continuous invert shaped therein. Rub'r Nek LTM, non-setting epoxy, dry packed cement or a combination thereof shall be used to provide a watertight seal between the pipe installed and the manhole wall.

25.3.10. Alignment of Sanitary Service Lines - Sanitary service lines shall be aligned in the shortest, most direct path between the sanitary main and the house. Service line stubs shall be located five (5) feet from the low side of the lot and a minimum of ten (10) feet downstream from the water service line. The point where the line crosses under the curb shall be marked by chiseling a symbol "X" on the curb.

If necessary, the service may be constructed with no more than four horizontal 45 degree bends between the house plumbing and the sanitary sewer main. If more than two bends are used a two way cleanout must be installed in the service line between the house and the sanitary sewer main. A two way cleanout must also be installed at a maximum interval spacing of 100 feet in all residential sanitary sewer service lines over 100 feet long. House

plumbing shall come out of the house on the side paralleling the main to which the connection is to be made.

Manholes and/or cleanouts shall be installed in commercial or industrial service lines, between the building and sewer main at all horizontal changes in flow and/or at a maximum interval spacing of 100 ft. Installation shall be performed in the same manner as specified for main line installations.

Sanitary service lines are not allowed to cross property other than the property being served, unless prior approval has been obtained from the City Engineer. Except as permitted below, the underground water service pipe and the building drain or building sanitary sewer shall be not less than ten (10) feet apart horizontally and shall be separated by undisturbed or compacted earth. Under extenuating circumstances, the sanitary sewer service pipe may be placed in the same trench with the building drain or building water service pipe provided prior written approval is given by the City Engineer and the following conditions are met:

1. The bottom of the water service pipe at all points shall be at least twelve (12) inches above the top of the sewer line at its highest point.

2. The water service pipe shall be placed on a solid shelf excavated at one side of the common trench.

3. The water service line is one (1) continuous section of Type "K" copper tubing, joint free.

4. The material and joints of the sewer service pipe shall be installed in such manner and shall possess the necessary strength and durability to prevent the escape of solids, liquids and gases therefrom under all known adverse conditions such as corrosion, strains due to temperature changes, settlement, vibrations and superimposed loads.

Service crossing under existing sidewalk or curb must be bored, jacked or tunneled through the earth under the concrete.

Service stub-ins shall be extended ten (10) feet beyond property line and then be plugged or capped with a gasketed plug or cap and a dead end marker installed. Glued plugs or caps are not allowed.

25.3.11. Tapping Sewer Mains - Tapping sewer mains to connect six (6) inch and larger service lines or those which serve buildings intended for industrial, manufacturing or other "process" uses, will not be allowed. This size and type of service shall be connected to the main through a manhole with a formed invert.

To connect four (4) inch service lines, where wyes have not been installed in the sewer main, the main shall be machine tapped by the contractor using a hole saw. Molded, gasketed “Wye” saddles shall be installed and manufactured to ASTM D3034, SDR 35, ASTM F679 and F1336 specifications. Saddle shall be banded to the sewer main with stainless steel straps. Saddle shall be as manufactured by GPK Products, Inc. or equal. Inserta Tee fittings by Inserta Fittings with SDR 35 gasketed bell are also allowed. Also allowed are elastomeric flexible saddles as manufactured by DFW/HPI. The drilling machine and method of drilling are subject to approval by the City Engineer.

The City's inspector shall inspect the main and saddle for each tap prior to backfilling. In the event the tap is covered before it is inspected, it shall be dug out by the contractor and any bedding material around the fitting shall be removed to allow visual inspection of the tap and the main. If the main sewer line is cracked or broken during the process of locating and

tapping, it shall be repaired immediately by replacing the broken section with a section of new PVC sewer main.

25.3.12. Sewer Service Connection Wyes and Riser Stubs - Cap with a gasketed watertight plug or cap and install a 2" x 4" timber.which extends vertical from the stub to a minimum of twelve (12) inches above finish grade.

Wyes shall be angled upwards so that the upper invert of a one-quarter (1/4) bend connected to the fitting will have an elevation equal to or higher than the inside crown of the main line.

Riser connections will be required to be installed on deep lines so as to extend from the wye fitting on the main line to an elevation of not less than ten (10) feet below finish grade.

25.3.13. Curb and Valley Inlets - Form and cast in place in accordance with the City of Rifle Standard Drawings, using Class "A" concrete. Precast inlets shall be placed on compacted subgrade to correct line and grade.

25.3.14. Contamination and Dilution - During construction and until such time that the new lines have been tested and accepted for warranty, the point of connection to the existing system shall remain plugged. Dilution of normal sewage flows with ground water or debris from the new lines will not be allowed.

25.3.15. PVC Pipe Storage - Pipe stored outside and exposed to sunlight for more than 30 days shall be covered with a solid canvas to block the light. Clear plastic is not allowed as a cover. Air circulation shall be maintained under the covering.

25.4. REHABILITATION OF SEWER MAINS, LATERALS AND MANHOLES

Rehabilitation of sewer lines and manholes by means of sliplining, cured in place pipe, expanded in place pipe, pipe bursting, point repair or joint sealing methods shall be performed in accordance with the requirements set forth herein.

Prior to proceeding with the rehabilitation work; each section of pipe between manholes shall be cleaned, televised and the exact location of all service connections, pipe or joint failures, root intrusion and other defects documented with respect to the insertion manhole.

25.4.1. Care of Raw Sewage: Bypassing sewage around the section or sections of the system being rehabilitated shall be performed by the contractor in a manner such that the dumping of raw sewage onto City streets or private property, into irrigation ditches, streams, or storm drains is not allowed. Bypassed sewage shall only be discharged into a downstream sanitary sewer manhole.

The contractor shall submit in writing to the Project Engineer, prior to starting construction, a detailed outline of the method he proposes to use in handling and bypassing raw sewage. The pumps and bypass lines shall be of adequate capacity and size to handle all sewage flows.

No service or trunk line is to be plugged and left for a period of time during rehabilitation which would cause backup into buildings.

Diversion of sewage by means of diesel or gasoline pumps will only be allowed during working hours. No pumps, except city approved electrical pumps, are to be operated during non-working hours.

If sewage backup occurs and enters buildings, private property, irrigation ditches, streams or storm drains, the contractor shall be responsible for clean-up, repair, property damage and all costs and claims.

25.4.2. Sewer Line Cleaning - Designated sewer pipe sections to be rehabilitated, between consecutive manholes, shall be cleaned by means of approved mechanically powered, hydraulically propelled or high velocity cleaning equipment. The equipment selected for cleaning shall be capable of removing dirt, grease, rocks, sand and other deleterious materials or obstructions from lines and manholes. Equipment used shall also provide a high-velocity gun for washing and scouring manhole walls and floors.

A. Precautions: During cleaning operations the contractor shall take all necessary precautions to protect the lines from damage that could result by the improper use of cleaning tools and equipment. Whenever hydraulically propelled cleaning tools, which depend upon water pressure to provide their cleaning force or any tools which retard the flow of water in the sewer are used, precautions shall be taken to ensure that the water pressure or surcharging does not cause damage or flooding of private or public property.

Water required to construct or maintain capital improvement projects may be obtained from the City, at no cost to the contractor, providing the following conditions are adhered to:

1. Contractor must pay a deposit in accordance with the Utility Division of the City of Rifle and obtain a designated fire hydrant permit, valve and meter. Deposit will be refunded, subject to the valve and meter being returned in equal condition as obtained.

2. Water consumption is reported to the Utility Division, on no more than seven (7) day intervals.

3. No water is drawn from the designated fire hydrant during fire demand in the immediate area.

B. Root Removal: Roots shall be removed in the designated sections where root intrusion is a problem. Special precautions should be exercised during removal to assure complete removal of visible roots from the pipe joints. Any extensive visible roots which could impede installation of a liner pipe shall be removed. Procedures may include the use of mechanical devices such as expanding root cutters and porcupines, hydraulic procedures such as high pressure jet cleaners or chemical foaming.

C. Material Removal and Disposal: Sludge, dirt, sand, rocks, grease, roots and other solid or semi solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section which may cause service plugging or line stoppage will not be permitted. Solids and semi solids collected in each manhole shall be removed and disposed of at a site approved by the Colorado Department of Health. Under no circumstances will the contractor be allowed to accumulate debris, etc. on the site for more than four hours, except in totally enclosed containers. Obnoxious smelling materials shall be immediately removed from the site.

25.4.3. Flow Control - Sewer line flows, at the upstream manhole of the pipe section being worked, shall not exceed those shown below for the respective pipe line size as measured in the manhole for performing television inspection, joint testing or sealing tasks.

Maximum Line Flow

Pipe ID Inches	Television Inspection % Full	Joint Testing/Sealing % Full
6-10	20	-

6-12	-	25
12-24	25	-
15-24	-	30
24 & larger	30	35

Control of flows in lines may be accomplished by pumping and by-passing, plugging or blocking methods. Providing, however, sufficient precautions are taken to prevent flooding or damage to private property, contamination of irrigation ditches or streams and surcharged lines. Should flooding, surcharging, contamination of streams and/or damage to property occur, the contractor shall be held responsible to make all repairs and pay all claims at his expense. Also, all engines shall be equipped in a manner to keep pump noise at a minimum. Pump discharge of sewer flows in streets, storm sewer inlets or streams will not be allowed.

25.4.4. Television Inspection - Immediately following line cleaning, each pipe section between manholes shall be visually inspected under controlled flow conditions by means of closed circuit television. The camera and equipment used shall be one specifically designed and constructed so as to provide a clear photograph and/or video picture for the entire periphery of the pipe, while operating in 100% humidity conditions.

During inspection of the line the exact location of service taps, defective pipe joints, cracked pipe, roots, intrusion, infiltration, sagging line, obstructions etc. shall be documented with respect to the metered distance from the insertion manhole. Documentation so developed shall be reviewed with the Project Engineer to determine the type and extent of the repair necessary to rehabilitate the line.

25.4.5. Point Repair - Point repair of a sanitary sewer line shall be the removal and replacement of a defective section or joint of pipe at a specified location in the line, including removal, replacement and reconnection of any sewer services found connected thereto.

A. Service Lines: Service line wyes or tees, connected to the defective pipe, shall be reconnected. The service line, if also found defective shall be replaced with ASTM D-3034 PVC pipe to the first solid section of the existing service line pipe or to property line, whichever is the lesser. Portions of existing service lines, determined to have been broken by the contractor shall be replaced at no cost to the City.

B. Exposing Defective Pipe: Excavation shall expose the area of defective line and at least five (5) feet of solid pipe on either side of the proposed repair area. Excavation, bedding, backfill, resurfacing etc., shall be performed in accordance with the applicable section of these standard specifications.

C. Defective Joints and Pipe: Excavations that reveal defective pipe joints, collapsed or cracked pipe shall be repaired or replaced as directed by the City Representative. The defective pipe section shall be removed and replaced with ASTM D-3034 PVC pipe of equal diameter to that being removed. Reconnection of the new pipe, to the pipe allowed to remain, shall be made using Calder or Fernco adaptors providing the ends of the section to be connected have been severed smooth and at 90 degrees to pipe centerline.

D. Sewage Handling: Handling sewage flows while making a point repair shall:

1. Be the responsibility of the contractor.

2. Not cause flooding or damage to private property or contamination of ground water, irrigation ditches or streams.

25.4.6. Sliplining - Sliplining of a pipe shall be the insertion of a polyethylene resin liner pipe into an existing sewer line section, between specified manholes, including reconnecting service lines connected thereto.

A. Excavation: Excavation for access shafts and at all service reconnects shall be made prior to insertion of the liner. Excavations shall create a void sufficient in size to provide ample working room to install all seal clamps and saddles with sufficient clearance to encase same with cement stabilized sand.

Access shafts are to be located at intermediate points where the liner is to be inserted into the existing system. Where possible, the shafts should coincide with a building service connection, an existing manhole or at critical deviations in line or grade. The distance between access shafts shall be not less than 300 feet or more than 900 feet, unless waived in writing.

B. Obstruction in Existing System: Obstructions such as protruding service connections, solids, tree roots, etc., that might prevent the entry or damage to the liner pipe shall be removed prior to commencing insertion of the liner.

C. Jointing of Liner Pipe: Jointing of liner pipe section shall be by the heat and butt fusion method and in strict conformance with the manufacturer's recommendations.

Sections of the plastic liner shall be joined and assembled in insertion lengths, above ground and on the site, in accordance with ASTM D-2657. Joints between liner sections shall be smooth on the inside and external projection beads shall not be greater than 0.10 inches.

D. Care of Raw Sewage: By-passing sewage around the section or sections of the system being lined shall be performed in a manner such that the dumping of raw sewage onto City streets or private property, into irrigation ditches, streams, or storm drains is not allowed.

The contractor shall submit in writing to the Project Engineer, prior to starting construction, a detailed outline of the method he proposes to use in handling raw sewage.

No service or trunk line is to be plugged and left for a period of time which would cause backup into buildings.

E. Liner Insertion: Insertion shall be made through an access shaft. The top of the existing main shall be exposed in the shaft to springline for its full length, prior to the cutting and removal of any portion of the existing pipe arch.

A cable from the drum of a power winch shall be strung through an existing manhole and line to the access shaft and then attached to a manufacturer furnished pulling head which has been securely anchored to the insertion liner. The power winch shall then be engaged and cause the cable to pull the liner section back through the existing line from the point of feed.

Precautions shall be taken during insertion so as not to over stress or damage the liner or cause the butt-fused joints to rupture.

As soon as the liner is in place, reached static equilibrium, and pressure tested, in the event there is reason to believe the liner was damaged, it shall be secured to the manhole walls by filling the annular space with a mechanical seal, chemical seal or combination of both. The method selected must be approved in writing by the City Engineer prior to starting construction.

F. Service Connections: Service reconnects shall be made as soon as the inserted liner reaches static equilibrium following the insertion of the liner.

A portion of the existing sewer around each service connection shall be removed to expose the new liner pipe and a prefabricated polyethylene saddle installed between the liner and the service. Care shall be exercised to assure the four (4) inch or six (6) inch stub-out attached to the saddle protrudes into the polyethylene liner a distance equal to the wall thickness of the liner pipe. The stub-out shall then be attached to the service lateral and the liner pipe with a CAM-TEX fitting and secured to both with stainless steel bands. The fitting, service line and liner pipe shall then be encased in twelve (12) inches of cement stabilized sand.

Cement stabilized sand shall be placed in a dry void around the connection in six (6) inch lifts. Each lift shall be hand tamped and care shall be exercised at all times to prevent damage or collapse to the liner, service connection or lateral.

G. Liner Connection in Trench: Liner pipe connections between manholes shall be made immediately following the reconnection of services to the line. The liner shall be trimmed in the trench so that the abutting ends are within one (1) inch of each other and then connected with a watertight stainless steel seal clamp.

The exposed liner and clamp shall then be encased in cement stabilized sand, placed in the same manner and limits as specified for service connections.

H. Existing Manholes Used for Access Shafts: Manholes used as access shafts shall be rebuilt to conform with these standard specifications. Material from an existing manhole which is salvaged in good condition may be reused.

I. Exfiltration: Exfiltration tests shall be performed prior to reconnecting services when difficulties are encountered during pulling operations, indicating obstruction in the line may have caused damage to the liner.

J. Resurfacing: Backfill and resurfacing at points of excavation shall be performed in accordance with Section 20 of these standard specifications.

K. Slip Liner Pipe - Polyethylene resin conforming to ASTM D-1248 and classified as Type III, Cl C, Category 5, Grade P-34. Pipe and fittings after extrusion and fabrication shall conform to ASTM D-3035 so that when measured in accordance with ASTM D-2122, it will meet the following dimensions:

Sewer ID Inch	Liner Min. OD Inch	Minimum Wall Thickness Inches SDR 32.5	SDR 21
6	5.375	0.166	0.256
8	7.125	0.220	0.340
10	8.625	0.266	0.411
12	10.750	0.331	0.512
15	13.380	0.416	0.634
18	16.000	0.493	0.762
21	18.700	0.576	0.891
24	22.047	0.679	1.050
27	24.803	0.764	1.182
30	27.953	0.861	1.332

Tolerances: OD + (.004 + .001 Diameter)
Wall Thickness + .12% Minus 0%

Pipe wall thickness conforming to SDR-21 shall be used when ground water elevation is found to be two (2) feet or more above the pipe centerline.

L. Liner Pipe Joints shall be joined by thermal butt-fusions conforming to ASTM D-2657 and provide a tensile strength at the fused joint equal to the parent material when tested in accordance with ASTM D-638.

M. Service connections to liner pipe shall be made using a prefabricated neoprene gasketed polyethylene CAM-TEX saddle with two (2) stainless steel bands and then encased with cement stabilized sand.

Heat fused saddles or shrink sleeves may be used, subject to request and approval by the City Engineer in writing, prior to starting construction.

N. Manhole sealant shall be a mechanical seal or chemical seal as recommended by the manufacturer.

O. Seal clamp for joining plastic liner pipe in access shafts shall be a circle stainless steel seal clamp, furnished by the manufacturer. Length of said clamp shall be one and one-fourth (1-1/4) times the OD of the liner pipe or fifteen (15) inches, whichever is the greater.

P. Cement Stabilized Sand shall consist of equal parts of Portland Cement and fine aggregate, as specified in Section 10 of the City of Rifle Standard Specifications, mixed dry and then hand tamped in place in six (6) inch lifts.

25.4.7. Joint Sealing and Testing - Joint sealing and testing of a pipe line shall only be performed after the line has been thoroughly cleaned. Work shall be performed in one continuous operation after initial insertion of the equipment into the line. The order of work to be performed shall be:

Progressive televising of line to locate each pipe joint or point of line failure.

Air testing of each joint or failure.

Chemically grout sealing of the joints or area that fail the air test.

Retest of the joint or failed area that was sealed, prior to proceeding further into the line.

A. Equipment: The basic equipment to be used shall consist of:

1. Television camera with viewing and recording attachments.

2. Combination air test and sealing packer heads, sized to the line being investigated.

3. Air pressure monitoring, metering and recording equipment accurate to one psi of differential pressure variation.

4. Cables, pumps, regulators, valves, hoses, gauges, approved chemical grout sealants, mixing chamber etc. necessary to control the volume and pressure during injection of the chemicals.

The contractor may be required by the field representative at any time during the project to satisfactorily demonstrate the effectiveness and accuracy of his equipment. This may require system purging, gauge calibration and "zeroing" system "proof" tests in pipe barrel sections and open sewer laterals to show that the

system is operating properly, and other demonstration required by the Project Engineer to ascertain the continued effectiveness of the testing and sealing equipment. At no time shall the packer-heads, when expanded, exert a pressure in excess of 25 psig against the barrel.

B. Air Test Procedure: Testing procedure shall consist of applying a precise pressure of no less than six (6) psig in excess of ground water pressure into the void area which has been formed to isolate the joint. When the pressure has been reached on the ground level meter for a sufficient time to stabilize the system, the application of pressure shall cease. The pressure recording meter shall be observed for a period of 30 seconds. Should the pressure in the void area drop one (1) psig or more, the joint will have failed the test and shall be sealed.

C. Joint Sealing Procedure: Joint sealing shall be accomplished by two separate pumping systems capable of supplying an uninterrupted continuous flow of approved chemical sealing materials at rates of between 1/4 and ten (10) gallons per minute at a minimum pressure of six (6) psig, for a continuous period of up to ten (10) minutes. Each pumping system shall include a tank for mixing additive solids and liquids which will form the final grout mixture. The system of pumps or pressure devices shall continuously maintain the exact manufacturer's ratio of the fluids contained in the mixing tanks. Jetting or driving pipes from the surface that could cause damage or cause undermining of the pipe lines shall not be allowed. The packer shall be positioned over the area of infiltration by means of a distance metering device and the closed circuit television camera in the line. This metering device shall be checked daily or at the field representative's request. The packer sleeve so positioned shall be expanded using precisely controlled pressures not to exceed 25 psig. The packer sleeve inflation system shall be constructed so that pressure in the elements can be increased or decreased at any time during a joint sealing operation. The pneumatically expanded sleeves or elements shall seal against the inside periphery of the pipe to form a void area at the joint or point of infiltration, which is now completely isolated from the remainder of the pipeline. The thoroughly mixed sealant material shall be pumped through the hose system into this isolated area under controlled pressures which are in excess of the ground water pressures.

To insure the complete mixing of the grouting materials, the sealing device shall contain a mixing chamber which accepts sealant materials, including initiator, activator and additives from the pumps and dual hose system, and combines them into a single catalyzed liquid which is then injected from a single orifice into the void area formed by the packer and the pipe wall.

The diameter of the orifice exiting from the mixing chamber shall be no greater than the largest hose of the dual hose system. The discharge orifice and dual hose system shall be connected to a mixing chamber which enables all components of the final grout to combine into a single mixing conduit.
The mixing chamber shall combine the proportioned grouting materials from the pumps and dual hose system and discharge them into the void area formed by the pipe wall and the packer as a completely catalyzed and homogeneous grout. To insure a predictable and consistent product at all times, sealing systems which do not include a mixing chamber and/or inject the grouting fluids unmixed from more than a single discharge orifice will not be allowed.

The pumps, meters and packer shall be integrated so that the proportions and quantities of materials and pressures for sealing can be regulated in accordance with the type and size of pipe, percentage of voids being filled, type of soil surrounding the pipe, and the rate of flow of sealing solution in relation to the back pressures.

D. Sealing Verification: Each sealed area or joint shall be air tested upon completion of the sealing operation. The sequence of retesting to be performed shall be:

1. Reduce pressure in the inflatable packer bladders such that complete 360 degree contact is no longer maintained with the pipe wall.

2. Pressurize the testing system and make certain that a free flow of testing medium is allowed to pass through the testing device.

3. Move the packer forward and backward or employ other (mechanical) scraping methods to dislodge loose grouting material from the joint.

4. Reposition the packer on the previously sealed joint and test as required by the sewer line joint testing procedure.

Joints that fail to meet this test criteria shall be resealed and retested until the test criteria can be met. All joints sealed shall be required to pass a minimum air pressure test, applied at the location or joint, equal to 0.43 psig per foot of depth of the sewer, or 6 psig, whichever is greater.

E. Residual Grout Material: Residual sealing material that protrudes into the pipe, adhere to roots or restrict the flow, shall be removed from the sealed area. The sealed areas or joints shall be left reasonably "flush" in dimension with the existing pipe surface. To insure that all grouting material has been removed from the interior of the pipe, all pipe sections which have been chemically grouted shall be cleaned with a high-velocity sewer cleaning jet.

F. Records: Complete records shall be kept on all sealing performed between manhole sections on City of Rifle forms or equal. These records shall document the location of the manhole section in which sealing was performed, station location of each joint, amount of material used to seal the area or joint, numbers of injections required to complete the seal, test verification results, inspector's name, date, and contractor's field representative.

25.4.8 Cured In Place Pipe (CIPP) - CIPP rehabilitation of pipelines and conduits shall be the installation of a resin-impregnated flexible tube which is inverted into the original conduit by use of a hydrostatic head. The resin is cured by circulating hot water or steam within the tube. When cured, the finished pipe (CIPP) will be continuous and tight fitting.

The work shall consist of cleaning, TV inspecting, and preparing the sewer, by-pass pumping as required, installing and curing the resin-impregnated tube, testing the installed CIPP, and reconnecting all live service lines.

The work shall consist of furnishing all labor, material, tools, equipment, and incidentals necessary to complete the project.

A. Methods: CIPP must be constructed with a process that has been approved by the City of Rifle Engineering Division. All approved methods must meet these specifications. Any proposed deviation from these specifications must be submitted in writing for approval. Any and all departures from these specifications must be pointed out and shown on the material submitted.

If an alternate process is approved, the contractor shall accept the responsibility for the performance of the installation and if it does not meet the intent or standard of the specified process/installer, the City reserves the right to have the installation removed and reinstalled, or corrected at the contractor's expense.

B. Referenced Standards: These specifications reference the latest edition and revision of the American Society for Testing and Materials (ASTM) Standard Specifications F1216-93, "Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube."

Where conflicts exist between the referenced standard and these specifications, these specifications shall govern.

C. Submittals: The following submittals are required prior to start of CIPP construction.

1. The contractor shall provide documentation of a minimum of three (3) year commercial use of CIPP in city sanitary sewer systems. A minimum of 15,000 LF of successful sanitary sewer rehabilitation in the United States must be documented to assure commercial viability of the process.

2. The contractor shall submit a tabulation of all projects completed in the past 5 years. This tabulation shall include the name of the city, sewer district or company, name of persons to contact, telephone number, address, year installed, size of pipe, length of line per size, total cost of project, and official acceptance date of the project. Failure to include this tabulation may constitute grounds for disqualification.

3. The contractor shall certify that the CIPP shall meet the chemical resistance requirements of ASTM F1216-93, appendix X2. Samples of testing shall be of tube and resin system similar to that proposed for actual construction. It is required that samples with and without plastic coating meet these chemical testing requirements.

4. The contractor shall submit test results from previous field installations made within the previous 12 months in the USA of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties listed in Table 1 of ASTM F1216-93 have been achieved in previous field applications.

5. The contractor shall submit design calculations per ASTM F1216-93, appendix X1 for each wall thickness proposed on the project.

D. CIPP Material:

1. Tube. The tube material shall meet the requirements of ASTM F1216-93, Section 5.1.

The tube shall have a uniform thickness that when compressed at installation pressures will equal the specified nominal tube thickness. The tube shall be fabricated to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion.

The outside layer of the tube (before inversion) shall be translucent plastic coated with a flexible material that clearly allows inspection of the resin impregnation (wet-out) procedure. The plastic coating shall not be subject to de-lamination after curing of the CIPP.

The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No materials shall be included in the tube that are subject to delamination of the cured CIPP.

The wall color of the interior pipe surface of the CIPP after installation shall be white or light brown so that a clear detail examination with closed circuit television inspection equipment may be made.

2. Resin. The resin system shall meet the requirements of ASTM F1216-93.

E. Structural Requirements: The CIPP shall be designed in accordance with ASTM F1216-93, Appendix XI. The design shall assume no bonding to the original pipe wall.

The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers cleanly with a pointed probe; nor shall separation of the layers occur during testing as required by this specification.

The CIPP shall conform to the minimum structural properties as listed in Table 1 of ASTM F1216-93.
The cured pipe material (CIPP) shall conform to the minimum structural standards, as listed below:

Flexural Stress (ASTM D-790 4500 psi

Modulus of Elasticity (ASTM D-790) 250,000 psi

The Proposer shall determine the actual lengths of the material needed by field verification.

F. Installation:

Except as otherwise indicated, comply with Section 7 of ASTM F1216-93.

The Project Engineer and his representative shall at all times have access to the work wherever it is in preparation or progress. The contractor shall provide proper facilities for such access and for inspection.

The contractor shall at all times maintain a clean and sanitary work site. Any spillage of wastewater on the ground surface shall be cleaned immediately and the area thoroughly washed down with fresh water.

G. Inspection of Pipelines: Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections by close circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation of the impregnated tube into the pipelines, and it shall be noted so that these conditions can be corrected. A video-tape and suitable log of the pre-insertion inspection shall be prepared by the contractor and submitted to the Owner. The contractor will be responsible for any by-pass pumping of sewer to perform this work.

H. Line Obstructions: It shall be the responsibility of the contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of the line. If inspection reveals an obstruction such as a protruding service connection, dropped joint, or a collapse that will prevent the inversion process, and it cannot be removed by conventional sewer cleaning equipment, then the contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the city representative prior to the commencement of the work and shall be paid for based on the bid price for this item.

I. Notification of Adjacent Property Owners and Managers: The contractor shall as a

minimum, be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be done, and when the sewer will be off-line and the following:

1. Written notice to be delivered to each home or business describing work, schedule, how it affects them and a local telephone number of the contractor they can call to discuss the project or problems.

2. Personal contact on the day of pre-installation inspection of the sewer. Each lateral shall be verified by having the homeowner run water down their drain. If the homeowner is unavailable, other arrangements shall be made to drain water through the lateral.

3. Personal contact and written notice shall be made 24-hours prior to beginning rehabilitation of the section of sewer to which they are connected.

4. Personal contact with any home or business which cannot be reconnected within the time stated in the written notice.

5. If so required by a served business or homeowner or at the discretion of the Project Engineer, portable toilets for use by the occupants will be furnished and serviced by the contractor.

6. All written or personal contacts shall be coordinated with the City's inspector.

J. Resin Impregnation: The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with an additional 5% to 10% allowance for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used to uniformly distribute the resin throughout the tube.

K. Temperature Gauges: During the curing process, gauges shall be placed to determine the temperature of the incoming and outgoing water from the heat source.

Another such gauge shall be placed inside the tube at the remote end to determine the temperature at that location during the cure cycle.

Installation and curing shall be accomplished by inversion utilizing water under hydrostatic pressure of a vertical standpipe.

L. Service Connections: After the CIPP has been installed, the contractor shall reopen/restore the existing active service connections and branch connections. It is the intent of these specifications that active service connections and branch connections be reopened without excavation, and in the case of non-man entry pipes, from the interior of the pipeline utilizing a remotely controlled curing device, monitored by a closed circuit television camera, that re-establishes them to not less than 95 percent capacity, while conforming to the shape of the existing opening.

The contractor shall certify he has a minimum of two complete working cutting devices, plus spare key components on the site before each inversion.

No service connection shall remain out of service for more than 24 hours at a time without the contractor, at his own cost, providing some means of temporary facilities or hotel accommodations for the residents.

No additional payment will be made for excavations for the purpose of reopening connections and the contractor will be responsible for all costs and liability

associated with such excavation and restoration work.

M. Workmanship: The finished pipe shall be continuous over the entire length of an inversion and shall be free of dry spots, lifts, and delaminations. If these conditions are present, the contractor shall remove and replace the CIPP in these areas at no cost to the Owner.

If the CIPP does not fit tightly against the original pipe at its termination points, the space between the pipes shall be sealed by filling with a resin mixture compatible with the CIPP.

Where the CIPP passes continuous through manholes during an inversion, the top of the CIPP shall be removed cleanly and flush with the manhole shelf.

N. Testing and Inspection:

1. CIPP Samples. CIPP samples shall be prepared and tested in accordance with ASTM F1216-93, Section 8.1 using both methods 8.1.1 and 8.1.2. The results shall be submitted to the Owner.

2. Leakage Testing. Leakage testing of the CIPP shall be accomplished during cure while under positive head. CIPP products in which the pipe wall is cured while not in direct contact with the pressurizing fluid (e.g., a removable bladder) must be tested by an alternative method of an acceptable low pressure air or water exfiltration test at 4 to 5 psi above the groundwater pressure.

3. Visual Inspection. Visual inspection of the CIPP shall be in accordance with ASTM F1216-93, Section 8.6. The contractor will provide the City's Wastewater Division with a color video-tape. The tape will include both the before and after conditions, the restored connections with addresses each connection serves, in audio, on the video-tape.

O. Patents: The contractor and the contractor's supplier shall warrant and save harmless the city against any and all claims and potential litigation involving patent infringement and copyright violations and any loss thereof.

P. Warranty: The contractor and the manufacturer shall warranty all materials and workmanship for a period of one year. The warranty shall cover, but will not be limited to the following:

1. Defects discovered in material used in the project

2. Failure of liner to remain formed to the previously existing sewer line.

3. Lateral connections that were active but not reconnected to the line at the time of construction and any damages resulting from the same.

25.4.9 Polyvinyl Chloride (PVC) Expanded-in-Place Pipe Liner (EIPP) - EIPP shall be the rehabilitation of sewer pipelines by the installation of a high strength polyvinyl chloride (PVC), folded or expanded-in-place pipe liner (EIPP) by pull through method into the original conduit. Reforming shall be accomplished by circulating hot water, steam, or other approved method under pressure to reform the PVC into a circular pipe. When reformed, the EIPP liner shall extend over the entire length of the pipe between access points in a continuous, tight-fitting, watertight pipe-within-a-pipe.

The work shall consist of host pipe cleaning, TV inspection, video logs, host pipe preparation,

sewage by-pass pumping as required, installation and testing of the EIPP, and reinstatement of all live service laterals, furnishing all labor, materials, tools, equipment, energy and other incidentals as necessary to complete the work.

A. Construction Methods: Contractors must construct the EIPP with a process that has been approved by the City of Rifle Engineering Division. All approved methods must meet these specifications. Any and all divergence from these specifications must be indicated on the submitted documentation.

If an alternative process is approved, the contractor shall accept full responsibility for the performance of the installation. If the process Installed does not meet the intent, standards or performance of the specified process or manufacturer, then the City of Rifle shall reserve the right to require that the contractor remove and reinstall, or correct the installation at the contractor's expense.

B. Referenced Standards: These EIPP specifications reference the following American Society for Testing and Materials (ASTM) standard specifications, which are made a part hereof by such reference and shall be the latest edition and revision thereof:

ASTM STANDARD	**DESCRIPTION**
D-638	Standard Test Method for Tensile Properties of Plastic
D-696	Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics
D-790	Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics
F-1504	Standard Specification for Folded Poly(Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation
D-1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

Where conflicts are noted between the referenced standard and these specifications, these specifications shall govern.

C. Submittals: The following submittals are required prior to start of construction:

1. The contractor shall provide documentation of a minimum of three (3) year commercial use of EIPP in municipal sanitary sewer systems. A minimum of 15,000 LF of successful sanitary sewer rehabilitation in the U.S. must be documented to assure commercial viability of the process.

2. The contractor shall submit a tabulation of all related projects completed in the last five (5) years. The tabulation shall include the name, address and telephone number of the city, sewer district or company, name of contact person(s), year completed, size and length of pipe, total project cost, and official acceptance date of the project. Failure to include this tabulation may constitute grounds for disqualification.

3. The contractor shall certify, in writing, that the EIPP meets all requirements of ASTM test procedures D-638, D-696 and D-790, ASTM materials specification D-1784, and ASTM standard specification F-1504 for folded poly (vinyl chloride) (PVC) pipe for existing sewer and conduit rehabilitation. Samples of material used in testing shall be of an EIPP system similar to that proposed for actual construction on this project.

4. The contractor shall submit test results from previous field installations completed in the U.S. within the past twelve (12) months of the same type of EIPP system as that proposed for actual construction on this project.

D. Materials:

1. PVC Pipe: The EIPP shall be made of virgin PVC material meeting the general requirements defined by ASTM F-1504-97, Section 6.1, and as further defined by ASTM D-1784.

The EIPP manufacturer shall provide certification that quality control for each coil delivered for installation has been performed on the specific product. Testing shall have been performed in accordance with ASTM D-638, D-696 and D-790.

The minimum PVC pipe thickness shall be DR35 for each specific pipe size, as defined by ASTM F-1504, table 1 and table 5.

The PVC material shall be fabricated to a size that when installed will neatly and tightly fit the internal circumference and length of the existing conduit. Allowance for longitudinal stretch during insertion shall be allowed. The minimum length shall span the distance from one access opening to the access opening of the respective pipe segment to be rehabilitated. The contractor shall verify field lengths prior to start of construction.

The PVC compound shall be chemically resistant to domestic effluents. For sewage other than domestic effluents, an analysis shall be performed to ascertain feasibility of the process.

The contractor shall provide, prior to use of any materials, satisfactory written certification of compliance with the manufacturer's standards and specifications for all materials used in the EIPP system.

2. Structural Requirements: The EIPP shall conform to the minimum structural properties listed in ASTM F-1504-97, Section 7, and ASTM F-1504-97, Tables 2, 3 and 4.

EIPP shall conform to the minimum structural standards as listed below:

Physical Characteristics	Test Procedure	Value
Wall Thickness	ASTM D-2122	DR35
Flexural Modulus	ASTM D-790	280,000 psi
Impact Strength	ASTM D-2444	210 ft-lbs
Pipe Flattening	ASTM D-3034	60% deflection
Pipe Stiffness	ASTM D-2412	31-41 psi (1)
Coefficient of Thermal Expansion	ASTM D-696	.00003 in./in. ☐F

(1) at 5% deflection without cracking, breaking, or splitting.

The contractor shall submit EIPP wall thickness calculations to the Project Engineer for approval prior to installation. The EIPP shall have a minimum wall thickness of DR 35.

E. Property Owner/Manager Notification: The contractor shall at a minimum, be responsible for contacting each home, apartment complex or business connected to the sanitary sewer, informing them of the nature of the work, and at what times the sewer operation will be interrupted. The following notification sequence shall be strictly adhered to:

1. Written notice shall be delivered to each home or business describing the work procedure, schedule, the affect to each homeowner, apartment manager or business owner. The contractor's business phone number will also be provided so that he may be contacted to discuss the project and any associated problems. The Project Engineer and his representative will provide such written notice in the form of a door hanger or letter to the contractor for distribution by the contractor.

2. Personal contact shall be made on the day of pre-installation inspection of the sewer main. Verification of each active service lateral shall be made by asking the homeowner or business owner to run water down their drain. Should the homeowner be unavailable, other arrangements shall be made to drain water through the service lateral.

3. Personal contact and written notice with all affected property owners shall be made at least 24 hours prior to beginning rehabilitation on the sewer segment to which they are connected.

4. Personal contact shall be made with any homeowner, apartment manager or business owner who cannot be reconnected within the time stated in the written notice.

5. If so requested by a homeowner, apartment manager or business owner, or at the discretion of the Project Engineer, portable toilets will be furnished and serviced by the contractor for use by occupants at the sole expense of the contractor.

6. All written or personal contact with property owners shall be coordinated with the City's engineering inspector.

F. Cleaning of Sewer Lines: The Contractor shall be required to remove all internal debris from the sewer line by use of water jet equipment prior to inserting the liner. The cleaning operation shall remove any and all debris so that each joint of pipe can be thoroughly inspected and successfully rehabilitated.

All sludge, dirt, sand, rocks, grease and other solid or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from one manhole to another will not be permitted.

All such debris resulting from the cleaning operations shall be removed from the site and disposed of in the proper manner. The Contractor shall bear all costs associated with testing of debris and proper dumping. Dumping of the debris shall be in accordance with all local, state, and federal regulations. If hazardous materials are encountered during testing, the City and Contractor will negotiate the costs of handling and disposal of these materials.

All debris shall be removed from the downstream manhole and the site no less often than at the end of each workday. The Contractor shall leave no debris unattended at the site. Under no circumstances will the Contractor be allowed to accumulate debris beyond the stated time. In the event the Contractor has not removed the

debris generated by the cleaning operation, the Contractor will not be allowed to proceed with the work until the debris is properly removed.

During all sewer-cleaning operations, satisfactory precautions shall be taken to

protect the sewer lines from damage that might occur by improper use of cleaning equipment. Precautions shall be taken to ensure that the cleaning operation will not cause any damage or flooding to public or private property being served by the sewer line segment being cleaned. The Contractor shall bear all costs associated with any flooding or damage to public and/or private basements or structures.

G. Pre-Insertion TV Video Inspection: Experienced personnel shall perform television inspection of the pipelines. Camera operators shall be trained in locating breaks, obstacles and service connections by closed circuit color television. A Pre-insertion video inspection shall be performed on all sewer lines to be rehabilitated to locate active services for reinstatement, as well as location and notation of any conditions that could prevent successful insertion of the EIPP for the purpose of correcting these conditions.

A color video-tape and suitable counter log of the pre-insertion inspection shall be prepared by the contractor and submitted to the City. The contractor will be responsible for any by-pass sewage pumping required to perform this work.

H. Line Obstructions: It shall be the responsibility of the contractor to clear the sewer line of obstructions such as solids and roots that will prevent the insertion of the EIPP liner. If the pre-insertion inspection reveals an obstruction such as a protruding service connection, dropped joint, or a separated or collapsed pipe section that will prevent the insertion process, and it cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a protruding tap repair or a trenchless point repair as required to remove the obstruction. Such repair shall be approved in writing by the Project Engineer or his representative prior to beginning the EIPP work and shall be paid for at the unit bid price for this item.

I. Liner Installation: Installation shall be in strict accordance with manufacturers instructions and conform to the requirements of ASTM F-1504 Standard Specification for Folded Poly (Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation.

Each PVC liner shall be subject to inspection by the Project Engineer and/or his representative immediately before installation, and all defective liners will be rejected.

The liner shall be inserted into the existing pipe through the access opening without any modification to the access points, and then pulled or winched to the next scheduled access opening. There shall be no roadway excavation for sending or receiving pits, unless the pipe length between access points exceeds the manufacturers maximum coiling length specifications.

1. Preheating: The contractor shall provide a suitable heat source to thoroughly heat the entire pipe segment to be inserted and such heat source shall be carefully monitored and regulated as recommended by the liner manufacturer and in accordance with ASTM F-1504. The entire pipe segment shall be heated both internally and externally prior to installation.

2. Pipe Insertion: Following heating of the EIPP both internally and externally, the contractor shall pull the liner into the access point and pipe segment using a winch as recommended by the manufacturer. The winch shall have sufficient capacity to pull the PVC liner through the host pipe without exceeding values as recommended by the manufacturer.

3. Expanding In Place: After insertion of the PVC liner is completed, the contractor shall supply a suitable heat source capable of delivering steam

through the pipe segment to uniformly raise the temperature to effect the forming of the liner. The steam for processing shall be monitored and regulated as recommended by the liner manufacturer.

The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing heat supply. Another such gauge

shall be placed at the remote access opening to determine the temperature at that location during the cure period.

Before the forming process begins, the minimum pressure required to hold the liner tight against the host pipe and the maximum allowable pressure so as not to damage the liner shall be provided by the liner manufacturer and submitted to the Project Engineer prior to any forming process. Once the cure has begun and dimpling for service taps is completed, the pressure shall be maintained between the minimum and maximum pressures until the cure has been completed. Should the pressure deviate from within the range of minimum and maximum pressures, as determined by the liner manufacturer, the installed liner shall be rejected and the contractor will remove and dispose of the liner at no cost to the City. The contractor will be responsible for its removal and disposal and replacement with new liner at no additional cost to the City. A complete log of the pressures shall be maintained on site and shall be submitted to the Project Engineer after each installation is completed.

The new EIPP shall be expanded until held against the existing host pipe wall. Following full expansion of the PVC liner, the liner shall held in that position for the required time as recommended by the manufacturer, while the steam pressure is replaced with compressed air pressure and cooled to a temperature of no greater than 100 degrees Fahrenheit.

If during this process the EIPP fails to form, the contractor shall remove the failed PVC liner and replace it with a new PVC liner. This replacement work shall be done at no additional cost to the City.

Following forming and cooling of the EIPP, each end of the PVC liner shall be cut away from the pipe segment access points, curled and sealed at those access points.

J. Sealing at Manholes: If the liner fails to make a tight seal against the original pipe segment at its access point(s), the space between the pipes shall be sealed by filling with a resin mixture compatible with the EIPP and as recommended by the manufacturer.

K. Workmanship: The finished EIPP shall be continuous over the entire segment between two access points and be free as commercially practical from visual defects such as foreign inclusions and pin holes.

Any defects which will affect the integrity or strength of the EIPP shall be repaired at the contractor's expense. Any ribs in the cross-sectional area of the pipe shall be removed or the PVC liner removed in its entirety unless allowance is made by the Project Engineer for offset joints or out of round pipe.

L. Service Connections: After completing the EIPP, the Contractor shall restore the existing <u>active</u> service connections and branch connections. It is the intent of these specifications that active service and branch connections be reopened without excavation, and in the case of non-man entry pipes, from the interior of the pipeline

utilizing a remotely controlled cutting device, monitored by a closed circuit television camera, that re-establishes them to not less than 95% capacity, while conforming to the shape of the existing opening.

The Contractor shall verify he has a minimum of two (2) complete cutting devices in good working order before each insertion.

No service connection shall remain out of service for more than 24 hours at a time unless the Contractor, at his expense, has provided temporary facilities or hotel accommodations for the affected residents.

No additional payment will be made for excavations for the purpose of re-opening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

M. Testing and Inspection: PVC liner samples shall be prepared and tested in accordance with ASTM F-1504, Section 11, ASTM D-638, ASTM D-696 and ASTM D-790. The tests will be performed by a Certified Independent Laboratory and approved by the City. Tests results shall be submitted to the Project Engineer at no additional cost to the city.

A post-construction color video tape will be made of all new EIPP to confirm the condition of the new PVC liner and the contractor shall provide the city s Wastewater Division with video tapes of each installation. The tapes will include both before and after conditions, as well as the counter and address locations of all restored service connections. All videos must be of adequate quality and coverage to inspect the condition of the entire new line. If in the opinion of the city s representative the video quality is deemed too poor to inspect the EIPP, the PVC liner will be video inspected again at no additional cost to the City.

N. Exfiltration Tests: In the absence of ground water, and if so ordered by the Project Engineer, an exfiltration test shall be performed. Leakage testing of the liner shall be accomplished while under a positive head and before any service connections are reinstated. This test is limited to pipe diameters of 36 inches or less. The allowable water exfiltration for any length of pipe between termination points shall not exceed 50 gallons per inch of internal pipe diameter per mile per day, providing all trapped air has been purged from the line. During exfiltration testing, the maximum internal pipe pressure at the lowest point shall not exceed ten (10) feet of water or 4.3 psi and the water level inside the inversion standpipe shall be 2 feet higher than the top of the pipe being tested or 2 feet higher than the groundwater level, whichever is greater. The leakage quantity shall be gauged by the water level in the temporary standpipe placed in the upstream plug. The test shall be conducted for one (1) hour.

O. Patents: The contractor and the contractor's supplier shall warrant and save harmless the City against any and all claims and potential litigation involving patent infringement and copyright violations and any loss thereof.

P. Warranty: The contractor and the manufacturer shall warranty all materials and workmanship for a period of one-year. The warranty shall cover, but will not be limited to the following:

1. Defects discovered in material used in the project.

2. Failure of liner to remain formed to the previously existing sewer line.

3. Lateral connections that were active but not reconnected to the line at the time of construction and any damages resulting from the same.

25.4.10 Pipe Bursting Technique and Materials - This specification shall cover the replacement of existing sanitary sewers using the pipe bursting technique. Pipe bursting is a system by which the pneumatic burster unit splits the existing pipe while simultaneously installing a new Polyethylene Pipe of the same size or larger size pipe where the old pipe existed, then reconnecting existing sewer service house connections, television inspection of the Polyethylene Pipe and complete installation in accordance with the contract documents. Only Pneumatically operated equipment with either front or rear expanders for the proper connection to the Polyethylene Pipe will be allowed for use. The pneumatic tool must be used in conjunction with a constant tension hydraulic twin Capstan Winch of either 20, 10, or 5 tons, the size of the winch depends on the diameter of the pipe to be replaced. In no case is the constant tension on the winch to exceed 20 tons.

A. Qualifications:

1. The Contractor shall be certified by the particular Pipe Bursting System Manufacturer that such a company is a fully trained user of the pipe bursting system. Contractor must use a Pipe Bursting System approved by the City of Rifle Engineering Division.

2. Polyethylene pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the polyethylene pipe. Training shall be performed by qualified representative.

3. The Contractor shall hold the City of Rifle whole harmless in any legal action resulting from patent infringements. Pipe bursting licenses, royalties, etc., are the responsibility of the contractor.

B. Submittals:

1. Shop drawings, catalog data, and manufacturer's technical data showing complete information on material composition, physical properties, and dimensions of new pipe and fittings. Include manufacturer's recommendations for handling, storage, and repair of pipe and fittings damaged.

2. Method of construction and restoration of existing sewer service connections. This shall include detail drawings and written descriptions of the entire construction procedure to install pipe, bypass sewage flow and reconnection of sewer service connections.

3. Certification that contractor is licensed in the pipe bursting technique

C. Materials:

1. High Density Polyethylene Plastic Pipe: HDPE shall be high density polyethylene pipe and meet the applicable requirements of ASTM F-714 Polyethylene (PE) Plastic Pipe (SDR-PR) based on outside diameter, ASTM D1248, ASTM D3550. **SDR 17 pipe shall be used.** Sizes of the insertions to be used shall be such to renew the sewer to greater than present flow capacity. All pipe shall be made of virgin material. No rework except that obtained from the manufacturer's own production of the same formulation shall be used. Material color shall be white, black or whatever is specified with interior of pipe having a light reflective color to allow easier viewing for

television inspection. Tests for compliance with this specification shall be made as specified herein and in accordance with the applicable ASTM Specification. A certificate with this specification shall be furnished, upon request, by the manufacturer for all material furnished under this specification. Polyethylene plastic pipe and fittings may be rejected to meet any requirements of this specification.

2. Saddles: Reconnection of service laterals to installed HDPE pipe shall be accomplished by various methods that are compatible with the new sewer pipe. If a saddle is used, the saddle, once secured in place, drill a hole full inside diameter of saddle outlet in pipe liner. Mechanical saddles shall be made of polyethylene pipe compound that meets the requirements of ASTM D1248, Class C, have stainless steel straps and fasteners, neoprene gasket and backup plate. Mechanical saddles shall be Strap-On-Saddle type as manufactured by Driscopipe or approved equal. Inserta-Tee Connection by Fowler Manufacturing is also allowed.

3. Flexible Couplings: Connections to existing service laterals shall be made using flexible couplings. All flexible couplings shall conform to ASTM C-245 and shall be as manufactured by Fernco Joint Sealer Co., DFW Plastics, Inc., or approved equal.

4. Joints: Sections of HDPE pipe shall be assembled and joined on the job site. Jointing shall be accomplished by the heating and butt-fusion method in strict conformance with the manufacturer's printed instructions. It is the sole responsibility of the contractor to provide an acceptable water tight butt-fusion joint. Joint strength shall be equal to or greater than the pipe and shall indicate a ductile rather than brittle fracture when tested. If sectional HDPE pipe is used, it shall be joined in accordance with the manufacturer's recommendation for a leakproof, stab joint method using EPDM 0-ring synthetic elastomer gaskets.

D. Equipment:

1. The pipe bursting tool shall be designed and manufactured to force its way through existing pipe materials by fragmenting the pipe and compressing the old pipe sections into the surrounding soil as it progresses. The bursting unit shall be pneumatic and shall generate sufficient force to burst and compact the existing pipe line. See manufacturer's specifications for what size tool should be used in what diameter of pipe, as well as parameters of what size tool for percentage of upsize allowed.

2. The pipe bursting tool shall be pulled through the sewer by a winch located at the upstream manhole. The bursting unit shall pull the polyethylene pipe with it as it moves forward. The bursting head shall incorporate a shield/expander to prevent collapse of the hole ahead of the PE pipe insertion. The pipe bursting unit shall be remotely controlled.

3. The pipe bursting tool shall be pneumatic. The bursting action of the tool shall increase the external dimensions sufficiently, causing breakage of the pipe at the same time expanding the surrounding ground. This action shall not only break the pipe but also create the void into which the burster can be winched and enables forward progress to be made. At the same time the polyethylene pipe, directly attached to the sleeve on the rear of the burster, shall also move forward.

The burster shall have its own forward momentum while being assisted by

winching. A hydraulic winch shall give the burster friction by which it can be moved forward. To form a complete operating system, the burster must be matched to a constant tension hydraulic winching system.

4. Winch unit - A winch unit shall be attached to the front of the bursting unit. The winch shall provide a constant tension to the burster in order that it may operate in an efficient manner.

   The winch shall ensure directional stability in keeping the unit on line.

   The winch shall be hydraulically operated providing a constant tension throughout the operation. The winch shall be of the constant tension type and shall be fitted with a direct reading load gauge to measure the winching load.

   The winch must automatically maintain a constant tension at a set tonnage reading.

   The constant tension winch shall supply sufficient cable on one continuous length so that the pull may be continuous between approved winching points.

   The winch, cable and cable drum must be provided with safety cage and supports so that it may be operated safely without injury to persons or property. The contractor shall provide a system of guide pulleys and bracing at each manhole to minimize cable contact with the existing sewer between manholes.

   The supports to the trench shoring in the insertion pit shall remain completely separate from the winch boom support system and shall be so designed that neither the pipe nor the winch cable shall be in contact with them.

E. Construction Method:

1. Insertion or launching pits shall only be allowed at locations of existing or proposed manholes, unless otherwise approved by the Project Engineer.

2. Equipment used to perform the work shall be located away from buildings so as not to create excessive noise impact. Provide a silent engine compartment with the winch to reduce machine noise.

3. The contractor shall install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances will the pipe be stressed beyond its elastic limit. Winch line is to be centered in pipe to be burst with adjustable boom.

4. The installed pipe shall be allowed the manufacturer's recommended amount of time, but not less than four (4) hours, for cooling and relaxation due to tensile stressing prior to any reconnection of service lines, sealing of the annulus or backfilling of the insertion pit.

5. Sufficient excess length of new pipe, but not less than four (4) inches, shall be allowed to protrude into the manhole to provide for occurrence. Restraint of pipe ends shall be achieved by means of. The couplings shall be slipped

over pipe ends against manhole wall and fused in place. Installation of couplings shall be done in accordance with the manufacturers recommended procedures.

6. Following the relaxation period, the annular space may be sealed. Sealing shall be made with material approved by the Project Engineer and/or his representative and shall extend a minimum of eight (8) inches into the manhole wall in such a manner as to form a smooth, uniform, watertight joint.

25.4.11. Manhole Rehabilitation Protective Coatings - Interior manhole barrel and eccentric cone surfaces as well as benches and inverts of all manholes to be rehabilitated shall be treated with two (2) ea. 10 mil thick coatings of Aquata Poxy; an approved moisture insensitive, solventless, amine cured, two component, 100% solids epoxy paint or gel as manufactured by American Chemical Corp., Menlo Park, California. Also allowed is a minimum ½" thickness spray applied coating of Sewpercoat Calcium Aluminate Cement as manufactured by LaFarge Calcium Aluminates, Chesapeake, Virginia. Coatings shall be applied by coating manufacturer's certified applicators only.

A. Surface Preparation:

1. Existing interior manhole surface to be restored shall be high pressure water blasted with a minimum 2,000 psi water pressure or sandblasted to remove existing coatings and all foreign matter before application of new coating.

2. Any new concrete interior cone and barrel surfaces shall be allowed to cure, after casting, for a minimum of ten (10) days. After curing, the surfaces to be treated shall be sweep sand blasted or high pressure water blasted to remove latents or curing agents thereon.

B. Repair of Concrete Surfaces: Following surface blasting the concrete surfaces shall be inspected for deterioration, i.e. exposed aggregated, spalling, holes, corroded, exposed steel, etc.

If rehabilitated with Aquata Poxy, exposed aggregate surfaces shall be coated with Aquata Poxy gel, applied with a trowel or squeegee so that the aggregate is completely covered. Spalled areas and holes one or more inches deep shall be filled with a high strength cementitious grout. In each instance the gel or grout shall provide a finish surface level with the surrounding area prior to coating.
Exposed steel areas, after cleaning by blasting, shall be treated with two coats of an EPA approved Dyna Bond System 1. Each coat shall be applied at 10 mils wet film thickness each. A minimum of 30 minutes shall separate the application of the first and second coat. A minimum of 36 hours cure time shall be provided between the application of the final coat of Dyna Bond System 1 and the application of the protective coating hereinafter detailed.

C. Protective Coating: The entire interior surface shall receive a minimum of two (2) coats of aquata poxy paint. The wet film thickness for each coat shall be no more than 12 mils with a total dry film thickness for the complete coating system of 20 mils minimum. Spray applied Sewpercoat Calcium Aluminate Cement shall be minimum ½" thickness.

D. Coating Application: Mixing and application of the protective coatings shall be in strict conformance with the direction of the coating manufacturer. Application shall

be by stiff brush, short nap roller (Aquata Poxy) or manufacturer approved spray system (Aquata Poxy or Sewpercoat).

E. Sealing of Penetration Through Coatings: Penetration through protective coatings at joints, fasteners, steps or other items installed after the coating system is complete in place shall be thoroughly sealed with Aquata Poxy gel or Sewpercoat.

F. Repair of Holidays: Holidays or pinholes found in the Aquata Poxy protective coating shall be repaired by applying additional Aquata Poxy Paint. Surfaces to be repaired shall be roughened with coarse sandpaper in the vicinity of the repair if the repair is to be undertaken after five (5) days have elapsed from application of the final coat of protective coating material.

25.5. BORING, JACKING AND THREADING OF CARRIER PIPE

25.5.1. Pit Excavation - Pits shall be excavated such that timber blocking can be installed to give an unyielding backing for the hydraulic boring machine or jacks and to prevent sloughing of the header face. Subgrade on which rails or guides are to be set shall be stabilized with washed rock where soft and springy ground is encountered.

Excavation and casing installation shall be performed simultaneously. At no time shall advancing edge of the casing trail the excavation by more than twelve (12) inches.

25.5.2. Casing Pipe Joints - Sections of the steel casing shall be trimmed, beveled and aligned in the pit so when welded together the thrust of the boring machine will be uniformly transmitted through the casing in a horizontal plane. Welds shall be made to provide solid firm watertight connection without the use of butt straps.

Jacked concrete pipe with R-2 joints shall be made watertight by the use of O-ring rubber gaskets. 1/4" to 1/2" plywood shims may be used in the joint to provide a uniform bearing between pipe sections.

25.5.3. Casing Pipe Sections Alignment - The casing pipe shall be installed by boring or jacking upgrade from the outlet end. When the carrier pipe to be installed is for gravity flow, the horizontal and vertical alignments of the casing pipe, when in place, shall not vary from those called for on the plans by more than the following:

ALIGNMENT	ENTRANCE	MIDPOINT	OUTLET
Horizontal	0.02'	0.35'	0.70'
Vertical	0.02'	+ 0.10' - 0.05'	+ 0.20' - 0.10'

25.5.4. Grouting Casing Pipe - When excavation exceeds the advancing edge of the casing pipe such that voids are created along or above the casing, external pressure grouting of the casing pipe will be required.

Grouting shall be accomplished by pumping at between five (5) and ten (10) lbs. per square inch pressure, equal parts of Portland Cement and mortar sand mixed with sufficient water to provide slump of less than two (2) inches through grout holes in the casing until all voids are filled. Grout holes (1"-2" in diameter) shall be provided or drilled in the casing on four (4) foot centers along the pipe arch and on eight (8) foot centers along each springline. As grouting advances each of the completed grout holes shall be plugged to a watertight condition.

25.5.5. Threading Carrier Pipe - Carrier pipe interior and the access pits at each end shall be kept

free of water at all times during the insertion and backfilling of the carrier pipe. Where the maximum elevation of the ground water table is at or above the casing pipe invert elevation, the carrier pipe shall have two (2) pair each of chocks and skids, steel banded on the pipe barrel section, at approximately six (6) foot centers or centering and restraining casing spacers and insulators installed every 10 feet on the carrier pipe prior to insertion with an additional spacer placed within 6" of each end of casing pipe. Chocks atop the carrier pipe or centering restraining casing spacers and insulators will not be required when the maximum ground water table elevation is below the casing pipe invert. Sand filler, however, is required if chocks or centering restraining casing spacers and insulators are not installed on the carrier pipe regardless of groundwater level. Sand filler shall not be required when chocks and skids are placed on the carrier pipe or when prefabricated, centering, restraining casing spacers and insulators are used.

Plastic or redwood skids and chocks shall be no less than three (3) inches in width by three and one-half (3 1/2) feet in length and varied in height such that during insertion in the casing the:

A. Bells of the pipe will clear the casing pipe invert a minimum of one (1) inch and;

B. The chocks when mounted seven (7) to ten (10) degrees each side of vertical centerline, atop the pipe barrel and in conjunction with the skids, will clear the casing pipe wall by no more than one-half (1/2) inch.

Once the skids and chocks or casing spacers and insulators are properly attached to the carrier pipe barrel, the section is ready for insertion. Subsequent sections shall be properly lubricated, gasketed and joined to each other as they are set. The assembled line shall then be progressively threaded through the casing by means of applying force at the exposed end of the carrier pipe. Care shall be exercised to provide watertight joints and to protect the ends of the pipe as they are pulled or pushed, by uniformly transferring said force through the carrier pipe axially along its horizontal plane.
On gravity lines it may be necessary to vary the location and thickness of the skids and chocks or casing spacers and insulators to obtain a uniform invert grade throughout the carrier pipe. This is especially critical when the alignment and grade for the casing pipe approaches the minimum allowable limits specified.

25.5.6. Backfill of Carrier Pipe - Immediately after threading and aligning the pipe through the casing, the void between the carrier and casing pipe shall be blown full with clean dry sand, or squeegee unless skids and chocks have been used or centering and restraining casing spacers and insulators are used on the carrier pipe. Dry pea-gravel may be used to fill the void when the diameter of the carrier pipe is equal or greater than thirty (30) inches in diameter. Filler material shall be blown in, under pressure, from each end of the casing pipe through one (1) inch to three (3) inch diameter pipe or hose with nozzle, making sure the center portion of the casing is filled first. Once the center portion is filled, the nozzle shall be caused to gradually recede, while continuing to blow filler material and filling the entire void throughout the entire length of the casing. Once the annular void has been filled the ends of the casing pipe shall be sealed shut with pull on rubber end seals, unless otherwise called for on the plans.

Unless otherwise specified the annular space will be considered full when the level of filler material is within two (2) inches of the crown of the casing pipe. When concrete pipe is installed as the carrier pipe the annular space will be considered full when the level of filler material is no less than two (2) inches above the carrier pipe springline.

25.6. TESTING OF SEWER LINES

Tests for watertightness shall be conducted by the contractor, in the presence and under the

direction of a city representative, on all new sewer lines prior to final acceptance.

Should the rate of leakage be found to exceed the prescribed amount, the contractor shall stop all construction, locate the leak, make appropriate repairs and then continue to test the conduit until the leakage is within the allowable limits.

25.6.1. Low Pressure Air Test - Low pressure air tests in accordance with UNI B-6-98 shall be used for testing of sewer lines.

A. Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. Plug all pipe outlets to resist the test pressure. For safety reasons it is extremely important that the various plugs be installed and braced such a way as to prevent blowouts. As a safety precaution, pressurizing equipment may include a regulator or relief valve set at ten (10) psi maximum to avoid over pressurizing and damaging an otherwise acceptable line.

B. Determine the test duration for the section under test by computation from the applicable formulas shown in UNI-B-6-98 or from Table 25-III. The pressure-holding time is based on an average holding pressure of three (3) psi gauge or a drop from three and one half (3.5) psi to two and one half (2.5) psi gauge. Add air until the internal air pressure of the sewer line is raised to approximately four (4.0) psi gauge. After an internal pressure of approximately four (4.0) psi is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test sections stabilizes.

C. When the pressure has stabilized and is at or above the starting pressure of three and one half (3.5) psig, commence the test. Before starting the test, the pressure may be allowed to drop to three and one half (3.5) psig. Record the drop in pressure for the test period. If the pressure has dropped more than two (2.0) psig during the test period, the line is presumed to have failed. The test may be discontinued when the pressure test time has been completed even though the one (1.0) psig drop has not occurred.

D. A timed pressure drop of 0.5 psig may be used in lieu of the 1.0 psig timed pressure drop. If a 0.5 psig timed pressure drop is used, the appropriate required test times shall be exactly half as long as the required test times for a 1.0 psig timed pressure drop.

25.6.2. Vacuum Testing Manholes – The City reserves the right to require a vacuum test on all new manholes installed, particularly in areas where the groundwater level is high or where there are questions regarding the integrity of the new barrel sections. All manholes shall be vacuum tested in accordance with ASTM C1244. All lift holes and any pipes entering the manhole shall be plugged prior to a vacuum being drawn and the drop over a specified time determined. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of mercury. The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values indicated below.

Depth	Manhole Diameter, in.								
(ft)	30	33	36	42	48	54	60	68	72
	Time, sec								
<= 8	11	12	14	17	20	23	28	29	33
10	14	15	18	21	25	29	33	38	41
12	17	18	21	25	30	35	39	43	49

14	20	21	25	30	35	41	46	51	57
16	22	24	39	34	40	46	52	58	57
18	25	27	32	38	45	52	59	65	73
20	28	30	35	42	50	63	65	72	81
22	31	33	39	46	55	64	72	79	89
24	33	38	42	51	59	64	78	87	97
26	36	38	46	55	64	75	85	94	105
28	39	42	49	59	69	81	91	101	113
30	42	45	53	63	74	87	98	108	121

25.6.3. Television Inspection - All newly installed, repaired or rehabilitated sewer mains or trunk lines will be inspected by the City's Wastewater Division Television Inspection Crew prior to the start of the warranty period. Any defects found during television inspection shall be repaired prior to connecting any services to the main. Newly installed sewer mains in areas to be paved will be television inspected only after the first lift of paving has been installed. All new sewer mains must be jet cleaned after the first lift of paving has been installed and prior to the television inspection.

25.7. HOUSEKEEPING, RESTORATION AND CLEANUP

See Section 5 of these standard specifications.

25.8. WARRANTY AND ACCEPTANCE

During the last three (3) months of the one (1) year guarantee and warranty period, the City will re-inspect the project and advise the contractor of any deficiencies and irregularities, if any, that may have developed which the contractor shall correct. A letter of final acceptance will be issued upon the contractor's completion of the remedial measures.

TABLE 25-III
AIR TEST - BASED ON FORMULAS FROM UNI-B-6-98

SPECIFICATION TIME (MIN:SEC) REQUIRED FOR PRESSURE DROP FROM 3 1/2 TO 2 1/2 PSIG
WHEN TESTING ONE PIPE DIAMETER ONLY

PIPE DIAMETER, INCHES

Length Ft.	4	6	8	10	12	15	18	21	24	27	30	33	36	39	42
25	3:47	5:40	7:33	9:27	11:20	14:10	17:00	19:50	22:40	25:30	28:20	31:10	34:00	36:50	39:40
50	3:47	5:40	7:33	9:27	11:20	14:10	17:00	19:50	22:40	25:30	28:20	31:10	34:00	36:50	39:40
75	3:47	5:40	7:33	9:27	11:20	14:10	17:00	19:50	22:40	25:30	28:20	32:19	38:28	45:09	52:21
100	3:47	5:40	7:33	9:27	11:20	14:10	17:00	19:50	22:48	28:51	35:37	43:06	51:17	60:11	69:48
125	3:47	5:40	7:33	9:27	11:20	14:10	17:00	21:49	28:30	36:04	44:31	53:52	64:06	75:14	87:15
150	3:47	5:40	7:33	9:27	11:20	14:10	19:14	26:11	34:11	43:16	53:25	64:38	76:56	90:17	104:42
175	3:47	5:40	7:33	9:27	11:20	15:35	22:26	30:32	39:53	50:29	62:20	75:25	89:45	105:20	122:10
200	3:47	5:40	7:33	9:27	11:24	17:48	25:39	34:54	45:35	57:42	71:14	86:11	102:34	120:23	139:37
225	3:47	5:40	7:33	9:27	12:49	20:02	28:51	39:16	51:17	64:55	80:08	96:58	115:24	135:26	157:04
250	3:47	5:40	7:33	9:54	14:15	22:16	32:03	43:38	56:59	72:07	89:02	107:44	128:13	150:28	174:31
275	3:47	5:40	7:33	10:53	15:40	24:29	35:16	47:59	62:41	79:20	97:56	118:31	141:02	165:31	191:58
300	3:47	5:40	7:36	11:52	17:60	26:43	38:28	52:21	68:23	86:33	106:51	129:17	153:51	180:34	209:25
350	3:47	5:40	8:52	13:51	19:57	31:10	44:52	61:05	79:47	100:58	124:39	150:50	179:30	210:40	244:19
400	3:47	5:42	10:08	15:50	22:48	35:37	51:17	69:48	91:10	115:24	142:28	172:23	205:09	240:45	279:13
450	3:47	6:25	11:24	17:48	25:39	40:04	57:42	78:32	102:34	129:42	160:16	193:55	230:47	270:51	314:07

Table based on allowable air loss of .0015 ft. ^{3}/min. per square foot of internal pipe surface and a maximum air loss per test section of 1.0 ft. ^{3}/min.

PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 30.

WATER TRANSMISSION, DISTRIBUTION AND SERVICE LINES

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 30.

WATER TRANSMISSION, DISTRIBUTION AND SERVICE LINES

30.1. GENERAL

Piping for water transmission, distribution and service lines to be installed in easements or public right-of-way under the jurisdiction of the City, shall be designed, cathodically protected, fabricated and installed as hereinafter specified. The specific requirements for excavation and resurfacing over pipelines are detailed in Section 20, "Excavation, Bedding and Backfill of Pipe" and Section 15, "Streets" of these Standard Specifications.

The contractor performing the work shall be properly licensed with the City, obtain all permits, give twenty-four (24) hours written notice to the Public Works Department Engineering Division, setting forth the time construction is to commence or when work is to be resumed following a delay. The contractor shall maintain a complete set of approved drawings and specifications, covering the work being performed, on the project at all times.

30.2. MATERIALS

Pipe, fittings and appurtenances to be installed in the City water system shall be equal or exceed the minimum standards as set forth by the: American Society of Testing Materials (ASTM); American Water Works Association (AWWA); American National Standards Institute (ANSI), etc. Referenced standards shall be the latest edition or revision thereof.

Standard specifications applicable to the manufacturing of the various types of pipe and fittings to be used are listed in Table 30-1. Special requirements modifying the standard specification are referred to in Part III Section 120, Table 120-I and under specific items throughout this and the Design Section of these specifications.

Manufacturers of pipe, valves and other in-line appurtenances shall furnish a certified statement that the inspection and all the specified tests have been made and the results obtained comply with the requirements of the applicable standards as herein specified. A copy of the certification shall be sent to the Project Engineer prior to installation.

TABLE 30-I
WATER PIPE

APPLICATION TYPE & MATERIAL	SPECIFICATION ASTM	SPECIFICATION ANSI/AWWA	DIAMETER	CLASS	JOINT
SERVICE LINES					
(CU) Copper	B-251		3/4" - 2"	TYPE K	Flared *or* Compression (1)
(PVC) Polyvinyl Chloride (Outside vaults)		C900	3" - 8"	CL 150	Bell and spigot or MJ
(DI) Ductile Iron (Inside vaults)		C151	3" - 8"	CL 150	Flanged
DISTRIBUTION & TRANSMISSION LINES: (2)					
(PVC) Polyvinyl Chloride Cell 12454 A or B	D-1784 D-2241	C900	4" ,6",8" or 12"	CL 200 DR 14	Bell and spigot ASTM F-477, D-3139 AWWA C900, C905, C909 UNI-B-1
		C905	14"-24"	CL 165 DR25	
(PVCO) Polyvinyl Chloride Molecular Oriented		C909	6", 8" or 12"	CL 200 DR 14	
(DI) Ductile Iron (3) (5) grade 60-42-10		C151 Pipe C104 Lining	30" – 54"	CL 200	Bell and spigot ASTM F-477, D-3139 AWWA C111
(STL) Steel (4) (5)	A36 A139	M11 C200 Pipe C205 Cement Lining C206 Welding C214 Tape Coating	30" – 54"	225 psi plus external loads	AWWA C200 O-ring
(CCP) Concrete Cylinder Pipe		M9 C300 C301 C303	30" – 54"	225 psi plus external loads	AWWA C300 Steel Bell and spigot with O-ring gasket

(1) Compression joints allowed are Mueller (110 only), Ford (Q only), AY McDonald (Q only), Cambridge (CB only), James Jones (SG only)
(2) See Section 20 for bedding type, gradation and compaction.
(3) Requires asphaltic protective coating, cement mortar lining, and polyethylene encasement. See Paragraph 30.2.7 of these standards.
(4) Requires AWWA C214 Tape Coating and AWWA C205 Cement Mortar Lining
(5) Requires cathodic protection system.

30.2.1. Fittings for Service Lines, Meters and Mains

A. Service Line Fittings: Service line fittings shall be of the manufacturer and types herein below specified only. Other manufacturers and model numbers must be approved by the Public Works Department prior to installation.

Corporation Stops - Ball Type Only			
Size	Brand	**Mueller**	**AY McDonald**
¾"	Compression	B-25008	4701BQ
1"	Compression	B-25008	4701BQ
1 ½"	Compression	B-25008	4701BQ
2"	Compression	B-25008	4701BQ
Curb Stop Valves - Ball Type Only with 1/4 Turn Check			
Size	Brand	**Mueller**	**AY McDonald**
¾"	Compression	B-25209	6100Q
1"	Compression	B-25209	6100Q
1 ½"	Compression	B-25209	6100Q
2"	Compression	B-25209	6100Q

Curb Stop Box			**Rod**
Size	**Mueller**	**AMETEK**	**AMETEK**
3/4" – 1"	H10314	110183	
1½" – 2"	H10336	110183	110046-33

Meter Pit			
¾" – 1"	20"	Plastic	Simplex or Duplex series 250
1 ½"	20"	Plastic	DFW Plastics Model Number DFW 242148H (48" Height, White Color, ½" wall thickness)
2"	20"	Plastic	Mid States Plastics "B" Series (48" Height, White Interior, ½" wall)

Meter Pit Dome and Cover	
Brand	**Castings Inc.**
	M-70 AL or M-70 CI

Service Saddles* - Bronze with Stainless Steel Straps (3/4" – 2" taps)		
Pipe Type	**A.Y. McDonald**	**Mueller**
PVC	3855	BR2S
Ductile or Cast Iron	3855	BR2S
Asbestos Cement	3855	BR2S

* Saddles must be installed in accordance with manufacturer's recommended torque specifications

B. Fittings for PVC and Ductile Iron Distribution and Transmission Lines: Distribution and transmission line fittings for PVC and ductile iron pipe shall be ductile iron and in accordance with ANSI/AWWA C153/A21.53 and ANSI/AWWA C110/A21.10. Fittings shall have a 350 psi pressure rating and be furnished with a cement-mortar lining of standard thickness and a bituminous seal coating as defined in ANSI/AWWA C104/A21.4. Fittings may also be coated both internally and externally with fusion bonded epoxy in accordance with ANSI/AWWA C116. The fittings shall be furnished with mechanical joint ends in accordance with ANSI/AWWA C111/A21.11 and, in addition, the tee-head bolts and hexagon nuts shall conform to ASTM A325, Type 3 and be fabricated from "Cor-Ten" or "Usalloy", a high strength, low alloy steel. 4" through 12" diameter fittings may also be ductile iron One-Bolt type with integral restrained joints as manufactured by One-Bolt, Inc.

C. Steel Pipe Transmission Line Fittings: All specials and fittings shall conform to the dimensions of AWWA C208. Fittings shall be of the same material and thickness as the pipe. The minimum radius of elbows shall be 2.5 times the pipe diameter, and the maximum miter angle on each section of the elbow shall not exceed 11 1/4 degrees. If elbow radius is less than 2.5 x pipe diameter, stresses shall be checked per AWWA M11 and wall thickness or yield strength increased if necessary. Fittings shall be equal in pressure design strength and shall have the same lining and coatings as the abutting pipe. Fittings shall be made of segmentally welded sections from hydrostatically tested pipe with ends compatible with the type of joint or coupling specified for the pipe.

D. Concrete Cylinder Pipe Transmission Line Fittings: Special fittings such as wyes, tees and crosses shall be constructed of steel cylinders and shall be mortar lined and coated. Fittings shall be at least equal in strength to the abutting pipe sections in accordance with AWWA C300, C301, C303 and M9. The design shall be approved by the Project Engineer prior to fabrication.

30.2.2. <u>Valves</u>

A. Resilient Wedge Gate Valves (3" - 12"): Gate valves shall be manufactured in accordance with AWWA C-509 "Resilient-Wedge Gate Valves" (3" - 12") for water systems, open left (counterclockwise).

Valves shall be epoxy coated both internally and externally in accordance with ANSI/AWWA C550 and have a non-rising stem. The operating pressure for all gate valves shall be 200 psi gauge.

The stem seal shall consist of two (2) each O-rings, designed to allow replacement of the seal above the thrust collar with the valve operating under pressure in the full open position.

Flat gaskets, either of the ring or full faced type, required at the bonnet connection shall be fabricated from compressed asbestos sheet with a rubber compound binder. Use of homogenous rubber or vegetable fiber sheet is not acceptable.

B. Butterfly Valves (14"-54"): Butterfly valves shall be manufactured in accordance with AWWA C504 "Rubber Seated Butterfly Valves", open left (counterclockwise).

Valves shall be Class 150 B and be drop tight for flows in either direction at a maximum static differential pressure across the valve of 150 psi.

Valve body material shall conform to that shown in Section 5.4 of referenced specification. All flanged end valves shall have a short body laying length conforming to Table 3 of specification, AWWA C504.

Manual valve operators shall be sized and designed to develop output torques for Class 150 B operating service and shall be sufficient to seat, unseat and rigidly hold the disc in any intermediate position for the above conditions. The operator shall be capable of withstanding an overload input torque of 300 ft/lbs at full open or closed position without damage to the valve or valve operator. The maximum input torque required to fully open or close the valve for Class 150 B conditions shall not exceed 150 ft/lbs., when applied to the operating nut. All gearing shall be totally enclosed, full gasketed, grease packed, and sealed from ground water. The operator shall be designed to resist a minimum pressure head of twenty-five (25) feet, when submerged in water.

External and internal valve coating shall be a 6 mil polyamide cured epoxy in accordance with ANSI/AWWA C550.

C. Pressure Reducing Valves: Pressure reducing valves shall operate at a pressure of 150 psi gauge and be capable of reducing a high existing pressure to a pre-adjusted lower downstream pressure for varying rates of flow without causing water hammer on the system. The maximum fluid velocity through the valve shall not exceed fifteen (15) fps at maximum demand flow. The valve shall be designed to provide an access opening into the valve body for removing internal parts without removing the main valve body from the line. Valves shall be supplied with position indicator assembly, open and close speed controls, sustainer and preset pilot valves in accordance with City of Rifle specified pressures.

Pressure reducing valves approved for installation are as follows:

Clayton Model 92-01, manufactured by Cla-Val Co., Newport Beach, California or Singer Valve Model 106-S

D. Air Release-Vacuum Valves: Combination air release-vacuum valves operating to 150 psi shall be of the single body, double orifice type allowing large volumes of air to escape out of the large air vacuum orifice when filling the pipeline and to close watertight when the liquid enters the valve. During closure of the large orifice, the small air release orifice shall open to allow small pockets of air to escape automatically and independently of the large orifice. The large air vacuum orifice shall also allow large volumes of air to enter through the orifice during pipeline drainage to break the vacuum. Valves shall be manufactured in accordance with AWWA C512. Drain plugs shall be removed before installation and broiler drains installed by the contractor before the valve is put into service.

The valve body and cover shall be cast iron conforming to ASTM A-48, Class 30. The body inlet must be baffled to protect the lower and upper floats from direct contact of the rushing air and water to prevent premature valve shut off. All floats shall be stainless steel conforming to ASTM A-240, be hermetically sealed and designed to withstand a minimum of 1000 psi. The upper float shall be center guided for position shut off.

The valve needle and seat shall be Nitrile Rubber conforming to ASTM SB-800. The seat must be fastened to the valve cover, without distortion, for drop tight shut off.

The level frame shall be Delrin conforming to ASTM D-638 and the lug shall be bronze conforming to ASTM B-124-55.

APCO valve series 143C, 145C, 147C, 149C, 150C and 151C, as manufactured by Valve and Primer Corporation or Val-Matic numbers 201C, 202C, 203C, 204C as manufactured by Val-Matic Valve and Manufacturing Corp. are allowed.

1. Guard Valve: The guard valve to be used with two (2) inch and smaller air valves shall be a Ford or Mueller brass ball valve with female iron pipe threads, or approved equal. Connections between the air and guard valve shall be made using brass nipples conforming to AWWA C-800, "Threads for Underground Service Line Fittings". Large guard valves may be flanged type.

A service saddle shall be used to install taps for all combination air release vacuum valves installed on water mains. Service saddles shall conform to the manufacturer and type shown in Section 30.2 of these specifications. For air release–vacuum valves installed on transmission mains larger than 16" diameter, saddle shall be equivalent to APAC 113 large diameter, double strap all bronze service saddle.

E. Tapping Valves: Tapping valves shall conform to all the requirements set forth herein above for resilient seat gate valves and the following:

The inlet end of the valve shall be Class 125 flange and the outlet end shall be a mechanical joint. Body of the valve and seat opening shall be sized large enough to accommodate the following sizes of shell cutters:

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

30.2.3. Valve Appurtenances:

A. Flanged Ends: Flanges shall be sized and drilled in accordance with ANSI-B 16.1, Class 125 specifications; flanges shall be machined to a flat face with a finish of 250 micro-inches, or machined to a flat surface with a serrated finish in accordance with AWWA C207 "Steel Pipe Flanges".

B. Mechanical Joint: Mechanical components of this type of joint shall conform with ANSI-A21.11/AWWA C-111 "Rubber Gasketed Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings". The tee-head bolts and hexagon nuts shall be fabricated from a high strength, low alloy steel known in the industry as "Cor-Ten", "Usalloy" or equal.

C. Bolting Material: Bolts and hex nuts used on the bonnet of the valve shall be manufactured from a low-alloy steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process, in accordance with ASTM A-153, is not acceptable for the threaded portion of the bolts.

D. Operators and Stem Extension: Operators shall be designed for buried service and to operate indefinitely in a fully buried condition. Operators shall be equipped with a standard AWWA 2" square operating nut. Valves shall open with a left (counterclockwise) rotation of the nut.

Top operating nut stem extensions shall be manufactured from cold rolled steel. Stem extensions shall be equipped with a standard AWWA two (2) inch square operating nut and shall be of sufficient length to place the stem operating nut to between three (3) to five (5) feet of finished grade. Stem extension shall be attached to the valve operating nut by means of two (2) each 5/16" x 1/2" set screws. 1/8" deep dimples shall be drilled into operating nut for set screws to hold on to.

E. Testing: Each valve after shop assembly shall be given the operation and hydrostatic tests in accordance with the applicable specifications.

F. Painting: All surfaces of the valve shall be clean, dry and free from grease before painting. All ferrous surfaces, exterior and interior, except the seating surfaces of flange faces, shall be evenly coated with a suitable primer to inhibit rust or black asphalt varnish in accordance with Federal Specification TT-V-51e, Military Specification C450C, Type 11 or Navy Specification JANT 450. Flange faces shall be shop coated with a rust preventive compound such as Dearborn Chemical "No-OX-Id", Houghton "Rust-Veto 344", or "Rust-O-Leum R-9".

On rubber seated valves, after above painting is complete, a lubricant compatible with the rubber seal shall be applied to the surface of the seal and the mating metal surface to prevent bonding of the two (2) surfaces during shipment and storage. Following application of the seal lubricant, the valve disc shall be placed in the fully closed position for shipment.

G. Valve Boxes: Valve box parts shall be made of gray cast iron and the boxes shall be two (2) piece, adjustable screw type, with 5 1/4" shafts. Extension pieces shall be used where necessary. Lids shall be of the drop type having 1 1/2" skirts and marked for water usage. Slip cheater type are unacceptable.

Tyler Pipe Company, Series 6850 or equal with Small Base are allowed unless a larger valve requires a Wide Base.

30.2.4 Tapping Sleeves for Wet Taps (3" - 12"): All tapping sleeves for use on PVC, ductile iron or existing asbestos cement water mains shall be designed for an operating pressure of 150 psi and shall be fabricated using Smith- Blair 622 or equivalent. Sleeve shall be furnished with gridded virgin SBR compounded gasket for water service that provides full 360° pipe coverage ("full gasket"). Gasket shall be shop glued to the body section of the sleeve and the gasket shall provide adequate seal for the design pressure. Sleeve flange shall be Type 304 (18-8) Stainless Steel having the flange face machined and recessed to receive standard tapping valve in accordance with MSS Standard SP-60 for sizes 4" through 12". Flange shall conform to AWWA C207 Class D ANSI 150 lb. drilling. Bolts shall be Type 304 (18-8) Stainless Steel per ASTM A193 and A194. The use of two (2) tapping saddles, when side by side or back to back, as a substitute for a cross will not be allowed. Edge of tapping saddle must be a minimum of 24" away from all joints as measured along the water main.

30.2.5. Fire Hydrants: Dry-Barrel Dry-Top Fire Hydrants: Except as modified or supplemented herein, all fire hydrants shall be designed to operate for a line pressure of 150 psi and manufactured in accordance with AWWA C502 "Dry-Barrel Fire Hydrants". Kennedy K81D Guardian or Mueller Super Centurion 250 are the approved City of Rifle hydrants

A. Size: Hydrants shall have a main valve opening size of 5 1/4 inches.

B. Type: Hydrants shall be the 3-way type with one (1) pumper nozzle and two (2) hose nozzles all located on the same horizontal plane, between eighteen (18) and twenty-four (24) inches above final grade. All extension kits are to be furnished and installed by Contractor. Proper breakaway coupling installation shall be verified by City inspector prior to reinstalling hydrant bonnet.

C. Base Connection: Hydrant base shall be provided with a mechanical joint to accommodate six (6) inch diameter AWWA C-900, CL200 or AWWA C-909, CL150

pipe complete with plain rubber gasket, gland, bolts and nuts all in accordance with ANSI A-21.11/AWWA C111.

The mechanical joint bolts and nuts shall be high strength, low-alloy corrosion resistant steel "Cor-Ten" or equal with a minimum yield of 50,000 psi conforming to ASTM Specification A-242. Incorporated into the base shall be two (2) lugs for rodding or strapping of pipe.

All mechanical joint accessories shall be attached to hydrant for shipment.

D. Traffic Breakaway: Hydrant shall incorporate a traffic breakaway feature of the barrel and stem. Stem coupling shall be of cadmium plated steel or bronze with fasteners of stainless steel.

E. Main Valve Assembly: The main valve of the hydrant shall be 5 1/4" diameter compression type which closes with the water pressure. Seat ring shall be bronze with a machined face and external threads for threading into a bronze drain ring. Provide bronze to bronze threads for the main valve assembly and a fully bronze lined drainway.

Gasket for valve shall be a replaceable type fabricated of a resilient material, with a threaded bottom plate or nut, complete with seal to prevent leakage of the hydrant shaft.

The valve assembly shall include one (1) or more drain valves which will work automatically with the main valve and drain the barrel when the main valve is in the closed position. Drain valves shall be positive, mechanically activated and be an integral part of the main valve assembly. Drain channels shall be bronze lined and sized large enough for the barrel to drain within twelve (12) minutes when the barrel is sized for a five (5) foot trench depth.

All parts of the main valve assembly shall be so designed that removal of the assembly from the barrel is accomplished without excavation in accordance with Section 201.13 of the referenced specification.

F. Operating Shaft and Nut: The operating nut shall be bronze or cast iron #17NS hexagonal shaped with a finish height of 1 1/4". The dimensions from point-to-point are 1 1/2" at the top and at the bottom. Bushings in the bonnet shall be so constructed that it will prevent the operating nut from traveling during opening or closing operation; also the bushing shall house a gasket or seal to prevent moisture or foreign material from entering the lubricant reservoir.

The hydrant shall open by turning the operating nut to the <u>left</u> in a counter clockwise direction and shall have an arrow on top of the bonnet to designate the direction of opening.

G. Pumper Nozzle and Cap: The pumper nozzle shall be 4 1/2" nominal diameter. Threads shall be right-hand and National Standard in accordance with NFPA #194.

Nozzle cap shall be furnished with a synthetic rubber gasket installed in a retaining groove and the dimensions and shape of the nozzle cap nut shall be the same as the operating shaft nut as described in Paragraph F above.

Nozzle caps shall be furnished with security chains with one (1) end of each securely attached to the upper barrel section of the hydrant.

H. Hose Nozzles and Caps: The two (2) hose nozzles shall be 2 1/2" nominal diameter. Threads shall be right-hand and National Standard in accordance with NFPA #194. Each hose nozzle shall include a nozzle cap with nut and security chain the same as described in Paragraph F above.

I. Nozzle Attachment: Outlet nozzles shall be fastened into the barrel by mechanical means. Threaded nozzles shall be secured by a stainless steel pin or screw and sealed by the use of O-rings. All bronze castings shall be of low zinc bronze ASTM B-62. Internal fasteners shall be of ASTM A-276, Type 302 or 305 stainless steel.

J. Painting and Coating: The buried portion of the hydrant shall be given a bituminous coating in accordance with AWWA C-106, Section 6-8. All ferrous metal parts shall be coated in accordance with AWWA C-500, Section 4.5 and Section 2.22. The bonnet and nozzle cap shall then be given one red shop coat of heavy-duty alkyd enamel paint conforming to Federal Specification #13538. The remaining above ground portion of the fire hydrant shall also be shop painted red enamel.

All internal ferrous metal surfaces that are in constant contact with pressured water shall have a minimum of four (4) mils epoxy-coating as outlined in AWWA C550 entitled "Protective Coatings for Valves and Hydrants."

K. Interchangeable Parts: Hydrants shall have interchangeable parts with presently installed hydrants. Kennedy K81D Guardian or Mueller Super Centurion 250 are the approved City of Rifle hydrants.

30.2.6. Restrained Joints for Steel or Concrete Pipe: Restrained Joints for steel or concrete transmission lines shall conform to the requirements set forth in AWWA Manual M9, "Concrete Pressure Pipe" or AWWA M11, "Steel Pipe Manual."

Joints shall be one of the following types as indicated on the construction plans:

1. Lap welded slip joint – The standard bell shall provide for a 2½ inch lap. The minimum lap shall be 1 inch. The design maximum joint deflection or offset shall be a 1” joint pull.

2. Double welded butt strap joint - Butt straps, where required will be a minimum of six (6) inches wide, the same thickness as the pipe wall, and will be welded to one end of each pipe section so the joint can be lapped on the outside of the pipe.

   On joints where butt straps are used for realignment, adjustment, or deflection, the pipe ends will be cut straight, and fillet welds shall be made on the outside of the pipe.

3. Flanged and bolted – Flanges shall be in accordance with AWWA C207 Class D for operating pressures to 150 psi and transient pressures to 225 psi. Flange face shall be coated with soluble rust-preventative compound.

Bolts for buried flanges shall be type 316 stainless steel conforming to ASTM A193, Grade B8M, Class 1 and ASTM 194, Grade 8M nuts.

4. Mechanical coupling – Mechanical couplings shall be Smith Blair Style 411, Baker Style 200, Brico Depend-O-Loc, or equal. Insulated mechanical couplings shall be double insulated Smith Blair Style 416, Baker Style 216, or equal for working pressures up to 150 psi only. Mechanical couplings shall be harnessed for the maximum pressure in accordance with AWWA M11.

5. Carnegie end rings restrained by means of: circumferential clamps, snap ring, bell bolts or filler rod welded to both the bell and spigot ring.

30.2.7. Exterior Coatings for Pipe and Fittings

A. Steel Pipe Coatings: Exterior coating for steel pipe shall be a multi-layer 80 mil prefabricated Polyken YG-111 Tape System conforming to AWWA C-214 "Tape Coating Systems for the Exterior of Steel Water Pipelines", or a cement mortar coating conforming to AWWA C-205 "Cement Mortar Protective Lining and Coating for Steel Water Pipe four (4) inches and Larger - Shop Applied".

1. Shop Applied Concrete Coating: Type V cement conforming to ASTM C-150 "Specification for Portland Cement" shall be used in concrete placed in the walls of concrete cylinder pipe or on metallic pipe to be coated in accordance with AWWA C-205.

Modified Type II Portland Cement, having a low tricalcium aluminate content, is considered as an equal alternate for Type V cement.

a. Dielectric Coating Over Concrete Coated Pressure Pipe: Prior to shipment, the exterior concrete surface shall be spray seal coated with a 100% solids cool for epoxy, applied at the rate of 61 sq. ft. per gallon and control cured. Epoxy and its application shall conform to the latest requirements of the U.S. Bureau of Reclamation.

2. Shop Applied Tape Coating: Shop applied tape coating shall be a continuous four (4) layer system applied to the exterior of the metallic cylinder and extend from the end of the bell to within 4 1/4" of the spigot. It shall consist of:

a. Primer Layer - applied over a pipe surface prepared as specified in SSPCSP 6, "Surface Preparation Specification #6, Commercial Blast Cleaning or NACE TM-01-75, Visual Standards for Surfaces of New Steel Centrifugally Blast Cleaned with Steel Grit and Shot."

b. Corrosion Protection - wrapped twenty (20) mil tape layer.

c. Inner Mechanical Protection - wrapped thirty (30) mil tape layer.

d. Outer Mechanical Protection - wrapped thirty (30) mil tape layer.

B. Ductile Iron Pipe Coating: Ductile iron pipe shall have a bituminous seal coating in accordance with ANSI/AWWA C151/A21.51, as well as a bituminous coated cement mortar lining in accordance with ANSI/AWWA C104/A21.4.

C. Field Coating Appurtenances: Field applied coatings for inline fittings, valves, welds and appurtenances shall conform to one of the following:

1. Polyethylene Encasement: Polyethylene shall be manufactured in accordance with ANSI/AWWA C105/A21.5 "Polyethylene Encasement for Gray and Ductile Cast Iron Piping for Water and Other Liquids" with the following additional requirements or exceptions.

   Materials and Physical Properties: The raw material used to manufacture polyethylene film shall be Type 1, Class A, Grade E-1, in accordance with ASTM D-1248. The film produced shall meet or exceed the following requirements:

Tensile Strength	1200 psi min.
Elongation	300% min.
Dielectric Strength	800 V/mil thickness min.
Thickness	0.008" (8 mils)
Melt Index	0.4 max.

2. Cold Applied Tape Encasement: Cold applied tape shall be Type II as described in AWWA C-209 "Standard for Cold Applied Tape Coatings for Special Sections, Connections and Fittings for Steel Water Lines". Protecto-Wrap #1170 Primer and #200 Mastic Tape or equivalent has been approved for this application.

   When pipe is tape coated according to AWWA C-214, the appurtenance shall be field protected using Polyken #927 primer and Polyken #930 and/or #934 tape or equivalent.

30.2.8. Insulators - Cathodic Protection

A. Service Line Insulators: Insulators for service lines at the corporation stop for taps on metallic mains shall be Ford Service Insulators or equal as approved by the Project Engineer.

B. Distribution, Lateral and Transmission Line Insulators: Insulated mechanical couplings on metallic lines, six (6) inches and larger, shall be Rockwell (Smith-Blair) Style 416 or Dresser Style 39, insulating couplings, or equal. Flanged by flanged joints shall be insulated using PSI-Pacific Seal Gasket with sleeves and double insulating washers.

30.2.9. Harness Rods

A. Lateral and Distribution Lines (6" - 12"): Harness rods shall be manufactured using Mild Steel (MS) conforming to ASTM Specification for "Structural Steel", designation A-36. Hex nuts shall be fabricated in accordance with ASTM Designation A-307, Grade A or B, hexagon heavy series.

B. Distribution and Transmission Lines (14" - 18"): Harness rods shall be manufactured using High Strength (HS) Steel conforming to ASTM Designation A-193, Grade B7. Nuts shall conform to ASTM Standard A-194, Grade 2H.

30.2.10. Retainer Glands - Mechanical joint retainer glands may be used in lieu of harness rods on PVC and Ductile Iron pipe and shall be cast from grade 60-45-12 ductile iron conforming to ASTM A536-80. Bolt circle, holes and bolts shall be dimensioned to be compatible with standard mechanical joint bells as per specification ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153. These glands shall have serrations or individually actuated gripping surfaces to maximize restraint capability to hold working and test pressures. The retaining glands shall have a pressure rating equal to that of the pipe on which it is used. Retainer glands for PVC pipe shall be equivalent to those as manufactured by EBAA Iron, Inc. Series 2000PV (4”-36”), Uni-Flange Series 1500 (4”-24”) or Star Pipe Products Allgrip Series 3600 (4”-12”). Retainer glands for Ductile Iron pipe shall be equivalent to EBAA Iron, Inc. Series 1100 (30”-48”), Uni-Flange Series 1400 (30”-36”) or Star Pipe Products Allgrip Series 3000 (30”-36”). Retainer gland bolts shall be torqued to manufacturer’s recommended torque specification.

30.2.11. Bell and Spigot Joint Restraints – In lieu of harness rods, restraint devices for bell and spigot joints of PVC or Ductile Iron pipe shall consist of split restraint rings, one installed on the spigot, connected to one installed on the pipe barrel behind the bell. The restraint devices shall incorporate a series of machined serrations on the inside diameter to provide positive restraint, exact fit, 360° contact and support of the pipe wall. A split bell ring in lieu of a serrated ring may also be used behind the pipe bell. Restraint devices shall be of ductile iron, ASTM A536, Grade 65-45-12 and connecting bolts shall be of high strength, low alloy material in accordance with ANSI/AWWA C111/A21.11. Restraint devices for PVC pipe shall be equivalent to those manufactured by EBAA Iron, Inc. Series 1600 (4”-12”) and 2800 (14”-36”) or Uni-Flange Series 1390 (4”-36”). Pipe bell restraint devices for Ductile Iron pipe shall be equivalent to EBAA Iron, Inc. Series 1700 (30”-36”) or Uni-Flange Series 1450 (30”-36”). Joint restraint bolts shall be torqued to manufacturer’s recommended torque specification.

30.2.12. Steel Casing for Bores - Welded steel casing pipe shall meet the requirements of AWWA C200 and shall have an inside diameter of at least twelve (12) inches greater than the outside diameter of the bell joint of the carrier pipe to be installed therein. Casing shall be coal tar epoxy coated. Casing pipe shall be cathodically protected using a minimum of one (1) anode bag per 400 foot length. The minimum wall thickness of the steel tubing shall be:

Wall Thickness	Casing O.D.
3/8”	30" and smaller
1/2”	33”-42”

30.2.13. Casing Spacers and Insulators - APS Model SSI or SI with fusion bonded epoxy or PVC coating as manufactured by Advance Products and Systems, Inc., Lafayette, LA or equal, installed at a maximum center to center spacing of ten (10) feet along the carrier pipe invert with an additional spacer placed within 6” of each end of the casing pipe. Spacers shall be 8” width for carrier pipe 6” to 14” diameter, 12” width for carrier pipe 16” diameter or larger.

30.2.14. End Seals for Casing Pipe – 1/8” thick synthetic rubber wrap around end seals with stainless steel bands shall be installed on casing pipe after carrier pipe insertion. End seals shall be APS Model AW Wrap Around End Seal as manufactured by Advance Products and Systems, Inc. Lafayette, LA or equal.

30.2.15. Miscellaneous Items

A. Concrete and Reinforcing Steel: Concrete and reinforcing steel shall be furnished in accordance with the requirements set forth in Section 10, "Concrete", of these Standard Specifications. Class "A" concrete shall be placed in all vaults and/or structures. Class "B" concrete may be used for kickblocks, protective pads and pipe encasement.

B. Standard Manholes: See Section 25 and Standard Drawings of these specifications.

C. Telemetry and Electrical System for PRV Vaults: The telemetry system installed shall be capable of transmitting signals via telephone to the Ralston Water Treatment Plant at 18975 West 66th Avenue.

Telemetry equipment to be provided and installed by contractor. City crews will install interconnect to Ralston Plant recorder. Equipment shall be as specified in Special Conditions for a specific project or as approved by the Utilities Division.

The equipment shall be electrically powered, connected via telephone and fully operational.

Electrical system to be installed in the vault shall be weather proof and include, but not be limited to, 2 each 75 watt explosion proof light fixtures and bulbs; 2 each non-metallic duplex receptacles with covers; non-metallic junction boxes, breaker box, single pole switches weather head as required. Contractor shall also supply #6 copper grounding rod, 1 inch EMT Riser tubing and wire and install meter setting.

D. Vent Pipe: Vent piping for manholes and vaults shall be 6 5/8" O.D. Schedule 40 PVC pipe or steel with threaded joints. In residential areas, the vent pipe above ground shall be painted green. In parks and range land, the vent pipe shall be painted caterpillar yellow. See Vent Pipe Assembly Standard Drawing W-49.

E. Pipe Detector Wire: Wire shall be AWG, Size #12, type UF or USE cable, UL Listed, and shall have a white plastic insulation jacket and single copper conductor.

F. Water Service Insulation: Insulation shall be IMCOAFLEX, as manufactured by Insulation Materials Corporation of America or equal, one (1) inch minimum wall thickness. Side slits and bolt joints shall be duct taped.

30.2.16. Cathodic Protection and Monitoring Systems - Metallic water transmission lines (18" and larger) shall be cathodically protected by means of a National Association of Corrosion Engineers (NACE) designed sacrificial anode system or an impressed current cathodic protection and monitoring system. Materials to be incorporated into the system shall be as hereinafter listed unless otherwise approved as equals prior to bidding by the Project Engineer.

Item	Manufacturer or Trade Name
Anode Junction Box	Cott
Test Stations, flush to grade	Cott-Fink, Gerome-Testox 500
Galvanic Anodes	Dow Galvomag
Thermite Brazing	Cadweld, Thermoweld
Brazed Coating	Koppers #50 Bitumastic
Voltmeters	D'Arsonral

Graphite Anodes	Harco-Centap-NA Treated
Cable to Anode	Duralar Halar
Calcined Fluid Petroleum Coke	Loresco, DW-2 or DW-3 C.E. Equipment Co.
Rectifier, air cooled	Good-All, Universal
ES-ABS Solid Casing	Armco
Zinc Grounding Cells	Federated Metals
Reference Electrodes	Harco Permacel
Field Bonding Straps	AWG Stranded Copper Wire w/HMWPE insulation
HIRDA Anode System	Harco

30.3. PIPE INSTALLATION

Installation of pipe and appurtenances shall be performed in accordance with the acceptable practices set forth by the American Society for Testing Materials (ASTM), the American Water Works Association AWWA C600, "Installation of Ductile-Iron Water Mains and their Appurtenances"; AWWA Manuals M9, M11, AWWA C605, “Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water”, approved plans and as modified herein.

At all times during construction of the pipeline, the contractor shall use every precaution to prevent damage to protective coating on the pipe. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workmen will be permitted to walk upon the coating only when necessary, in which case they shall wear shoes with rubber or composition soles and heels. Any damage to the pipe or protective coating from any cause during the storage or installation of the pipeline shall be repaired prior to laying of the pipe, as directed by the Project Engineer, by and at the expense of the Contractor.

30.3.1. Storage of Materials - The contractor shall store and adequately protect all material prior to installation. Any damage to the materials resulting from improper storage or handling by the contractor shall be repaired or replaced by and at the expense of the contractor.

Stored pipe shall at all times be supported on sawdust bags, timbers, sand bags or other suitable support. Bags shall be of sufficient size to prevent contact of the pipe coating with the ground or any obstruction. Rolling pipe sections on its coating surface will not be permitted.

When pipe laying is not in progress, the ends of the pipeline, all special openings and all pipe waiting to be laid shall be kept closed with suitable bulkheads to prevent unauthorized access by persons, animals, water or any other undesirable substances. The bulkheads shall be so designed to prevent drying out of the interior lining of the pipe. The contractor shall introduce water into the pipe to keep the mortar lining moist where moisture has been lost due to damaged bulkheads.

It shall be the responsibility of the contractor to prevent damage to coatings which might be caused by handling and/or embrittlement caused by storage of the completed pipe at low temperature.

PVC Pipe stored outside and to be exposed to sunlight for more than 30 days shall be covered with a solid canvas to block the light. Clear plastic is not allowed as a cover. Air circulation shall be maintained under the covering.

30.3.2. Handling Pipe - Pipes, fittings, etc., shall be carefully handled and protected against damage to lining and coating, impact shocks, and free fall. All pipe handling equipment shall be approved by the Project Engineer. Pipe shall not be placed directly on rough ground but shall be supported in an approved manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. No pipe shall be installed where its coating or lining shows cracks that may be harmful. Damaged coating or lining shall be repaired to the satisfaction of the Project Engineer, or a new undamaged pipe section shall be installed, at no expense to the City.

Pipe shall be handled, hauled, and placed using wide slings and padded cradles of canvas, leather, or other suitable material so designed and constructed to prevent damage to the pipe lining or coating. The use of bare metal cables, chains, hooks, or other equipment which might injure the pipe coating will not be permitted.

A. Pre-installation Coating Inspection: The contractor shall permit and aid in the inspection of all coating on the underside of the pipe, at the time of the installation, and shall repair any damage before lowering the pipe into the trench. While being laid, the pipe shall not be rolled, skidded or otherwise moved when in contact with the ground at any point.

At the trench site, just prior to installing, the contractor shall inspect the pipe coating for flaws, cracks, spalling, etc. Tape coated pipe shall be inspected for holidays with a contractor furnished coil spring or brush type electrode, having a primary wattage no higher than twenty (20) watts and a minimum pulse, at crest voltage, of twenty (20) per second. Where holiday flaws are detected, they shall be repaired to the satisfaction of the Project Engineer before the pipe section is placed in the trench.

Cement mortar coated pipe shall be inspected for cracking or spalling while supported in belted or canvas slings, prior to lowering in the trench. Where coating imperfections are found, and providing there is no visible damage to the pipe lining, straight pipe sections shall be rotated so the damaged coating is atop the pipe after being lowered and set in the trench.

The coating shall then be cement mortar repaired and allowed to cure for a period of 24 hours before backfilling. Concrete coatings on beveled sections, bends and other special sections which cannot be rotated, as herein above described, shall be repaired to the satisfaction of the Project Engineer prior to lowering and setting in the trench.

B. Pipe Struts: Struts in steel and pretensioned concrete cylinder pipe shall be left in place until backfilling operations have been completed. After the backfill has been placed, the struts shall be removed and will remain the property of the contractor.

30.3.3. Excavation, Bedding and Backfill - Excavation, bedding and backfill required for the installation of pipe covered by this section of the specifications shall be performed in accordance with Section 20 of these standard specifications. See Standard Drawings for pay limits of select backfill and trench resurfacing. Valve boxes installed in streets shall be backfilled with special backfill material for the entire width of the trench. Trenches in streets shall be backfilled with special material at the discretion of the Project Engineer.

30.3.4. Alignment and Grade - When called for on approved plans or by the laying diagram, the water lines, including their appurtenances, shall be constructed to the specified line and grade. When not shown on plans, minimum pipe cover shall be four and one half (4½) feet and a maximum of seven (7) feet. Gate valve and curb stop valve operators on services must not be deeper than five (5) feet from finished grade.

The grade and alignment of the pipe, structures and appurtenances shall be controlled by means of laser beams or offset grade stakes, set in the field by professional survey parties. The contractor shall be responsible to accurately transfer said grade and alignment to the trench and construct thereto.

A. Laying Diagram: Each section of pipe shall be laid in the order and position shown on the laying diagram. In laying pipe, it shall be laid to the set line and grade, within a reasonable tolerance, approximately one (1) inch plus or minus. On grades of zero (0) slope, the intent is to lay pipe to grade. Fittings, valves and hydrants shall be installed at the specified stations and elevation. Three copies of the approved laying diagram signed by the contractor shall be submitted prior to installation.

30.3.5. Pipe Laying - The contractor, with the assistance of the Project Engineer and City Inspector, shall inspect each pipe and fitting to insure that there are no damaged portions of the pipe. Metallic pipe joints will inherently have small amounts of burrs, gouges, weld splatter or other small defect, which the contractor will be required to remove or smooth out. On other than transmission lines, the pipe shall be cut, whenever necessary, to conform to location of fittings, line or grade. All cuts shall be straight and true, in a workmanlike manner so as to leave a smooth end without damaging the pipe. All burrs shall be removed from the ends of cut pipe, and the end lightly rasped or filed.

No dry cutting or beveling of existing asbestos cement pipe will be allowed. MOA-PVC pipe shall be used in place of MOA Asbestos-Cement Pipe.

Before placing pipe in the dry trench, each pipe section valve and fittings shall be thoroughly cleaned of all foreign material, kept clean at all times thereafter, and carefully examined for cracks and other defects before installation. Bell ends and spigot ends are to be examined with particular care. The openings of all pipe and fittings in the trench shall be closed to the satisfaction of the inspector during any interruption to the work, overnight or over the weekend.

A. Frost Foundations: No pipe, fitting or appurtenance shall be installed upon a foundation into which frost has penetrated or at any time when the Project Engineer shall deem there is danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

B. Order of Laying Pipe:

1. Bell End Ahead and Uphill: Pipe shall be laid with bell ends facing in the direction of laying unless otherwise approved by the Project Engineer. In general, pipe shall be laid starting at the lower end of the line and proceeding uphill. In no case shall pipe be laid in a downhill direction where the slope is greater than ten (10) percent, unless permitted by the Project Engineer in writing.

2. Downhill: When approved, pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed and anchored in place before continuing laying downhill.

3. Curves: When laying pipe on curves, the intent is to lay each section to the alignment. The pipe shall be kept in alignment by placing all deflection joints or bends on the curve. Short lengths of pipe shall be used as necessary to accomplish curvature without exceeding individual deflection specified by the manufacturer. Bends shall be used whenever individual deflections exceed those specified by the manufacturer.

C. Laying Procedure:

1. Holes for Jointing and Sling Removal: Holes for jointing pipe sections and sling removal shall be excavated prior to setting the pipe in the trench. Bell holes shall have a minimum clearance of one (1) foot on each side of the pipe end and not less than eight (8) inches deep to allow room for taping or grouting the joint. For field welded joints the minimum bottom clearance shall be three (3) feet each side of the joint and one (1) foot deep.

2. Lubricating Joint: Following final cleaning of the bell and spigot a non-toxic, water-soluble joint lubricant shall be applied to the gasket, and the spigot end of the pipe. Caution shall be exercised to insure the correct type of gasket is used and the manufacturer's recommendations are followed when joining pipe sections.

3. Rotating and Jointing: When the pipe is being laid, it shall be turned and placed where possible, so that any slight damaged coating will be on top. All damaged lined or coated areas shall be repaired using materials and methods as approved by the Project Engineer.

   Pipe shall be laid directly on bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. The spigot end shall be aligned with the bell end and carefully centered so that the pipe is still supported by the slings such that the gasket will not drag as it is entered into the bell. The pipe shall be pulled together by an approved method such as bands and come-alongs or band and hydraulic jacking head as recommended by the pipe manufacturer. In all cases, the joint shall be assembled with the axis of the pipe lengths in a straight line; and deflection, if required, shall be taken by swinging the pipe end after the joint has been completely assembled. Pipe furnished without a depth mark shall be marked before assembly to assure insertion to the full depth of the joint. The spigot end of field cut pipe lengths shall be filed, or ground to resemble the spigot end of such pipe as manufactured. Care shall be taken to assure that the gasket is not twisted or pulled when the pipe is jointed.

   Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the Project Engineer may change the alignment and/or grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joints shall be out of home any amount which, in the opinion of the Project Engineer, will be detrimental to the strength and water tightness of the finished joint. In all cases, the joint opening, before grouting or finishing with the protective mortar inside the pipe, will be the controlling factor.

4. Detector Wire: The contractor shall furnish and spirally wrap detector wire around PVC water pipe as it is installed into the system. Wire shall be white, AWG size #12, type UF or USE cable, UL listed, with single copper conductor.

   During installation, wire shall be spirally wrapped around the pipe exterior, two (2) wraps minimum per twenty (20) feet of pipe. Splices due to breaks in wire continuity shall be made by stripping insulation from each wire end with wire stripper pliers. Wires shall be joined with a solderless connector such as a 3M DBY direct bury splice kit by 3M or approved equal installed in accordance with the manufacturer's instructions. The solderless connector shall then be covered with Seal-A-Conn II putty, manufactured by Emmerson Electric, or approved equal.

   The wire shall form a continuous electrical circuit between any two contact points on the new pipeline including branch lines and fire hydrant laterals. Wire shall be stubbed out to the point where new pipe connects to existing mains unless otherwise directed by the City representative. Where the wire terminates at a point where there is not an installed wire, the ends of the wire shall be stripped bare a minimum of 18 inches and grounded into the native soil material. Wire shall be extended to each fire hydrant installed and looped through a test station. Tracer wire cannot be coiled in a water valve box. Wire shall not be cut at the test station and shall not be connected to the test station leads. Test station shall only serve as an access point for the wire. Test station shall be a CP Test Services, Glenn Series Glenn-4 with locking lid, 3½ x 4, or approved equal.

5. Bell and Spigot Steel Pipe Joint Seating:

   a. Pipe with Carnegie Joint End Rings: As the spigot is thrust home, its advance shall be checked by two (2) steel inserts held in the seat of the bell 180 degrees apart. These inserts shall be removed and a feeler gauge entered into the recess to detect any irregularity in the position of the rubber gasket. If the gasket cannot be felt all around, the joint shall be disassembled. If the gasket is undamaged as determined by the Project Engineer, it may be reused, but only after the bell ring and gasket have been resoaped, as previously specified. After reassembling the joint, the position of the gasket shall again be checked.

      The tied joints shall be jointed as above, and then the necessary wedging or clamping shall be done as recommended by the pipe manufacturer.

   b. Pipe with Expanded Bell and Rolled Spigot Ends: After the joint has been pulled completely together as indicated by the stab marks, the gasket shall be checked using a feeler gauge. This check shall be made around the complete circumference of each joint to be sure that the gasket has not rolled out. If a gasket has rolled out, the joint shall be pulled apart, the gasket inspected, and, if damaged, shall be discarded and a new gasket installed. It should be noted that it is extremely important to obtain full engagement of the stab joint and to check each joint as it is laid.

Each steel pipe length shall be backfilled at least partially before the next length is installed to prevent pullout or movement of the pipe from expansions and contraction.

30.3.6. Jointing Specials and Fittings

A. Mechanical and Flexible Coupled Joint: When installing mechanical and flexible steel couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. These couplings shall be assembled and installed in conformity with the recommendation and instructions of the coupling manufacturer. All mechanical couplings shall be fusion-bonded epoxy coated with stainless steel bolts.

Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the middle ring, follower rings and the body of the pipe with all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with torque wrenches set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only.

B. Field Welded Joint: When laying pipe requiring a field welded joint, pipe deflection shall be limited to that which will produce a lap of one and one-half (1½) inches.

1. Butt Strap Joint: Butt straps, where required will be a minimum of six (6) inches wide, the same thickness as the pipe wall, and will be welded to one end of each pipe section so the joint can be lapped on the outside of the pipe.

   On joints where butt straps are used for realignment, adjustment, or deflection, the pipe ends will be cut straight, and fillet welds shall be made on the outside of the pipe.

2. Lap Joints: On lap joints, exterior fillet welds shall be made as shown on the drawings. The remaining seal weld, where required, shall be 3/16" minimum. An inside weld will not be required. The clearance, before field welding, between the outside circumference of the spigot end and the inside circumference of the bell end shall be not less than 0.09" nor more than 0.41".

3. Bell and Spigot Joints: Where welding of a bell and spigot joint is required, the all around gap between the bell and spigot as delivered from the manufacturer shall not be less than 1/32 (0.03125) nor more than 3/32 (0.09375) of an inch.

C. Flanged Joint: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable approved and calibrated torque wrench to a torque value as recommended by the manufacturer. All clamping torque shall be applied to the nuts only.

D. Harnessed Joints: Joint harnessing by use of rods and clamps shall be installed at interference crossings; on fire hydrants, bends, offsets, domestic and fire sprinkler connections.

Rod material required to harness six (6) inch to eighteen (18) inch pipe joints is specified in paragraph 30.2.9 of this specification. After the rods are bolted in place, they shall be double wrapped with eight (8) mil thick polyethylene or other approved cold applied tape. In addition to rodding, restraints, bends, fire hydrants and tees shall be kickblocked against undisturbed soil with concrete.

Harnesses, where required, on twenty (20) inch and larger steel and concrete cylinder pipe transmission lines, shall be of a type as specified in AWWA Manuals M-9 and M-11.

E. Retainer Joints: Mechanical joint retainer glands may be used in lieu of rods and clamps for joint harnessing at interference crossings, fire hydrants, tees, bends, offsets, domestic and fire sprinkler connections on PVC and ductile iron mains. (See Paragraph 30.2.10) After the retainers are bolted in place, they shall be double wrapped with eight (8) mil thick polyethylene or other approved cold applied tape. In addition to the retainer gland, all bends, fire hydrants and tees shall be kickblocked against undisturbed soil with concrete.

F. Insulated Joints: Extra care shall be exercised when installing insulating joints. After the insulating joint has been installed, an electrical resistance test shall be performed by an independent corrosion engineering company selected by the City. Should the resistance be found less than 10,000 ohms, the insulating joint shall be removed and any necessary repairs made. The joint shall then be reinstalled and retested. This process shall continue until the joint is successfully tested. Retesting shall be at contractor's expense. Test results shall be submitted to the Project Engineer.

G. Bonding Joints: The contractor shall provide and make two (2) each electrical bonds between the metallic cylinders of adjoining pipe sections and across all non-insulating joints. In line valves shall be made electrically continuous where called for on the drawings.

Electrical bonds shall be installed, one each side of the Pipe crown centerline, at approximately twenty (20) degrees apart, when measured from the pipe centerline. Bonding rods shall be long enough and provide sufficient slack to allow for a total joint displacement of two (2) inches.

Expanded bell and spigot steel joints shall be bonded using #4 AWG insulated copper wire, Cadweld CA-15 brazing cartridges and thermite weld caps. Carnegie end ring joints shall be bonded by welding each end of a 6" x 3/8" steel jumper rod, rolled to the mean diameter of the annular space between the rings, to the bell and spigot.

Bonding across insulated flanged joints or insulated couplings will not be allowed.

30.3.7. Joint Coating and Lining on Steel and Concrete Cylinder Pipe - The inside and outside of all joint recesses shall be thoroughly wiped clean to the satisfaction of the inspector. In this cleaning operation, all water, loose scale, dirt and other foreign material shall be removed from the surface of the pipe joints to be coated and lined in the field.

A. Interior Joint Lining of Welded Steel Pipe Joints: Material used for mortar lining shall conform to AWWA Standard 205. At welded joints, the contractor shall furnish and tack weld 2" x 4" 13/13 gauge self-furred welded wire fabric to the inside of the joint

recess prior to application of mortar. The mortar shall be applied with a uniform pressure producing a smooth surface and a uniform thickness of lining to match the shop applied mortar lining. At no point shall there be an indentation or projection of the mortar which exceeds 1/16 of an inch. Every precaution shall be taken to prevent damage to the lining. After the mortar lining has set sufficiently, clear seal compound "Protex" or equal, shall be applied to the joint lining to the satisfaction of the Project Engineer.

With the approval of the Project Engineer, Probond or equal may be used in place of the welded wire fabric.

B. Exterior Tape Coated Pipe Joints: The exterior of all joints shall be thoroughly cleaned of all foreign material to the satisfaction of the inspector and primed with Polyken #927 primer and wrapped with two (2) wraps of #930 Polyken tape. Each tape layer shall be thirty five (35) mils thick and applied so that joints lap. The primer and tape shall be manufactured by the same manufacturer as the shop applied tape coating.

C. Exterior Cement Mortar Coated Pipe Joints: After cleaning, the outside joint recess shall be filled with grout composed of one (1) part cement and two (2) parts sand. The grout shall be poured under a polyethylene lined grout band placed around the joint recess and thoroughly rodded with a stiff wire. The joint recess at the top shall then be closed with a stiffer grout of the same mix as above. Except for piped joints, prefabricated joint protectors may be used as an alternative to mortaring the outside of the joint. If such protectors are used they shall be made from a high density polyester, polyurethane foam containing at least the equivalent of nine (9) bags per cubic yard of unhydrated Portland Cement. The protectors shall be of suitable cross section to fully protect the joint rings and shall be supplied in the form of continuous rings.

No backfilling around the outside of the joints shall be done until the grout has set, and the joint has been inspected and approved.

D. Interior Cement Mortar Lined Pipe Joints on Steel and Concrete Pressure Pipe: After cleaning, the inside pipe joint recess shall be dry packed filled with a grout composed of one (1) part cement and one (1) part sand. This grout shall be troweled flush with the interior surface, and all excess shall be removed. At no point shall there be an indentation of projection of the mortar exceeding 1/16".

30.3.8. Coating of Flexible Joints, Valves and Fittings for Steel and Concrete Cylinder Pipe - After assembly and cleaning; the exposed metal surface shall then be primed by brush or spraying and then wrapped with two (2) layers of Type II elastomeric tape, all in accordance with AWWA C-209 "Standard for Cold-Applied Tape Coatings for Special Section Connections and Fittings for Steel Water Pipelines".

NOTE: When line pipe, coated in conformance with AWWA C-214 is installed, the appurtenances shall be primed and tape coated using Polyken Primer and Tape.

The two (2) layers of tape, each thirty five (35) mil thick, shall overlap the adjoining pipe sections a minimum of three (3) inches. A final six (6) inch wide tape wrap shall be placed over the above two tape wraps to seal all seams, folds or overlaps.

A. Coating Non-Metallic Pipe Line Appurtenances: Metallic fittings, valves and inline appurtenances installed in nonmetallic water lines, (existing asbestos cement and polyvinyl chloride) may be wrapped in two (2) layers of polyethylene in lieu of the Type II tape as specified above.

The polyethylene shall have a minimum thickness of eight (8) mils and shall be in accordance with AWWA Standard C-105. A two (2) inch wide, ten (10) mil thick polyethylene sensitive tape shall be used to close seams and hold folds over overlaps. Damage to polyethylene wrapped fittings and appurtenances in the trench prior to and during backfill shall be repaired to the satisfaction of the City. All polyethylene wrapping shall be repaired and in a state of readiness prior to tapping a line.

30.3.9. Field Welding Procedures for Steel Water Pipe - Field welding shall be performed in accordance with AWWA C-206 "Field Welding of Steel Water Pipe".

All welding shall be done by skilled welders who have had adequate experience in the method and materials to be used. All welding operators shall be qualified under the provisions of Section 4.4 of referenced specification. Welders shall be qualified by a local approved testing agency not more than six (6) months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the work shall be used in qualification test. The test will include welding an actual field section to the top of the pipe.

The contractor shall furnish all materials and bear the expense of qualifying welders and submit to the City, proof of their certification.

A. Pipe Coating Protection During Welding: An eighteen (18) inch wide strip of heat resistant material shall be draped over the top half of the pipe on each side of the coating holdback during welding to avoid damage to the coating by hot weld splatter. No welding ground shall be made on the coated part of the pipe.

B. Stress Relief: Where more than one (1) welding pass is required, the welding procedures set forth in AWWA C-206 shall be strictly adhered to; all dirt, slag and flux shall be removed before the succeeding bead is applied.

30.3.10. Valves and Valve Boxes - Valves shall be handled in such a manner so as to prevent any injury or damage to any part of the valve. Joints shall be thoroughly cleaned and prepared prior to installation. If so ordered by the Project Engineer, valves shall be operated prior to installation to insure proper operation ability.

A line or outlet valve that is to be buried in soil shall be thoroughly cleaned and then wrapped as specified under exterior coating of flexible joint, valves, etc. above.

All valves shall be installed such that the valve stems are plumb and in the location shown on the drawings with disk seat bolts facing nearest access manhole.

A valve box shall be provided with three (3) inch and larger tapping valves. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the valve wrench nut, with the box cover set to finish grade. It is the responsibility of the contractor to insure that valve boxes are plumb and raised to the proper elevation.

Operating nuts for butterfly valves shall be placed to the north and east of the water main.

Valve box and stem extensions shall be furnished and installed on all valves that are installed in lines buried greater than five (5) feet below finish grade. The top elevation of the operating nut on the valve or valve stem extension shall be no greater than five (5) feet, nor less than three (3) feet below finish grade. This also applies to curb stop valves on service lines.

30.3.11. Marker Posts – When valves, manholes (or bends on mains larger than 12") are installed outside of a paved surface, a marker post shall be installed adjacent to the valve or manhole or on top of the bend. Marker post shall be a 5 foot long 3" diameter steel post set in concrete to a depth of 2 feet. Post shall be filled with soil and capped with 6" of concrete. Post shall be painted fire hydrant yellow.

30.3.12. Service Taps - Service saddles and corporation stops shall meet the standards shown in Table 30.2.1. Taps shall be made only after release of mains by the Public Works Department following their installation, chlorine and pressure testing, payment of appropriate fees and completion of the tap application papers. Service installations shall be performed by a contractor or plumber licensed and bonded with the City of Rifle.

Notification and requests for tapping on mains shall be made in writing to the Public Works Department twenty four (24) hours prior to the time the tap is to be made. The contractor shall excavate, expose the main at least twenty-four (24) inches on all sides, and provide a safe dry trench perpendicular to the main which is considered as being:

A. Three (3) foot wide by five (5) feet long and excavated to a depth of one (1) foot below the main.

B. When unstable ground conditions exist or the trench is deeper than five (5) feet, the trench must be shored, sheeted or sloped and dewatered before making the tap.

PVC pipe shall not be tapped when the ambient temperature or the temperature of the PVC is less than 32 degrees Fahrenheit. If taps are desired when the temperature is less than 32 degrees Fahrenheit any pipe failures will be the responsibility of the contractor and/or developer.

Under no circumstances shall a main be tapped within twenty four (24) inches of the ends of a pipe or pipe collar or within eighteen (18) inches of an existing tap.

Dry tapping of a distribution or lateral main is strictly prohibited unless approved by the Public Works Department.

C. 3/4" through 1" Service Tap - Connection of a 3/4" or 1" diameter service line to four (4) inch through twelve (12) inch laterals or mains shall be made by wet tapping the line by means of a corporation stop installed by the Contractor into an approved service saddle installed by the Contractor. Direct tapping into the line is not allowed. In all instances, the corporation stop, when in place on the service saddle, shall be at an angle of forty-five (45) degrees above springline and perpendicular to the centerline of the lateral or main being tapped.

D. 1 1/2" through 2" Service Tap – 1 1/2" through 2" diameter service line connections to four (4) inch through twelve (12) inch laterals or mains shall also be made by wet tapping the line by means of a corporation stop installed by the contractor into an approved service saddle. The service saddle shall be mounted on the line such that the corporation stop installed is perpendicular to the centerline and at the springline of the lateral or main being tapped.

E. 3" and Larger Service Tap - Three (3) inch and larger service lines shall be connected to the lateral or main by means of an approved stainless steel tapping saddle and resilient seat tapping valve installed perpendicular thereto. Valve boxes and covers shall be installed directly over the valve operating nut on all valves three (3) inches and larger.

30.3.13. Fire Hydrant Laterals - Piping for fire hydrant lateral shall be rodded and/or mechanically retained and clamped between the mechanical joint end of the valve at the main and the fire hydrant. A concrete thrust block shall also be required.

Pipe for the fire hydrant lateral shall be Class 200 PVC (Polyvinyl Chloride) conforming to AWWA C900 and extend perpendicular from the main. The hydrant shall be set plumb at the end of the lateral, face the main and be adjusted to finish grade. The use of horizontal bends, vertical bends and offsets to install the lateral or tapping into the lateral line is strictly prohibited unless approved by the Project Engineer.

30.3.14. Water Service Lines - Water service line pipe (3/4" - 2") from the main to the curb stop and box or to the meter yoke in the pit shall be one continuous length of seamless copper tube of the type designated as Type "K" (soft) in the industry. Three (3) inch and larger service lines shall utilize ductile iron or PVC pipe. The size of the service line shall be the same size as the meter except for a 5/8" x 3/4" meter the service line shall be 3/4". A 4” tapping sleeve and valve may be used on a 3” service. The service line shall be reduced to 3” diameter just outside the meter vault. The service line through and on both sides of the meter pit must be copper and/or brass only for services 2” or less. Leaded joints and galvanized piping shall not be allowed inside meter vaults or on service lines. Installation of increasers or reducers at or between the corporation stop and the meter yoke will not be allowed except on 3” services and no branch connections will be allowed inside the meter vault. Sprinkler system connections must be made a minimum of 5 feet outside of the downstream side of the meter vault.

A bypass is to be installed on all 1½” and larger meters for domestic use. Irrigation only services do not require a bypass. See Standard Drawings.

Service piping between the meter and the building for ¾” – 2” services shall be Type K copper only. Transition fittings for copper shall be Mueller or Ford (or equal) flared fittings or Mueller #110 or Ford Quick Joint (or equal) compression fittings with integral metal insert. Piping for 3” and larger services shall be PVC outside of the meter vault and Ductile Iron inside the meter vault.

Connection of copper to all metallic water mains shall be electrically insulated by means of an approved insulator fitting installed on the corporation stop. After installation, the fitting shall be cleaned and wrapped with a double layer of eight (8) mil polyethylene tape before backfilling. An insulator fitting shall also be installed on the outlet side of the meter setter.

A. Curb Stop Valve, Valve Boxes and Meters: Single family service line installations shall terminate at a meter yoke in the meter pit or curb stop (under approved conditions only) at a point near the property line. Service lines 1 1/2" and larger shall terminate at a curb stop valve and box at or near the property or easement line. See

Standard Drawings. Curb stop valves shall be of the same size as the service pipe. A curb stop valve shall be installed on each service line leaving a manifold.

Locations of meter pits shall be established by the Project Engineer. Installation of curb stop valve and box or meter pit in driveways, parking areas or sidewalks is strictly prohibited. With special approval, heavy duty frames and covers shall be installed in instances where it is impossible to meet the above requirements. See Table 30.2. If the street or ground is not to final grade at the time of meter pit installation, the property owner must raise or lower the meter pit to coincide with final grade when established. Ramneck shall be placed between the dome or set ring and top riser ring and also between all subsequent riser rings. All service line installations including meter settings must be inspected by a representative of the Engineering Division before backfill.

B. Separation of Water Service and Sanitary Sewer Service or Drains: Except as permitted below, the underground water service pipe and the building drain or building sanitary sewer shall be not less than ten (10) feet apart horizontally and shall be separated by undisturbed or compacted earth. Under extenuating circumstances, the water service pipe may be placed in the same trench with the building drain or building sanitary sewer provided prior written approval is given by the City Engineer and the following conditions are met:

1. The bottom of the water service pipe at all points shall be at least twelve (12) inches above the top of the sewer line at its highest point.

2. The water service pipe shall be placed on a solid shelf excavated at one side of the common trench.

3. The water service line is one (1) continuous section of Type "K" copper tubing, joint free.

4. The material and joints of the sewer service pipe shall be installed in such manner and shall possess the necessary strength and durability to prevent the escape of solids, liquids and gases therefrom under all known adverse conditions such as corrosion, strains due to temperature changes, settlement, vibrations and superimposed loads.

C. Service Line Crossing Curb, Gutter and Sidewalks: The point where the service line crosses under an existing or proposed curb, gutter or sidewalk, the curb shall be marked. The point shall be indicated by chiseling a symbol "V" on the curb directly over the service line.

Service lines shall be pushed, bored or jacked through the soil under existing curb, gutters and sidewalks. Tunneling or open trench cutting beneath existing curbs, gutters and sidewalks is strictly prohibited.

For pipe with an internal diameter of twelve (12) inches or less, the depth of backfill over the pipe, measured from official street grade or finish grade to the top of the pipe, shall be four and one-half (4 1/2) feet and shall be known as the pipe cover. If difficulties arise when crossing interferences and where specifically approved by the Project Engineer, deviations of the four and one-half (4 1/2) foot pipe cover may be permitted at a point in the line. A maximum of seven (7) feet of cover shall be maintained in these instances. When approved by the Project Engineer and where the pipe cover is less than four (4) feet, the carrier pipe shall be insulated against frost with an approved insulating material sufficient in thickness to prevent frost penetration and freezing.

D. Service Line Crossing a Foreign Line: A water service line crossing over a foreign line (storm sewers, water transmission lines, etc.) shall be insulated through areas and at points where its bury is less than 4.5 feet. Imcoaflex or equal insulation shall be of sufficient thickness dependent on bury, to prevent frost penetration and freezing of the service line. Butt joints between sections and side slits in insulation shall be duct or mole taped upon placement around service line.

E. Backfill of Service Lines in Streets: Service line trenches cut through surfaced streets or adjacent to existing curbs, gutters, and sidewalks in public ROW shall be bedded using squeegee and backfilled using material conforming to CDOT Class 6 Base Course, Flow Fill or Flash Fill.

Base course backfill shall be compacted by vibrating, tamping or a combination thereof, to ninety-five (95) percent of maximum proctor density when tested in accordance with AASHTO T180. Granular bedding material shall be compacted to seventy (70) percent relative density for sand materials as determined by the relative density of cohesionless soils test, ASTM D-2049. The trench backfill material shall be compacted to within six (6) inches of the finished street grade and the trench then topped out to finish grade with six (6) inches of CDOT Grading S Asphaltic Concrete. Asphaltic concrete shall be placed and compacted in accordance with these standard specifications.

30.3.15. Interruption of Water Service - The contractor must, in writing, advise affected users twenty four (24) hours prior to performing work on a service, distribution or transmission line which will interrupt a customer's supply of water. Contractor prepared notices shall be hand delivered to each customer or occupant. If the occupant cannot be contacted, the written notice shall be left attached to the door knob or screen.

In addition, the contractor must contact City of Rifle's Collection and Distribution (C & D) Department (970-625-2121, extension 324) and schedule the closing of valves necessary to isolate the line or lines on which work is to be performed. Only City personnel are to operate existing system valves or new valves if they are connected to the City system. Also, it is the contractor's responsibility to advise Rifle Fire Protection District (970-625-1243) as to time and interval the system will be down and also the location of all fire hydrants that will be out of service.

A normal outage shall be a maximum of four (4) hours and between the hours of 8:30 a.m. and 3:00 p.m. If the outage will be greater than four (4) hours, the work shall be done in a manner to minimize the inconvenience to users, such as working at night in a continuous operation until service is restored. A connection which will require an outage longer than four (4) hours shall be subject to review by the City as to the appropriate time for the connection. If in the process of installing a connection there exists a customer, industry or building in the area that cannot be out of water such as a hospital, school, etc., the contractor shall take appropriate means to provide and convey potable water to them at all times during the performance of the work.

30.3.16. Sanitary and Storm Sewer Crossings - It shall be the contractor's responsibility to protect all utility, sanitary and storm sewers which either parallel or cross the line being installed.

Contractor cost for protecting parallel or crossing utility sanitary and storm sewers, sprinkler irrigation lines and raw water irrigation pipes and ditches, shall be included in the unit price bid in the proposal for furnishing and installing pipe.

A. Crossing Over Sanitary Sewer: When a water line crosses over a sanitary sewer with less than a two (2) foot clearance between the sewer and water line, the contractor will encase the sanitary sewer with concrete, to a distance of two (2) feet each side of the outside edge of the water line.

B. Crossing Under Sanitary Sewer: When a water line crosses under a sanitary sewer, any VCP sanitary sewer pipe must be replaced with PVC pipe and all joints on the sewer line within ten (10) feet of the water line shall be concrete encased, unless otherwise approved by the Project Engineer.

All drains that previously existed under the sanitary or storm sewer shall be restored in a manner that will not allow any flow in the drain to enter and flow down the trench in which the water conduit is laid. When a water line crosses under a storm or sanitary sewer, compacted bedding must be installed to one (1) foot over the storm or sanitary sewer.

C. Paralleling Foreign Conduits: The City reserves the right to require concrete encasement of pipe joints or the entire pipe of sanitary or storm sewer which are within ten (10) feet and/or less than two (2) feet below the flowline of a water line being installed.

30.3.17. Boring of Casing Pipe and Threading of Carrier Pipe – Boring of casing pipe and threading of carrier pipe shall be completed in accordance with Section 25.5 of these Specifications. Carrier pipe for water mains shall be installed in the casing pipe using approved centering, restraining casing spacers and insulators only. Steel banded skids and chocks are not allowed. Sand filler is also not allowed for water main carrier pipes. End seals of casing pipes shall be rubber boots as described in Section 30.2.14

30.3.18. Special Items

A. Vent Piping: Vent piping from manholes and vaults shall be trenched with a minimum cover of eighteen (18) inches and carried to a location as designated by the Project Engineer in the field, at which point the vents shall be projected to a height of four (4) feet above the ground, or flush with the ground, to permit installation of the six (6) inch vent pipe box assembly. The steel and PVC pipe to be supplied shall be Schedule 40.

B. Painting: All metal exposed to atmosphere or buried in the ground, except aluminum, brass, bronze, or copper, shall be painted.

All exposed metal and that portion of the black steel vent pipes that is to be buried shall be given two (2) coats of CA-1180 mastic cold coating or equal as manufactured by Protecto Wrap Company, Denver, CO, except for metal with shop applied coating approved by the Project Engineer. All metal exposed to the atmosphere shall be painted with one (1) coat of red-lead priming paint and two (2) coats of aluminum paint, unless otherwise directed by the Project Engineer.

All surfaces to be painted shall be cleaned of oil, grease, weld spatters, burrs, grit, dust, or other objectionable surface irregularities. Cleaning solvent used shall be mineral spirits or equivalent.

Paint shall not be applied, except under shelter, during wet, damp, or foggy weather, or when windblown dust, dirt, debris, or insects will collect on freshly applied paint. Paint shall not be applied at an air temperature below fifty (50) degrees Fahrenheit,

or to surfaces of metals, such as the surface of a valve or pipe containing cold water, with a temperature below fifty (50) degrees Fahrenheit regardless of the air temperature, or when metal temperature and atmospheric conditions cause condensation on the surface of the metal.

Painted surfaces which have become damaged prior to acceptance shall be repainted with the same or equivalent paint used in the original application to the satisfaction of the Project Engineer.

C. Trench Support: The trench shall be adequately supported and the safety of workers provided for as required by the Occupational Safety and Health Administration (OSHA). Sheeting and shoring shall be utilized where required to prevent any excessive widening or sloughing of the trench which may be detrimental to human safety, to the pipe or appurtenances being installed, to existing utilities, to existing structures or to any other existing facility or item. Where excavations are made under severe water conditions, the Project Engineer may require the contractor to use an approved sheet piling, instead of sheeting and shoring.

Excavated material shall not be placed closer than two (2) feet from the top edge of the trench. Heavy equipment should not be used or parked near the sides of the trench unless the trench is adequately braced.

D. Test Site and Anodes: The test site and anode installations shall be as called for on the project drawing. If not specified thereon they shall be as shown on City of Rifle Standard Drawings W-63 and W-64.

E. Manholes and Vaults: The contractor shall furnish materials for and construct all manholes and vaults as shown on the drawings. All manholes and vaults shall be so constructed that they are as watertight as practicable throughout the full depth, including the areas where valve operators or blowoffs extend through the barrel or wall sections.

F. Concrete and Reinforcing Steel: Concrete and reinforcing steel to be incorporated in the project shall be furnished and installed in accordance with Section 10 - "Concrete", of these standard specifications.

G. Thrust Anchor Blocks: Thrust anchor blocks shall be placed behind outlets, bulkheads, bends, branches, tees, fire hydrants and fittings which require support due to unbalanced thrust. These anchor blocks shall be Class "B" concrete and of the size and shape indicated in the standard drawings or on the project drawings. Care shall be taken not to block outlets or to cover bolts, nuts, clamps, or other fittings with concrete, making them inaccessible. A polyethylene bond breaker shall be placed between the pipe and the thrust block to aid in future removal. Thrust anchor blocks larger than one (1) cubic yard shall have a minimum of two lifting hooks placed into the top.

The contractor's attention is particularly called to the requirements that the entire face of the excavation against which the anchor block will bear shall be undisturbed earth and shall be flat and at the proper angle with the pipe unless otherwise specified by the Project Engineer.

All forming for concrete thrust blocks and anchors will be done by bulkheading around the shape of the thrust blocks and anchor with bracing or burlap sacks filled with sand or earth. Sacks shall be left in place in the trench. No horizontal struts or braces required for trench shoring shall remain in the concrete kickblocks. Before

any concrete is placed, the excavation for concrete shall be inspected and approved by the Project Engineer and/or City Inspector.

Backfill may be placed over thrust blocks once the surface has set sufficiently to resist the weight of the backfill. However, no tamping or compacting of the backfill shall be allowed above the thrust block for a minimum of twenty four hours (24) after placement of the concrete.

H. Progress of Work - The maximum amount of open trench allowed shall be that amount which, in the opinion of the Project Engineer, is reasonable and prudent for conditions existing at any particular location. That amount may be as little as sixty (60) feet at some locations. It is not the intention of this specification to impede the contractor's progress; however, the Project Engineer will be the judge of the amount of open trench allowed.

In streets, the complete backfilling operation to the finished grade and cleanup operation shall proceed on a continuous basis and shall follow within 150 feet of the installation of the pipe. However, at the end of each working day, pipe backfill shall cover the installed pipe sufficiently to protect the coating and/or lining of the installed pipe. Any deviation from the above requirements shall be made only with the written approval of the Project Engineer.

30.4. TESTING AND CLEAN UP

30.4.1. Testing Cathodic Protection System - The contractor shall furnish all material and properly construct and connect in place a cathodic protection system where called for in strict accordance with contract documents. The contractor shall locate, expose and repair all points along the pipeline, where by testing, there is a lack of electrical continuity or improper isolation. Test stations shall be free of debris or dirt and test leads left with sufficient slack for easy testing and repair. Test stations shall be tagged with the words "City of Rifle" and the diameter of the water main in inches that they are connected to.

The City and/or contractor will employ a corrosion engineering firm to conduct tests and report results obtained during and after completion of the installation or the work may by conducted by City Personnel as determined by the City Engineer. Testing will be performed in accordance with accepted practices as recommended by NACE - "National Association of Corrosion Engineers".

All insulated fittings shall be tested for proper isolation. Electrical continuity tests of the bonded and tied portion of the pipeline shall also be performed. Structure for soil potential measurements, shall be recorded on all protected structures along with DC current outputs of the components. Testing shall be repeated and repairs made, at contractor's expense, until the system is functional and operating to the standard it was designed for.

30.4.2. Testing Pipe Detector Wire – Electrical continuity in the wire must be restored and maintained. City personnel will test for electrical continuity and alignment after trench backfill is complete and after permanent asphalt surfacing is installed, as a condition of warranty acceptance.

30.4.3. Hydrostatic Testing and Disinfecting Lines - Potable water lines shall be hydrostatic tested, disinfected and flushed prior to being placed into service. Line disinfection performed simultaneously with hydrostatic testing must satisfy the requirements of the Colorado Health Departments.

Hydrostatic testing shall only be performed after the line has been cleaned of debris, concrete anchor blocks have cured and all backfill is in place. Water Division personnel shall be the sole operators of existing valves through which water for testing, disinfecting and flushing is obtained.

A. Disinfection of Water Lines: Disinfection of potable water lines shall be performed in accordance with AWWA C651 "Disinfecting Water Mains" and to the satisfaction of the Colorado Health Departments.

Following twenty-four (24) hour soak and absorption time, the residual chlorine content of the water shall be no less than twenty-five (25) milligrams per liter, when tested at any one or all fire hydrants, blow-offs, corporation stops, stub ends, etc., on the line.

Suggested methods of chlorination and their limitations are:

1. Tablet Method: Five (5) gram calcium hypochlorite tablets, each containing 3.75 grams available chlorine, shall only be used when the line cannot be flushed prior to chlorination. The tablet method shall not be used when trench water or foreign materials have entered the water line during installation or the ambient temperature is below forty-one (41) degrees Fahrenheit. The tablets shall be secured to the crown of each pipe section, as it is installed in the trench, with "red" PERMATEX or other approved adhesive. Under normal conditions to obtain the 25 MG/L residual chlorine concentration, after twenty-four (24) hour solution time, will require the use of the number of tablets called for under pipe diameter and opposite pipe joint length as listed below.

Pipe	Tablets per Joint					
Joint Length	6"	8"	10"	12"	14"	16"
13'	2	2	3	5	7	9
20'	3	4	5	7	11	14

2. Continuous Feed Method: This method shall be used when it is necessary to flush the line prior to chlorination or for rechlorination.

Water from an existing distribution source shall be made to flow at a constant rate through the line to be disinfected. Chlorine is then pumped into the line from the water supply source at a rate which will result in a chlorine concentration of no less than 50 MG/L, when tested at any or all accessible discharge locations. The amount of chlorine to be inserted per 100 feet of pipe, to produce 25 MG/L residual concentration after a twenty-four (24) hour solution time, will normally be as shown below.

Pipe Dia. In.	100% Cl. lbs/100 ft.	1% of Cl. Solution gal/100 ft.
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88
14	0.333	3.98
16	0.435	5.20

3. Slug Method: The slug method shall be used for 18" and larger transmission mains or where use of the tablet or continuous feed method are impractical.

   Chlorine in gaseous or super chlorinated liquid form shall be introduced at the water supply source, after the line has been filled. The chlorine slug shall be caused to traverse the entire length of the line, at a velocity, length and concentration, such that the entire interior surface of the pipe is exposed to the equivalent of 300 MG/L of chlorine for at least three (3) hours.

4. Cut and Repair Method: When a water line breaks or is cut into and it is impossible or impractical to rechlorinate using the continuous feed or slug methods, the following procedure shall be used.

   All fittings, valves, couplings and make up pipe sections shall be swabbed with a 5% sodium hypochlorite solution (Clorox) or a 350 MG/L available chlorine solution made from calcium hypochlorite, just prior to being installed. (One 5 g. tablet as specified under the tablet method, dissolved in 10 liters of water is equal to 350 MG/L).

B. Pressure Testing Lines: Once the line has been cleaned of debris and backfilled, the pipe shall be filled with potable water. Filling for pressure and/or chlorination testing shall be done at a velocity rate at which air can be released to atmosphere through fire hydrants, air valves, blow-offs, etc., on the line, without causing surges or damage to the line and its appurtenances. All air within the pipe shall be purged therefrom, and twenty-four (24) hours lapsed time allowed for water absorption into the pipe lining, before pressure testing.

The hydrostatic test pressure shall be the higher of 150 psig at the lowest point in the line or section under test or 1 ½ times normal operating pressure at the connection. Test pressure shall be maintained continuously for a minimum period of two (2) hours. Pressure shall be applied in a manner satisfactory to the Project Engineer with all testing apparatus furnished by the contractor.
Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain the specified leakage test pressure after the air in the pipeline has been expelled and/or displaced with water. No pipe installation will be accepted if the leakage in U.S. gallons per hour is greater than that set forth herein below in accordance with AWWA C600, C605 and M11: Allowable leakage for steel pipe is for O-ring rubber gasket joints only. The allowance shall be zero on all-welded or mechanically coupled steel pipe.

ALLOWABLE LEAKAGE - ELASTOMERIC JOINT PIPE

U.S. GALLONS PER HOUR

Pipe Diameter Inches	Nominal Allowable Leakage per 1000 ft.		
	DIP	PVC	Steel
4	0.37	0.33	
6	0.55	0.50	
8	0.74	0.66	
12	1.10	0.99	

14	1.29	1.16	
16	1.47	1.32	
18	1.66	1.49	
20	1.84	1.66	
24	2.21	1.99	
30	2.76	2.48	5.91
36	3.31	2.98	7.09
42	3.85		8.27
48	4.41		9.45
54	4.97		10.63

The City reserves the right to substitute its own calibrated meter and/or pump for the contractor's meter or pump for testing.

C. Flushing Super Chlorinated Water Lines: Prior to connecting super chlorinated lines to the City system, the lines shall be flushed with potable water until the residual chlorine does not exceed 1.0 parts per million. Care in flushing must be taken to prevent erosion and/or killing desirable vegetation. The contractor is responsible in providing any special materials or supplies to meet this requirement.

Super chlorinated water in the line must be dechlorinated so that no more than 1.0 ppm chlorine residual is detected prior to release to streets or into storm sewers, ditches, streams and/or their tributaries. Contractors proposed method of dechlorination must be approved by the City Engineer and be performed within the limits set forth in the NPDES permit, as issued to the City by the Colorado Department of Health. Sodium Thiosulfate Pentahydrate XTL can be used as a dechlorinator, available from Van Waters & Rogers, Inc. If the super chlorinated water is released to a dirt area that will not run to a receiving water then the requirement to dechlorinate may be waived by a representative of the City's Water Quality Section.

A City representative shall be present and operate all valves during flushing and dechlorination of lines.

30.4.4. Connecting to City System - Connection to the City system shall be in a neat and workmanlike manner. An inspector shall be present at all times during the construction of the connection. Under no circumstances shall a non-disinfected main, which cannot be isolated, be connected to an existing disinfected main. Disinfection of the line shall meet the requirements of the City of Rifle, Jefferson County and Colorado Health Departments.

The City is not responsible for water tightness of its valves and existing facilities. If existing valves leak, the City will assist in reducing the influx of water as much as possible, but the contractor must use methods at his own disposal at his own cost to work with the resulting leakage.

When connecting lines to the City water system, it may be necessary to operate new and existing valves. Valves on or connected to the City system must be operated by City personnel only. The City system includes lines that have been recently placed in service even though no taps have been made off of the mains. The contractor shall give the inspector twenty-four (24) hours notice to arrange for operating the valves. Both the contractor and the inspector shall be present when the valves are being operated.

A. Placing Line in Service: A line will only be accepted for tapping and/or placing in service after all of the following conditions have been met:

1. The main has been installed to the satisfaction of the inspector and all pertinent notes and measurements have been made.

2. The main has been successfully filled, chlorinated, de-chlorinated and pressure tested to the requirements of the City of Rifle.

30.4.5. Housekeeping, Restoration and Cleanup

See Section 5 of these standard specifications.

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 35.

INDUSTRIAL PIPING, EQUIPMENT & STEEL TANK REHABILITATION

35.1. GENERAL

Rehabilitation work on industrial piping, clarifiers, floculators, flumes, steel tanks, etc., owned and/or operated by the City shall be performed in accordance with approved engineered plans, these specifications and the General Conditions of the Engineering Code of Standard and Specifications for the Design and Construction of Public Improvements of the City of Rifle.

Rehabilitation shall consist of the preparation and painting of submerged and exposed metal surfaces, and the furnishing and installation of cathodic protection material and equipment to control corrosion of the metal. Hangers for anode systems shall be installed immediately following blasting of the steel surface, then primed and painted in accordance with the requirements set forth herein.

Anodes and collector circuits shall be installed after the paint system has been applied. Rigid conduit and appurtenances shall be installed immediately after exposed surfaces have been primed.

Cathodic rehabilitation and painting of industrial metal surfaces shall be coordinated by the general contractor. Cathodic reconditioning shall be performed by a qualified cathodic protection company certified by NACE. Paint systems shall be applied by a firm specializing in industrial piping and equipment painting.

35.2. MATERIALS

Materials that are to be furnished, applied on or installed shall conform to the minimum standards hereinafter referred to.

Materials and workmanship shall conform, be equal or exceed the minimum standards as set for by the American Society for Testing Materials (ASTM), the American Association of State Highway Testing Officials (AASHTO), the American Water Works Association (AWWA), the National Association of Corrosion Engineers (NACE), Steel Structures Painting Council (SSPC), Federal Specifications, Bureau of Reclamation Paint Manual, etc. Reference standards shall be of the latest edition or revision thereof.

35.3. PREPARATION OF STEEL SURFACE FOR PAINT SYSTEM

Unless modified in the special conditions, submerged and/or exposed metal surfaces shall be blast cleaned in accordance with Steel Structures Painting Council (SSPC) procedures, to the degree of surface cleanliness as herein below specified and defined, prior to applying the paint system.

35.3.1. Near White Cleaned Metal Surface SSPC - SP1O - Tank Interior and Submerged Surface - A near-white blast cleaned surface finish is defined as one from which all oil, grease, dirt, mill scale, rust, corrosion products, oxides, paint or other foreign matter have been completely removed from the surface except for very light shadows, very slight streaks, or slight

discolorations caused by rust stain, mill scale oxides, or slight, tight residues of paint or coating that may remain.

At least 95% of each square inch (645.2 sq. mil.) of surface area shall be free of all visible residues, and the remainder shall be limited to light discoloration mentioned above.

35.3.2. Commercial Cleaned Metal Surface SSPC - SP6 - Exterior and Non-submerged Surface - A commercial blast cleaned surface finish is defined as one from which all oil, grease, dirt, rust scale and foreign matter have been completely removed from the surface and all rust, mill scale, and old paint have been completely removed except for slight shadows, streaks, or discolorations caused by rust stain, mill scale oxides or slight, tight residues of paint or coating that may remain; if the surface is pitted, slight residues of rust or paint may be found in the bottom of pits; at least two-thirds of each square inch (.00065 sq. mil) of surface area shall be free of all visible residues and the remainder shall be limited to the light discoloration, slight staining or light residues mentioned above.

35.3.3. Treating Blast Cleaned Metal Surfaces - Blast cleaned surface shall be primed within eight (8) hours after blasting when practicable, but in any event not later than twenty-four (24) hours after blasting and before any visible or detrimental rusting occurs. Surfaces which rust before painting is accomplished shall be recleaned by the Contractor at his expense.

35.4. PAINT SYSTEM

Metal surfaces after blast cleaning, shall be primed and painted using today's (standards and practices) best technology and materials pre-approved by the Engineering Division. No request for material substitution will be considered that would decrease film thickness, number of coats or alter a change in the generic type of coating specified. Paint application and dry film thickness shall conform to AWWA Inside System No. 1

35.4.1. Submerged Metal, Tank Interior Non-Submerged

Surface Preparation: SSPC-SP10, Near White Blast Cleaning

Coat	Color	Paint System	Dry Film Mils
Prime	Beige	Tnemec 20-1255 Pota-Pox Cook Epicon MW High Build Epoxy	4.0 - 6.0
Finish	White	Tnemec 20-2000 Pota Pox Cook Epicon MW High Build Epoxy	4.0 - 6.0
			8.0 - 12.0

35.4.2. Non-Submerged Metal

Surface Preparation: SSPC-SP6, Commercial Blast Cleaning

Coat	Color	Paint System	Dry Film Mils
Prime	Red	Tnemec 66-1211 Hi-Build Epoxoline Cook-Co poxy Primer	4.0 - 6.0
Finish	Desert Sand	Tnemec Series 71 Endura - Shield Cook-Acrothane	1.5 - 2.5
			5.5 - 8.5

35.4.3. Steel Tank Exterior

Surface Preparation: SSPC-SP6, Commercial Blast Cleaning

Coat	Color	Paint System	Dry Film Mils
Primer	Aluminum	TNEMEC 50-330 Poly-URA-Prime Cook-Corothane 502	2.5 - 3.0
Finish	Desert Sands	TNEMEC Series 73 Endura Shield III Cook-Acrothane II	4.0 - 5.0
			6.5 - 8.0

35.5. PAINTING

Paint shall be homogeneous, free of contaminants, and of a consistency suitable for the use for which it is specified. The pigment shall be finely ground and properly dispersed in the vehicle according to the requirements of the paint; and this dispersion shall be of such nature that the pigment does not settle appreciably, does not cake or thicken in the container, or become granular or curdled. Paint and paint materials shall be delivered to the job site in new, unopened, air-tight containers, appropriately identified with the manufacturer's name, date of manufacture, type of paint or paint material, state specification number, lot or batch number, and accompanied with an M.S.D.S. sheet.

35.5.1. Weather Conditions and Ventilation - Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather. Except as provided herein, painting will not be permitted when weather conditions are such that the receiving surface temperature is at or below 50 degrees F, or when freshly painted surfaces may become damaged by rain, fog, or condensation. If fresh paint is damaged by the elements, it shall be replaced by the contractor at his expense. Coatings are to be applied in accordance with the paint manufacturer's printed instructions.

Inside tank or buildings, the contractor must provide adequate ventilation which will effectively remove air borne dust and evaporated solvents within the specified drying time of the paint. Ventilation shall meet current Occupational Safety and Health Administration (OSHA) standards. Provisions must also be made to artificially control atmospheric conditions within limits suitable for painting inside and throughout the painting operation. The cost of providing and maintaining such conditions shall be considered as included in the prices paid for the various contract items of work and no additional payment will be made therefore.

35.5.2. Thinning Paint - Thinning shall be per manufacturer's printed instructions.

35.5.3. Application - Painting shall be done in a neat and workmanlike manner. Unless otherwise specified, paint shall be applied by brush, roller, or spray methods in accordance with the paint manufacturer's recommendations.

The prime coat shall be applied by brush to all weld seams, bolt heads, sharp corners and edges, immediately following blasting. The City Engineer or his representative shall determine which areas must be brushed. **It is anticipated that 90% of all edges or corners will be deemed "sharp" and therefore need to be brushed.** Care shall be exercised to insure that all close areas are holiday free. Also, paint shall be considered to have been improperly applied if an inordinate amount of residual brush marks remain.

Where spray methods are used, the operator shall be thoroughly experienced. Runs, sags, thin areas in the paint coat, or skips and holidays shall be considered as evidence the work is unsatisfactory and the contractor may be required to apply the remainder of the paint by brush.

A water trap acceptable to the engineer shall be furnished and installed on all equipment used in spray painting.

Mechanical mixers shall be used to mix the paint a sufficient length of time to assure a thorough mix of the pigment and vehicle. To keep the pigment in suspension, paint shall be kept thoroughly mixed while being applied.

35.5.4. Paint Coats - Excessively thick coats of paint will not be permitted. The thickness of each coat shall be limited to that which will result in uniform drying throughout the paint film. All previous coats of paint shall be dry and fully cured and the surface of the paint coat being

covered shall be free from moisture, dust, grease, or any other deleterious material which would prevent the bond of the succeeding paint coats.

The dry film thickness of each coat of paint shall be measured in place with a calibrated magnetic film thickness gauge by the contractor, in the presence of the project engineer or his authorized representative. Each surface coat of paint shall also be of a different color.

35.5.5. Curing - Elapsed time for curing between brush and/or roller priming of weld seams, interior primer and finish coat shall be in accordance with the paint manufacturer's recommendation. The cure time between finish coat and immersion in water of the painted surface shall be equivalent to seven (7) days at a mean average temperature of 75 degrees F.

35.5.6. Protection of the Work - The contractor shall protect all parts of the structure against disfigurement as a result of his blasting and painting operations. The contractor shall be responsible for any damage caused by his operations to vehicles, persons, or adjoining property, and shall provide at his expense protective means to guard against such damage.

Paint stains on adjacent improvements which result in an unsightly appearance shall be removed by the contractor at his expense.

When ordered by the engineer to abate a dust nuisance and to protect the wet paint film, the contractor shall dampen the adjacent areas with water at his expense on each side of the location where painting is in progress. The contractor shall furnish and post at his expense DRIVE SLOWLY signs and take other Precautions necessary to prevent dust and dirt from accumulating on freshly painted surfaces.

35.5.7. Housekeeping and Cleanup - At all times during the performance of the work, the contractor shall maintain the site in a reasonable state of order and cleanliness. Upon completion the contractor shall remove from the job site all sand, rubbish, unused materials, etc., and repair any damages resulting from his operation, leaving the site in a condition equal or better than existed at the commencement of the work.

35.6. CATHODIC PROTECTION SYSTEM FOR STEEL TANKS

The cathodic protection system shall be installed in tanks which are subjected to freezing and thawing cycles during the winter months. The system shall be of the submerged anode type.

The system shall be designed for and demonstrated capable of continuously providing one milliampere of direct current per square foot of interior tank wall and bottom surface.

35.6.1. Rectifier - The rectifier unit shall be housed in a weather proof cabinet with provision for locking. The rectifier shall be selenium or silicon, and shall be equipped with an integral AC isolation transformer, a unit voltmeter and a separate ammeter for each output circuit. The secondary voltage output shall be manually adjustable in 20 or more equal steps from 0-100% of rated capacity. The rectifier shall be as manufactured by Good-All, or approved equal.

35.6.2. Automatic Controller - The controller shall be housed integrally with the rectifier unit in the weatherproof cabinet. The automatic controller shall be of completely solid state design, having no moving Parts, and shall be capable of automatically maintaining the tank-to-water potential at (-)900 millivolts with respect to a copper-copper sulfate reference electrode within an accuracy of 25 millivolts. The tank-to-water potential measured and maintained by the controller shall be free of "IR" drop error.

35.6.3. Tank-to-Water Potential Meter - The controller shall be equipped with a calibrated voltmeter which shall be so connected to read, from the system reference cell, the tank-to-water potential being maintained by the cathodic protection system. This voltage reading shall be free of "IR" drop error.

35.6.4. Reference Electrode - The system shall be equipped with either a copper-copper sulfate or silver-silver chloride reference electrode designed for a minimum five-year life. A second similar reference electrode shall also be installed for system verification testing purposes.

35.6.5. Conductors - All wiring shall have Type "TW" insulation and shall be sized in accordance with the National Electric Code. All wiring installed underground shall have High Molecular Weight insulation for direct burial use. Ground connection of the negative lead shall be made at an accessible point on the tank structure.

35.6.6. Conduit - All conduit shall be of rigid galvanized steel.

35.6.7. Anode - The submerged anode system shall utilize a platinized niobium wire anode. The anode system shall be attached to a stabilized structure which is maintained in a totally submerged condition below the minimum ice free water level by flexible attachment to the tank wall. The anodes shall have a minimum design life of 10 years. Anode and reference electrode lead wires shall enter the tank below the minimum winter ice-water level, through pressure tight fittings.

35.7. SPECIAL REQUIREMENTS FOR CATHODIC PROTECTION SYSTEM

35.7.1. Power - The owner shall make 115V, 60 HZ single phase AC power available to the site. The contractor shall be responsible for furnishing and installing all conduit and wire necessary to connect the rectifier unit at the tank with the power source.

35.7.2. Pre-Construction Submittals - Before any material or equipment is purchased, the contractor shall submit for approval in quadruplicate, design calculations, a complete list of materials and equipment to be incorporated in the work and the engineering drawings for the submerged anode system(s). The list shall include catalog numbers, cuts, diagrams, drawings and other descriptive data as may be required by the City Engineer. No consideration will be given to partial lists submitted from time to time. Approval will be based on the manufacturer's published ratings. Any materials and specification requirements not in compliance with specifications will be rejected and must be revised and resubmitted.

35.7.3. Criteria for Protection - The cathodic protection system shall be capable of automatically maintaining a tank to water potential of (-) 900 millivolts plus or minus 25 millivolts on the entire submerged surface with respect to a copper-copper sulfate reference electrode, which is measured free of electrolyte IR drops. The tank-to-water potentials at which the cathodic protection system is set to operate shall be in accordance with the criteria for protection of steel as established by the National Association of Corrosion Engineers in the NACE Standard RP-01-69.

35.7.4. Installation - The system installation shall be coordinated by the general contractor. Installation shall be by personnel who are specifically trained in this type of work and who are engaged full time in the installation and servicing of cathodic protection equipment. Installation of the submerged anode system and testing thereof shall not be made until the paint system has cured for 7 days.

35.7.5. Energizing and Testing - After the installation is completed, the system shall be energized and adjusted for optimum operation by a trained employee of the design engineer. After the unit is adjusted, measurements of tank-to-water potential shall be taken using a copper-copper sulfate half cell a reference electrode. A report shall be submitted which includes all of the test results obtained.

Note: Permanent induction of current into the anode system will not be allowed until the interior paint system has cured for 28 calendar days.

35.7.6. Training Owner's Personnel - The cathodic protection engineer or his representative responsible for the design and installation of the system, shall check the installation of the equipment, direct the energizing and testing and train owner personnel in the operation and maintenance of the system. A minimum of four hours shall be allocated to training. All costs for such service shall be included in the amount shown on the Bid Schedule for Cathodic Protection.

35.7.7. Post-Construction Submittals - Triplicate copies of all fabrication assembly and installation drawings, together with detailed specifications of the design and function of the voltage control system and an 0&M Manual for the system shall be submitted to the Owner, prior to their placing the system under warranty.

35.7.8. Re-testing - At the end of the one year warranty period, the installing cathodic protection engineering firm shall re-test the system and submit an attendant report to the City. Re-testing shall be performed in the presence of the owner's operation and maintenance personnel. All cost for retesting service shall be included in the amount shown on the Bid Schedule for Cathodic Protection.

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 36.

CHAIN LINK FENCES AND GATES

36.1. GENERAL

Fencing of City property shall be performed in accordance with approved engineered plans, these specifications and the General Conditions of Rifle's Standard Specifications and Drawings for Design and Construction.

36.2. MATERIALS

Fencing shall be eight (8) feet high unless otherwise specified. All fencing materials shall be hot dip galvanized after fabrication. Fencing shall be topped with three (3) lines of barbed wire unless otherwise specified. Contractor shall furnish and install new, first quality, items specifically manufactured for the intended application. Installation shall include fencing, gates, and all appurtenant work complete in place, in accordance with these contract documents.

A. Fence fabric shall be No. 9 gate galvanized steel wire, 2-inch mesh. The fabric shall have a knuckled finish on the top edge and a twisted and barbed finish on the bottom edge.

B. Fabric ties shall be No. 9 galvanized steel wire, spaced 14 inches apart on posts and 24 inches apart on rails. Aluminum ties will not be permitted. A continuous No. 7 gauge galvanized steel wire shall be interlaced with the fabric or attached to the fabric with clips along the extreme bottom of the fence.

C. All posts shall be one-piece without circumferential welds, and shall be:

1. Line posts shall be 2-inch schedule 40 pipe, 3.65 lbs. per foot.

2. End and corner posts shall be 2-1/2-inch schedule 40 pipe, 5.70 lbs. per foot.

3. Gate posts shall be 3-1/2-inch schedule 40 pipe, 9.1 lbs. per foot.

D. Top rail and braces shall be 1-1/4-inch schedule 40 pipe, 2.27 lbs. per foot.

E. Barbed wire shall be 2-strand, No. 12-1/2 gauge zinc-coated steel or iron wire with 4-point, 14 gauge barbs spaced not more than 5 inches apart.

F. Stretcher bars shall be 1/4-inch by 3/4-inch steel bars and steel bands for fastening stretcher bars to the posts shall be 1/8-inch by 3/4-inch.

G. Nuts, bolts and screws shall be of steel, hot-dipped galvanized after fabrication, minimum size 3/8-inch diameter.

H. Swing gate frames shall be constructed of pipe at least as heavy as the top rails for the fence and shall be fabricated by welding with all welds ground smooth prior to hot-dip galvanizing. Each gate leaf shall be provided with at least one diagonal brace. Frames shall be galvanized after fabrication. Galvanized malleable iron fittings for latching the gate shall be provided. Swing gates shall be hung by at least

2 steel or malleable iron hinges not less than 3 inches in width. Fabric shall match the fabric used in the fence. Each pair of gates shall be provided with a heavy drop rod latch assembly with a locking device for a padlock.

I. Concrete shall have a minimum compressive strength of 2,000 psi at the age of 28 days.

36.3. INSTALLATION

A. All earth, brush, or other obstructions which interfere with the proper alignment of construction of fences shall be removed and disposed of.

B. Line posts shall be spaced at not more than 10-foot intervals, measured from center to center of the posts and generally parallel to the ground slope. Posts shall be set plumb and shall be centered in 12-inch diameter concrete encasement extending 36 inches into the ground.

C. Changes in the fence lines, where the horizontal angle is 15 degrees or more, shall be considered as corners and corner posts shall be installed.

D. Bracing shall be provided at all end, gate, and corner posts, the latter in both directions. Horizontal brace rails shall be set midway between top rail and ground running from the corner, end, or gate post to first line post. Diagonal tension members shall connect tautly between posts below horizontal braces.

E. Corner posts shall be installed in lieu of line posts at intervals not exceeding 500 feet and shall be braced horizontally in both directions.

F. The chain-link fabric shall be fastened on the side of the posts as shown or as designated by the engineer. The fabric shall be stretched and securely fastened to the posts, and between the posts, the top and bottom edges of the fabric shall be fastened to the top rail and tension wire, respectively. The tension wires shall be stretched tight with turnbuckles at the end and corner posts. The bottom tension wire shall be installed on a straight grade between posts.

G. The fabric shall be fastened to the end, corner, and gate posts with stretcher bars and stretcher bar bands spaced at approximately 14 inches on line posts and at approximately 18 inches on tension wires.

H. Encasement concrete for footings shall be placed immediately after mixing in a manner such that there will be no concentration of the large aggregates. The concrete shall be consolidated by tamping or vibrating in an approved manner. Concrete for footings may be placed without forms, providing the ground is firm enough to permit excavation to neat line dimensions. Prior to placing the concrete, the earth around the hole shall be thoroughly moistened. The concrete shall completely fill the hole and top surfaces of the concrete encasement shall be sloped outward to shed water and shall have a neat appearance. Not less than 7 days shall elapse after placing the concrete footings before the fence fabric or barbed wire is fastened to the posts.

I. Any galvanized coating damaged during construction of the fencing shall be repaired by application of molten Galvo-Weld; Galvinox; or equal.

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 40.

SPRINKLER IRRIGATION SYSTEMS

40.1. GENERAL

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

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 Project Manager any deviations between the drawings, specifications and the site. Failure to do so prior to installing the equipment, resulting in replacing and/ or relocating equipment, shall be done at the Contractor's expense. Any inconsistencies shall be noted by the Project Manager and a written copy of the corrections shall be given to the Contractor.

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 Project Manager for final inspection with date and time given, at least seventy-two hours in advance.

40.2. DRAWINGS

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 Owner's approval without further cost to the Owner.

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 Owner of any discrepancies between the drawings and the site.

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.

Omissions from the specifications or drawings or any misdescription 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.

The Owner will supply the Contractor 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 Owner at the time of acceptance. *Contractor shall supply to the Project Manager four 8.5" x 11" drawings of the as-built and a C.D. Rom disc file of the final as-built drawings. The Contractor will provide two 24" x 36" hard copy drawing sets to the City.*

The Contractor shall dimension from two permanent reference points (such as sidewalks, road intersections, manholes, abutment walls, etc.) the location of the following items:

(a) Connections to existing water lines.
(b) Public Service electric supply connections.
(c) Sprinkler control valves.

The Contractor shall deliver, on or before the date of final inspection, the corrected and completed Record Drawings to the Owner or Project Manager. Delivery of the Record Drawings will not relieve the Contractor's responsibility to provide location information during the one year guarantee period.

40.3. 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.

40.4. 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 Owner'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.

40.5. TESTING

A. Notify the Owner'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 Owner'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 visual 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 gate valves and sprinkler lateral isolation gate 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 gates 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 120 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. The Owner'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 Owner.

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 Owner'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.

40.6. CONSTRUCTION REVIEW

The purpose of on-site reviews by the Owner'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.

A. Scheduled reviews such as those for irrigation system layout or testing must be scheduled with the Owner's Representative as required by these specifications.

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

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

40.7. GUARANTEE/WARRANTY AND REPLACEMENT:

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

A. For a period of one year from commencement of the formal maintenance period, guarantee/warranty irrigation materials, equipment, ad 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 Owner's Representative.

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

C. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

40.8. MATERIALS

40.8.1 QUALITY

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

40.8.2. 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 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.

40.8.3. SLEEVING:

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 PVC Class 200 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.

40.8.4. PIPE AND FITTINGS:

A. Mainline Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-13, ASTM Standard D1784, with an integral belled end.

2. Use Class 200, SDR-21, rated at 200 PSI, conforming to the dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 200 in the case of small nominal diameters which are not manufactured in Class 200.

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 D1 784. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564.

5. No plowing/pulling of mainline accepted.

B. Lateral Pipe and Fittings

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-13, ASTM Standard D1784, with an integral belled end suitable for solvent welding.

2. Use Class 160, SDR-26, rated at 160 PSI, conforming to the dimensions and tolerances established by ASTM Standard D2241. Use solvent weld pipe for lateral pipe.

   Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1 784 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.

3. For drip irrigation laterals downstream of riser connections, use 3/4-inch UV radiation resistant Netafim Techline 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.

   Use Techline 17mm (.057") insert fittings with the Techline drip lateral pipe. Use tubing stakes or landscape fabric staples to hold above-ground pipe in place.

4. No plowing or pulling of lateral lines accepted.

C. Specialized Pipe and Fittings:

1. Ductile iron pipe: Use Class 50 conforming to ANSI A21.51 (AWWA C151). Use a minimum of Class 53 thickness pipe for flanged piping.

   Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).

2. 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.

3. Assemblies calling for threaded pipe connections shall utilize PVC Schedule 80 nipples and PVC Schedule 40 or 80 threaded fittings.

4. 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. Use thrust blocks for fittings on pipe greater than or equal to 3-inch diameter or any diameter rubber gasketed pipe.

2. Use 3,000 PSI concrete.

3. Use 2 mil plastic.

4. 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.

40.8.5. MAINLINE COMPONENTS

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

B. Winterization Assembly: as per local practice and in compliance with local code.

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 3/4-inch gravel for each assembly with a 2-inch operator.

E. Quick Coupling Valve Assembly double swing joint arrangement as presented in the installation details.

40.8.6. SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals: Provide Rainbird GB Series brass valves 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 3/4-inch gravel for each assembly.

B. Sprinkler Assembly: Provide Rainbird alcon models F4-FC-SS-HS and F4-PC-SS-HS as presented in the drawings and installation details. Use the sprinkler manufacturer's pressure compensating screens (Rain Bird PCS) to achieve 30 PSI operating conditions on each sprinkler and to control excessive operating pressures.

40.8.7. 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. Install a separate valve box over a 3-inch depth of 3/4-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 3/4-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 3/4-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 3/4-inch gravel for each assembly.

40.8.8. CONTROL SYSTEM COMPONENTS

A. Irrigation Controller Unit

1. As presented in the drawing specifications and installation details.

2. Lightning protection: Provide 8-foot copper-clad grounding rod at controller location. Use American Wire Gauge No. 6 bare copper wire between the controller and grounding rod assembly.

3. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading 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. Install low voltage wires using the following color coding:

Controller "A" control wires: Red
Controller "A" common wire: White with Red stripe

Controller "B" control wires: Orange
Controller "B" common wire: White with Orange stripe
Spare wires from master valve locations to future stub-out locations: Green
Spare control wires along wire routing from each controller: Yellow
Spare common wires along wire routing from each controller: Yellow with Blue stripe

Splices: Use wire connector with waterproof sealant. 3M DBY. Contractor will label valve wires.

Valve wires - Red
Common wires- White
Spare wires - Yellow
Master valve wire - Blue
Flow meter wire - Orange

4. 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 bermaid master valve to controller "B". These four wires need to be two different colors. Contractor must numerically label all valve wires.

5. 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."

C. Existing Control Wire

1. 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' 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.

   Fittings for PVC conduit shall be Schedule 40, Type 1, PVC solvent-weld sweep fittings, ASTM Standards D2466 and D1784.

5. Lightning protection: Provide 8-foot copper-clad grounding rod at each controller location.

6. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading 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.

3. Conduit: PVC Schedule 40.

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."

40.8.9. 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 City of Rifle 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.

40.9. EXECUTION

40.9.1. INSPECTIONS AND REVIEWS:

A. Site Inspections:

1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Owners 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 Owner's Representative at this review.

40.9.2. LAYOUT OF WORK:

A. Stake out the irrigation system. Items staked include: sprinklers, Techline 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.

40.9.3. 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. 36" over mainline pipe and over electrical conduit.

2. 36" over control wire.

3. 15" over lateral pipe to sprinklers and over supply header lateral pipe to drip system riser connections.

4. Netafirn Techline 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 and compacting to the 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 Owner'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 I 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 City of Rifle.

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. Submit manufacturer's analysis.

7. Notify the City of Rifle 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 City of Rifle to be necessary the area will be regraded, 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 City of Rifle, 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, of 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 City of Rifle after contract signing.

9. Sodding dates must be approved by the City of Rifle.

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

40.9.4. <u>SLEEVING AND BORING:</u>

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

B. Extend sleeve ends six inches 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 Owner's Representative.

40.9.5. ASSEMBLING PIPE AND FITTINGS:

A. General:

1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.

2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.

3. 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 the pipe lengths. No deflection will be allowed at a pipe joint.

	RADIUS	OFFSET PER 20' LENGTH
	25'	7'-8"
	25'	7'-8"
	100'	1'-11"
	100'	1'-11"
	100'	1'-11"

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 priver 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. Techline Dripperline 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. Ductile Iron Pipe:

a. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.

2. Low Density Polyethylene Hose: Install per manufacturers recommendations.

3. No galvanized pipe will be allowed.

4. 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.

5. 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:

1. Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.

40.9.6. 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.

40.9.7. 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 manufacturers recommendations.

3. Install a ball valve in front of each valve. Install only one RCV to a valve box. 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.

40.9.8. 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.

4. Arrange grouped valve boxes in rectangular patterns.

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

C. Techline Emitter Grid Layout

1. Locate as shown on the drawings and installation details.

2. Flush lateral supply header pipe before installing Techline grid.

3. Use tools and techniques recommended by the manufacturer.

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

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

40.9.9. INSTALLATION OF CONTROL SYSTEM COMPONENTS:

A. Irrigation Controller Unit

1. The location of the controller unit as depicted on the drawings is approximate; the Owner's Representative will determine the exact site location upon commencement of contract.

2. Lightning protection: Provide grounding components such as ground rod 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. Identifying wire and valve box lids numbering will be in sequential order of our Motorola system furnished by the City and given to the contractor prior to installation. Contractor will pour pad for Motorola controller and strong box for backflow device. Template will be supplied by the City.

5. 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.

6. Install combination switch/GFCI outlet inside the controller enclosure.

7. 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 instructions. 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 above 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. Contractor will set Motorola controller on concrete pad and supply 110 electrical power to controller from the nearest approved (by Public Service and owner) power source.

2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.

3. Green wire shall be used as the common ground wire from power source to all satellites.

4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.

5. Encase power wire in electrical conduit with a continuous run of warning tape placed in the backfill, 6-inches above the wiring.

40.9.10. INSTALLATION OF OTHER COMPONENTS

A. Tools and Spare Parts:

1. 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.

40.9.11. 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 construction completion, obtain from the Owner's Representative a reproducible Mylar copy of the drawings. Mylars or CAD data files compatible with AutoCAD software, can be purchased from the Engineer. Cost of Mylar reproducible drawings is $25 per sheet and the cost of AutoCAD data files on diskette is $25 per file. Using technical drafting pen or CAD, duplicate information contained on the project drawings maintained on site. Label each sheet "Record Drawing".

D. Turn over the "Record Drawings" to the Owner's Representative. Completion of the Record Drawings will be a prerequisite for the Review at the completion of the irrigation system installation.

40.9.12. WINTERIZATION AND SPRING START-UP

A. 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 in improper winterization at no additional cost to the Owner. Coordinate the winterization and start-up with the landscape maintenance personnel.

40.9.13. MAINTENANCE:

A. Upon completion of construction and Review by the Owner'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 Owner 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.

40.9.14. CLEANUP

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

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 45.

PLANT LANDSCAPING

45.1. GENERAL

Fertilizing, seeding, mulching, sodding, planting, or transplanting of trees, shrubs, or other plants required to provide landscaped areas for the City shall be supplied and installed using current approved horticultural practices, these specifications and the contract documents. See Chapter 12 of Rifle Municipal Code, Title 17

45.2. MATERIALS

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

45.2.1. Shrubs, Trees and Other Plants - 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, a well as all federal regulations governing interstate shipment of nursery stock.

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.

The contractor shall be responsible for and furnish the City 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.

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

A. 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.

B. 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, as manufactured by Kraft or 3M. Waterproof tape will be used to hold the wrap in place.

C. 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 and specifications.

D. 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.

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 in 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 manger prior to delivery.

5. Miracle Compost as manufactured by Majestic Mushroom Company, Golden, Colorado.

45.2.2. 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 filter fabric (Myrify, Typar, Trevira) will be used in shrub beds or tree pits if designated on the drawings.

45.2.3. Grass Materials - All bluegrass seed shall be eighty percent "Baron" bluegrass and 20 percent "Pennfine" rye grass unless otherwise indicated in the plans, drawings or specifications. Other blends will not be allowed unless specifically called for in the special conditions.

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.

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 - Dyed wood cellulose fiber that is free of any substance which will inhibit germination or grass growth, will evenly dispense and suspend when agitated in water, will absorb water while allowing infiltration and when air dry will contain less than ten percent moisture especially at the time of delivery.

Cellulose fiber shall be supplied in packages, having a gross weight of 100 pounds or less and marked to show the air dry weight content.

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.

45.3. TREE, SHRUB AND PLANT LANDSCAPING

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

45.3.1. Transplanting of Plants - 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.

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.

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.

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

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

45.3.2. Pruning - 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 project manager, may be required.

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.

45.3.3. Excavating for Planting Pits - 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 suitably 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.

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.

45.3.4. Planting Trees and Shrubs - 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.

Excavation for planting shall not commence until the project manager has staked all planting pits or shrub 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.

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.

In irrigated areas all deciduous trees will be planted two (2) inches above finished grade, evergreen trees will 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 and cord removed from each tree will be set to the side of the newly planted tree for inspection by the project manager.

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 (1/2) to two and one-half (2 1/2) inch caliper. Shrubs shall have two (2) tablets each placed 180 degrees apart in the pit.

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.

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

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.

45.3.5. 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.

45.4. GRASS LANDSCAPING

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

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.

45.4.1. Season for Planting Grass Seed - 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:

Grass Area	Early Season	Late Season
Sprinkler Irrigated	March 1 to April 15	September 1 to October 1
Non-Irrigated	March 1 to April 15	---------

Seeding shall not be performed during windy weather or when the ground is frozen or otherwise untillable. 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.

45.4.2. Bed Preparation for Seeding or Sod Placement - Commercial fertilizer (18-46-O NPK) 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.

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

45.4.3. 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:

lbs. (PLS) = lbs. seed x % Purity x % Germination

45.4.4. Planting Seed - The contractor will seed over fertilized ground using approved mechanical power-drawn drills followed by packer wheels.

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.

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.

45.4.5. Mulching Seeded Areas - 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.

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 this expense.

45.4.6. Placing Sod - 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 layed on slopes of 3:1 or greater will be secured with six (6) inch long wood stakes, as needed, until growth is established.

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.

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

45.5. 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.

45.5.1. Trees, Shrubs and Other Plants - 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.

45.5.2. Seeded Grass Areas - Seeded areas shall be mowed to a two inch height at least once by the contractor. 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.

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 City, 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.

45.5.3. Sodded Areas - 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.

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.

45.6. GUARANTEE AND WARRANTY OF PLANTS

The contractor will replace all plants which die during the one 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 City of Rifle standards.

Contractor agrees to replace dead plants within two weeks after notification by the project manager. The project manager will maintain an accurate copy of the planting plan indicating which specimens were removed and/or replaced.

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PART II - CONSTRUCTION MATERIALS AND METHODS

SECTION 50.

TRAFFIC CONTROL

50.1. GENERAL

Where the contractor's work requires either partial or complete closure of any public street, road, highway, alley or sidewalk, the contractor shall submit a Traffic Control Plan to the City of Rifle for approval at least 48 hours in advance of the actual closure. If the City of Rifle approves the complete closure of an arterial or collector street, the Traffic Control Plan shall be submitted 14 days in advance of the actual closure, so that there will be sufficient time for public notification. The contractor shall notify the City Police Dispatcher and Rifle Fire Protection District 24 hours prior to the time the closure is to begin and again when the street is reopened.

Where the control and maintenance of traffic has not been performed as specified in the Special Conditions and/or the contractor does not provide or conform to the devices and methods in the latest Manual on Uniform Traffic Control Devices (MUTCD) and the latest revisions of the Colorado Supplement thereto adopted by the City of Rifle, the Engineer shall act to provide for the control and maintenance of traffic as directed by the City. All costs incurred by the City shall be borne by the contractor.

50.2. TRAFFIC CONTROL PLAN (TCP) AND METHOD OF HANDLING TRAFFIC (MHT)

The Traffic Control Plan and Method of Handling Traffic shall be prepared be a certified traffic control firm for the Contractor for review by the City of Rifle. No work shall commence without an accepted TCP and MHT. Any changes to the TCP or MHT must be approved by the City of Rifle or their designated representative prior to implementation. The TCP and MHT will be reviewed with the Contractor at the preconstruction meeting. The TCP shall include:

- Identification of construction zones (work area).
- Scheduling (start/completion date).
- Signs (size and type to be used and their location relative to the work area)., including advance notification sign.
- The method and materials to be used for delineation and channelization of traffic movements.
- Placement and maintenance of traffic control devices
- Removal and/or application of pavement markings.
- Location of flagging persons, where required.
- Detour routes where the use of detours is approved by the City of Rifle.
- All elements of the TCP will be dimensioned and these dimensions will be followed as closely as possible in setting up the work zone and the associated signing.

The written Method of Handling Traffic (MHT) shall be submitted with the TCP and shall include:

- Advance notification sign, including an example containing the Contractor's name and telephone number.
- Example of handbill to be delivered to each business and property owner affected by the TCP.
- Allowable speed limits signs and why they need to be reduced, if necessary.
- Method of closing and reopening, lengths of roadway affected and time durations of each phase of traffic control.
- Location of flaggers and time duration of flagging.
- Maintaining emergency vehicle access.
- Maintaining delivery access.
- Maintaining pedestrian access and bicycle access.
- Access to businesses and property owners within the construction or detour zone.
- Locations of vehicle parking, equipment storage and material storage.
- Contractor ingress and egress locations.
- Driving lane + shoulder or gutter width (shall not be less than 14 feet). If width is not available, provide alternate methods and appropriate signage.
- Name and cell telephone number (Calls must be responded to within one hour of receipt during period of work that traffic control measures remain in place) of the Contractor's certified traffic control supervisor.
- Tabulation of all traffic control devices to be used by the Contractor during each phase of construction.

Once the TCP and a written method of handling traffic (MHT) for each construction phase is reviewed and accepted by the City of Rifle, the Contractor is solely responsible for the notification of businesses and residents, furnishing, installation, moving, maintenance, inspection of the construction zone and removing the traffic control devices. If the construction zone is not maintained by the Contractor, the City of Rifle will either:

- Order and install the traffic control devices and charge the Contractor, or,
- Not allow the work to continue.

The work area shall be understood to include all open trenches, other excavations, material piles, equipment, obstructions, parking, detours and other temporary roadways, and other similar hazards within or related to the project. Approval of the TCP and MHT in no way shall relieve the Contractor of liability. If the construction time is exceeded, the Contractor shall personally notify each business or residence affected by the work of a new construction completion time.

50.3. TRAFFIC CONTROL DEVICES

50.3.1. General Requirements

On or adjacent to all streets, roads, highways and other public thoroughfares which require closure, either partial or complete, under the authority of a proper permit, the work area and the traveling public, either vehicular or pedestrian, shall be protected by means of approved traffic control devices as provided in the MUTCD and CDOT Standard specification and Plans. When a copy of these manuals are available for inspection at the City of Rifle.

50.3.2. Specific Requirements

1. Barricades shall be painted, kept clean, weighted, and the face material shall be retro-reflective.

2. All signs (warning, regulatory, etc.) shall be kept clean and shall be replaced when the face is damaged. These sign faces shall be retro-reflective. All signs shall be removed or turned away from the roadway immediately after they are no longer applicable.

3. Traffic cones are for daytime use only. Vertical hazard panels and/or Type I (sawhorse) barricades, with lights, shall be used at night.

4. When lights are used, steady burn lights shall be used for delineation and channelization. Flashing lights shall be used to denote a specific hazard.

5. Under certain conditions the use of pavement markings shall be required in addition to the devices used for delineation. This shall be shown on the TCP and the City of Rifle will determine the extent of the striping. When temporary markings are used, the existing markings shall be removed (not painted black). Temporary markings shall be installed by the contractor. These temporary markings shall be removed when the construction is completed. The permanent markings shall be reinstalled by the contractor.

6. Pedestrians shall not be diverted onto the roadway.

7. Open trenches will not be allowed after work hours, without prior approval of the City of Rifle.

8. Work hours on arterials and collector streets are from 8:30 AM to 3:30 PM, Monday through Friday, unless other hours are authorized by Traffic Engineering. Work hours on local streets are from 7:00 a.m. to 9:00 p.m., Monday through Friday.

9. Spillage and mud trackage from trucks and equipment shall be cleaned up immediately.

10. When the normal operation of a traffic signal must be interrupted, uniformed officers shall be used to direct traffic. Any expense incurred during this operation shall be borne by the contractor.

11. Construction within the right-of-way will not begin until all traffic control devices are in place.

12. Contractors will notify the Police Department, Fire Department, and the Public Works Department prior to commencing construction.

13. Contractors will notify all Utilities (Blue Stakes, City of Rifle Utilities, etc.) 48 hours in advance of the start of construction.

14. The contractor will keep a signed copy of the TCP at the work area during work hours. This will be available for inspection by the City of Rifle (or State) personnel.

50.4. STATE HIGHWAYS

Any work performed on a State Highway must have the approval of the Colorado Department of Transportation. Any detours from a State Highway onto a City of Rifle street must have approval from the City of Rifle prior to the detour being implemented.

50.5. MAJOR STREETS

1. As a general rule, parkway streets, arterial streets and collector streets will not be completely closed, nor will traffic be detoured.

2. On multi-lane streets (2 or more through lanes in each direction), two-way traffic must be maintained at all times. One lane may be closed in each direction with proper signing and barricading.
3. Left-turn lanes or bicycle lanes may be used as a through lane providing pedestrians have adequate protection from traffic.

4. On single lane streets, (one through lane in each direction), one lane may be closed provided that adequate signs, barricades and a minimum of two flaggers are used.

50.6. LOCAL STREETS

1. One-half of a local street may be closed if adequate barricading is present and a minimum of one (1) flagger is used to direct traffic.

2. Total street closures will be allowed if an alternate access is available to all property owners and is approved by the City of Rifle.

50.7. ADVANCE SIGNS

1. On major and/or collector streets, the advance warning signs shall be placed at the following minimum distances in advance of the construction area.

   a. Road Construction Ahead - 1,000 feet
   b. Right/Left Lane Closed Ahead - 750 feet
   c. Merge Right/Left or Flagger Ahead - 500 feet

2. On local streets, the advance warning signs shall be placed at the following minimum distances in advance of the construction area.

   a. Road Construction/Road Closed Ahead - 500 feet
   b. Flagger Ahead (if needed) - 250 feet

3. In some cases, the City of Rifle may determine that a reduction in vehicle speeds is advisable or necessary. This shall be accomplished using advisory speed plaques, and speed limit signs, which conform to the standards of the MUTCD.

4. The City of Rifle may require special, advance notice signs.

50.8. FLAGPERSONS

Anytime a flagger is required to direct the flow of traffic, that flagger must be visible to traffic. Orange clothing (vest, shirt or jacket) and hardhat must be worn by the flagger. For nighttime operations, this clothing must be reflectorized. The flagger must follow the flagging procedures stated in the MUTCD.

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PART III - MINIMUM DESIGN STANDARDS

SECTION 100.

STREETS

100.1. GENERAL

All curb, gutter, sidewalk and street design, rights-of-way and street widths shall conform to the minimum requirements of the City of Rifle Standard Specifications and Drawings for Design and Construction and the City Subdivision Regulations. Definition of streets shall be as defined therein. Care shall be taken to insure 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 City Engineer.

100.2. GEOMETRICS AND GRADES

Street widths shall conform to City of Rifle 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 is 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 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-scope condition, matching the intersecting streets flowline grade. In no case shall a flowline slope at an intersection

The following shall be the maximum and minimum grades and minimum length of vertical curves for all street design. The City 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 City 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.

Design Geometrics	Type of Street		Minor & Unit	Local	Collector	Arterial
Nominal Design Speed			MPH	30	35	45
Maximum Grade			%	10	8	6
Min. Grade	(1)		%	1	1	1
Vertical Curve @ Crest	(1)	(2)	K	25	50	100
Vertical Curve @ Sag	(1)	(2)	K	35	50	80
Centerline Radius	(1)		Ft.	100	175	350
Sight Distance - Stopping	(1)	(3)	Ft.	200	250	375
Sight Distance - Intersection	(1)	(4)	Ft.	300	350	450
Tangent Section between Reverse Curves	(1)		Ft.	50	150	150

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.

100.3 STREET DESIGN (17.95.050)

Construction of streets shall conform with the following design standards and regulations:

A. The street pattern shall conform to any transportation plan or comprehensive plan adopted by the City Council and shall afford sage 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 Commission and the City Engineer.
2. No more than two streets shall intersect at one pint.
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 feet (100').
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 (200').
5. The City 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 City, or as specified by the City of Rifle Public Works Manual.

D. Streets, which are 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. Dead end streets shall not be permitted. A street may end in a permanent cul-de-sac providing that the street is not longer than six hundred sixty feet (660') 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.

H. All subdivision streets shall comply with the "Recommended right-of-way Cross-Sections, "which may be adopted and amended from time to time by resolution to the City Council. Streets, alleys, rights-of-ways, sidewalks and easements shall comply with all federal and state specifications, and in addition, shall meet the following minimum width standards:

1. Arterial streets shall have a minimum right-of-way of one hundred feet (100'). The minimum paved portion to the street measured from flow line to flow line shall be sixty-four feet (64');
2. Collector streets shall have a minimum right-of-way of eighty (80'), with a minimum paved portion, and measured from flow line to flow line, of forty-seven feet (47')
3. Local residential streets shall have a minimum right-of-way of fifty feet (50'), with a minimum paved portion of thirty-six feet (36'), measured flow line to flow line'
4. Alleys (where permitted), twenty feet (20');
5. Crosswalk easements, ten feet (10')
6. Drainage easements, ten feet (10'), or larger if so required by the City Engineer;
7. Half-streets shall not be permitted, except when required to complete a half street already in existence;
8. Where a street classified as arterial intersects with any other arterial street, no on-street parking shall be allowed on the arterial street within one hundred feet (100') 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 City Engineer to enable vehicles to make left turns at such intersections without impeding other traffic;
9. All utilities shall be installed before streets or alleys are surfaced;
10. Subdivision as-builts shall show dedicated right-of way;
11. All sewer and water utilities to clearly show;
    a. Invert in, Invert out, and rim elevation on all manholes,
    b. Locate all valves, manholes, fire hydrants and/or other utilities with at least two (2) ties from discernible objects.
    c. Distance and slope between manholes to be noted as offsets to mains from curbs or property lines;
    d. Dimension existing and/or added water and sewer taps from lot corners or readily discernible objects. Sewer taps shall have additional dimensions from the tap to the downstream manhole;
    e. All dimensions to be from fixed permanent or readily discernible objects. Where water and sewer taps are located from lot lines, front footage will be noted from fixed and permanent point of origin,
    f. Depth of the lateral or service line shall be noted at the property line.

100.4. ALLEYS & EASEMENTS (17.95.060)

Paved alleys may be provided and shall be required unless other provisions are made and approved for service access. Easements for utility purposes shall be required along all sides and real lot lines except those bordering dedicated streets and alleys. Drainage easements shall be designed to accommodate expected runoff and shall comply with the provisions of the City of Rifle Public Works Manual.

100.5 STREET IMPROVEMENTS (17.95.070)

All street improvements described in the City of Rifle Public Works Manual are the financial responsibility of the subdivider, subject to the provisions of the City of Rifle Public Works Manual, unless specifically exempted through written agreement with the City Council. All streets and alleys proposed for dedication to the public shall be laid out, graded and paved from curb to curb, and paved to the specifications to the City. Curb and gutter and sidewalks shall be installed on all streets unless special circumstances warrant the City Council to specifically waive installation in writing. In cases where a previously existing street, which has not been brought up to City 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 City specifications. If any subdivision is located adjacent to any existing street right-of-way, the developer shall provide at least the adjacent half of such street with improvements as required to bring such street up to City specifications. The developer shall provide and install street name signs to all street intersections and also traffic control signs as shown on the plans, or shall reimburse the City for their initial installation. Permanent reference monuments and monument boxes shall be installed by the developer to City specifications, as shall bicycle paths and trails where they are required by City regulations. Streetlights when required by City regulations shall be installed by the developer, unless prior arrangement is made between the developer and the City. Striping, pavement marking and guardrail shall be installed by the developer as required by the City.

100.6. CURBS, GUTTERS, SIDEWALKS AND CROSSPANS

All curbs, gutters, sidewalks and crosspans shall conform to the City of Rifle Standard Drawings. Standard combination curb, gutter and sidewalk sections shall be 6'6" wide in locations noted as follows:

A. 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 Owner. (Intermittently shall be interpreted to mean at least three (3) different sections with at least (1) section on each side of the street).

B. Where obsolete sections exist to boundary of earlier subdivision, this section shall be continued in new subdivision to first radius point.

C. Where existing obsolete section is being replaced.

D. Sidewalks are required on both sides of all streets and shall be at least four feet (4') wide in residential areas and six feet (6') wide in commercial areas. Residential areas shall have sidewalks of the Hollywood design on local residential streets. Collector streets shall have vertical curb and gutter and attached sidewalk. In residential areas, sub arterial streets shall have a vertical 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') Design of streets in commercial and industrial areas shall be approved by the Planning Commission.

1. Construction of sidewalks shall be to specifications set by the City Council through their designated representatives.
2. All sidewalks shall be provided with handicap ramps at all street intersections or other pedestrian crossing areas in accordance with standards in the Public Works Manual.

100.7. UTILITIES

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

100.8. DRAINAGE

All streets shall be designed to provide continuous surface drainage directed to storm drain inlets and drainage courses. Grades shall permit flow without ponding. Four (4) feet concrete crosspans shall normally be installed across those streets at intersections carrying traffic, which must stop. Installation of pans between intersections or across streets carrying through traffic at intersections shall be avoided in all possible cases. A check shall be made to be sure of continuity of drainage design between the proposed construction and existing of future construction. In no case shall surface drainage be permitted to be disposed of overland except by approved storm drainage facilities. See Section 105 of these Standards for design requirements.

100.9. FLEXIBLE PAVEMENTS

Flexible pavement shall consist of deep strength asphaltic concrete or a combination of asphaltic concrete and granular base course. 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. 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. Where testing indicates maximum average group index values less than 4.0, deep strength thickness shall be taken as six (6) inch minimum for collector and five (5) inch minimum for local streets. Minimum thickness of base and asphaltic pavement combinations shall be three (3) inch asphaltic concrete, eight (8) inch and six (6) inch granular base for collector and local streets respectively. Where group index values exceed 4.0, pavement thickness shall be determined from standard drawing. Where appreciable changes in group index values occur for different streets throughout a subdivision, thickness may vary but thickness shall remain constant throughout each street.

100.10. CONCRETE PAVEMENT

Concrete pavement (6" min. thickness) shall be designed in accordance with Portland Cement Association requirements for applicable soil group index number. Batching and installation shall be in accordance with the Colorado Department of Highways specifications for Portland Cement Concrete Pavement.

100.11 TRAILS

Concrete paved trails shall be in accordance with standard drawing ST-3, when required by the city.

100.12 TRAFFIC CALMING DEVICES

A speed reducing device shall be installed as directed by the Public Works Director in accordance with ST-4. Pavement marking using MUTCD triangle and line details and dimensions shall be placed on the traffic surface leading to a speed hump.

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PART III - MINIMUM DESIGN STANDARDS

SECTION 105.

STORM DRAINS AND IRRIGATION

105.1. STORM DRAINS

All design and analysis of storm drainage systems in the City of Rifle shall be done in accordance with the following specifications.

Drainage easements and improvements shall be designed by a registered engineer to accommodate expected runoff as determined by the drainage plan. Improvements shall be installed to specification by the City Council through their designated representative. All drainage improvements described herein shall be the financial responsibility of the subdivider, subject to provision under the City of Rifle Public Works Manual.

The rate of runoff from any developed area shall not exceed the historic rate of runoff based on a twenty-five (25) year rainfall event.

105.2. METHODS OF ANALYSIS

The following methods of runoff estimation shall be utilized for determining the rate of runoff from a particular site as applicable:

1. Rational Method: Used for Drainage Basins less than 20 acres in size and for minor system design.
2. SCS TR 55 Methods: Used for drainage basins up to 20 square miles in size. Also used for flood flow determination and design in minor and major systems. Also used to compute flood storage volumes.
3. Unit Hydrograph: Used for drainage basins up to 1000 square miles in size. Also used for flood flow determination and design in minor and major systems. Also used to compute flood storage volumes.

105.2.1. Rational Method - Flows may be determined by the extended form of the rational formula: for basins under twenty (20) acres in size.

A. Rainfall intensities shall be taken from City of Rifle 1DF curves. (At end of this section)

B. Concentration times for flow analysis should never be less than ten (10) minutes.

105.2.2. Facility Capacity Criteria - All drainage facilities must be approved by the City Engineer.

A. Curb flow capacity is reached when the flow crosses the back of the curb or the crown of the street is reached, whichever is less.

B. Transfer of water from one flow line to another, by flow over the crown, will not be allowed.

C. Storm sewer shall be designed to carry the 25-year Storm runoff.

D. Minimum size for storm drainage pipe shall be fifteen (15) inches.

E. Pipe under streets shall be designed for soil and live loads in accordance with acceptable highway design criteria. The D-Load method is an acceptable method of design.

F. Collector streets shall be drained so that the center twelve (12) feet are clear of water during the 25-year storm.

G. Arteries shall be drained so that the center 24 feet are clear of water during the 100-year storm.

H. Local streets shall have the catch basins at the point where either side of the street reaches its capacity for the 25-year frequency storm.

I. Catch Basin Capacity in cubic feet per second: Shall be calculated in accordance with the methods outlined either 105.2.1 or 105.2.2.

J. Culverts under streets (excepting arterials) shall be designed with an emergency overflow for passing the 100-year storm. In determining the required capacity of the overflow, the culvert shall be assumed blocked unless its cross-sectional area exceeds twenty (20) square feet, in which case 60% of its flow capacity may be used.

K. Major channels shall be designed to safely pass the 100-year storm. If major channel has been mapped by FEMA, then proof shall be provided to the City that installation of the crossing will not negatively impact the floodplain of that particular stream. When impacts are found, then those impacts shall be properly mitigated to the discretion of the Public Works Director.

L. Velocities in any conduit or channel shall be controlled so that the conduit or channel will not be damaged by flows from the 100-year flood, unless otherwise instructed by the Public Works Director.

M. Suggested values of Manning's "n" appear in Table 105-I below.

TABLE 105-I

Roughness Coefficient

Character of Section		**Mannings 'n'**
Polyvinyl Chloride Pipe		0.011
Concrete Pipe		0.013
Corrugated Metal:	2 2/3" x 1/2" Corrugation	0.024
	3" x 1" Corrugations	0.027
Structural Plate:	6" x 2" Corrugations	0.033
Open Channels:	Undisturbed	0.035
	Earth Reshaped	0.020
	Grassed and Shaped	0.030
	Smooth Concrete Lined	0.013
	Rip Rap Lined	0.035

105.2.3. Runoff Detention - The City of Rifle Landuse Code requires that additional runoff caused by development be detained on the development site. The base storm for calculation and design is that of the 25-year rainfall. The Public Works Directormay "release" a developer of the runoff detention obligation if it can be shown that the down stream drainage appurtenances and/or receiving stream are not negatively impacted or brought to a point in excess of their capacity. This statement, however, does not relive obligations stated in 105.3, below.

105.2.4. Detention Volume - Detention volumes shall be determined in accordance with The Manual. The acceptable means applicable to the method of runoff estimation.

105.2.5. Detention Time - No specific detention time is required under normal conditions. However, if the Public Works Directordetermines that a longer detention time is in the City's best interest, he may require a flow rate less than half the historic peak flow rate ($Q_H/2$) before two (2) times the historic concentration time ($2T_c$) is reached.

105.2.6. Maximum Release Rate - The maximum release rate from the detention facility shall not exceed the historical peak runoff rate for the same frequency storm.

When it is in the City's best interest to alter this release rate, the Public Works Directormay request a specific release rate.

105.2.7. Detention Structures - The type and design of the detention structure must be approved by the City Engineer.

Generally acceptable examples of detention facilities are ponds or buried pipe.

Overflow structures shall be provided where the design capacity of the detention structure can be exceeded. This overflow structure shall return the overflow water to the historic channel without causing damage to either the detention or overflow structures.

105.2.9. Detention Pond Slopes – Side slope on detention ponds shall be a maximum of 2:1. Bottom of pond shall be a minimum of 2% across landscaped areas.

105.2.10. Flood Hazard Exposure - Developers shall design and accomplish final grading in such a manner that buildings and basement openings will be at or above an elevation that will prevent adverse effect from storm water due to a 100-year return frequency storm.

105.3. WATER QUALITY ENHANCEMENT

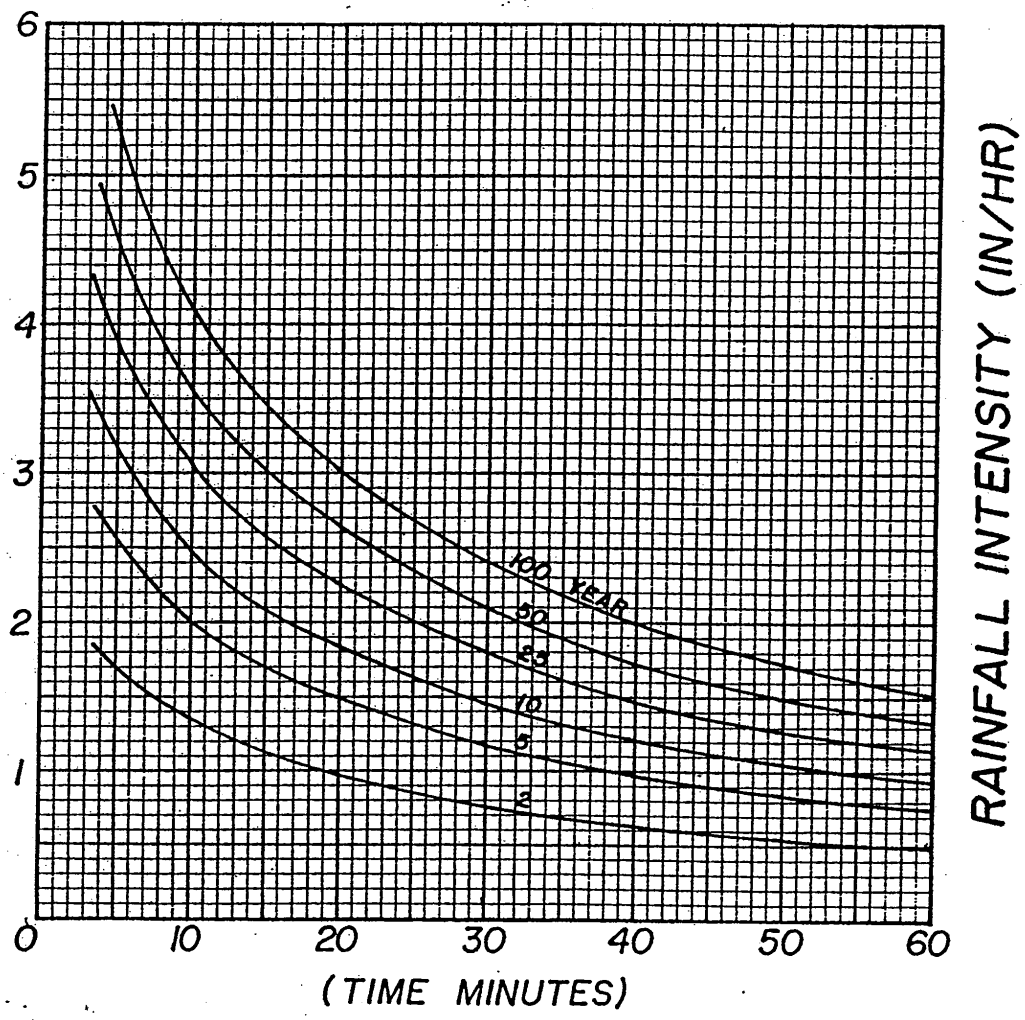
Water quality enhancement of stormwater runoff must be provided in accordance with the requirements of the Colorado Department of Public Health and Environment.

105.4 IRRIGATION

Required ditch flow shall be determined by existing water rights flowing across and below the design point and certificate of water rights flowing across and below the property shall be submitted to the City Engineer. Alternatively, the ditch pipe and/or structures shall be designed to carry a consistent flow of water as existing ditch is capable. Unless otherwise approved by the City Engineer, all irrigation ditches must be piped.

All irrigation ditch piping must be approved, signed and dated by the President or other authorized officer of the ditch company, prior to approval by the City Engineer.

INTENSITY - DURATION - FREQUENCY CURVES



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PART III - MINIMUM DESIGN STANDARDS

SECTION 110.

SANITARY SEWERS

110.0 SANITARY SEWAGE COLLECTION

If the City is to supply sanitary sewage collection, the sewage collection system shall be designed to connect with the City system and provide service to each lot in the proposed subdivision. Design of the system shall be the responsibility of the subdivider with all plans subject to the approval of the City Council through their designated representative. Financial responsibility for the sanitary sewage collection system shall be subject to existing City regulations and agreements relating thereto between the City council and the subdivider, subject to the provisions of the City of Rifle Public Works Manual.

110.1. DESIGN FLOW

Sanitary sewer lines shall be designed to transport wastewater, exclusive of storm run-off, at peak flow rates corresponding to the population and land use saturation density of all land area tributary to the outfall point of the line. The density of the tributary areas shall conform to the requirements set forth in the City of Rifle Comprehensive Plan, Land Use Code, and applicable Master Plans.

Design flow rate of a sanitary sewer line shall be the accumulative total of all wastewater contributions from each of the various types of land use areas; within a tributary basin, sub-basin or development to its outfall point; plus an allowance for infiltration/inflow and peak flows where applicable. The design flow rate shall be developed using the average daily flow rates, peak hour factor and I/I allowances as set forth in Table 110-I.

All calculations made in determining the design flow rate shall be submitted for approval, at time of platting or submission of development plans, whichever occurs first.

110.2. HYDRAULIC DESIGN

Sanitary sewer collector lines, those subject to having service connections thereon and hereafter referred to as laterals and mains, shall be sized to flow 75% full at peak hour flow rates. City designated interceptor and trunk lines, lines which require specific City approval for service connections, shall be **sized** to **flow full** at peak hour flow rates.

Flow through inverts in manholes shall provide a minimum of: 0.1 ft. drop in a straight through manhole; 0.2 ft. drop in a manhole angled at 45 degrees or less; and 0.3 ft. drop in manholes angled greater than 45 degrees. The maximum allowable deflection through a manhole connecting eighteen (18) inches and larger diameter lines shall be 45 degrees. The maximum interior drop through any manhole shall be 0.3 ft.

In manholes where the downstream sewer line is larger in diameter than the upstream line, the pipe crown elevations of the two pipes shall match.

Types of sewer pipe, allowable manhole spacing, minimum line slope between manholes, Manning's coefficient, minimum and maximum allowable flow velocities, peak hour factor, infiltration/inflow allowances etc., shall be as set forth in Table 110-I and 110-II of this section.

TABLE 110-I

Basis for Developing Design Flow Rates for Sanitary Sewers

SOURCE	Average Daily Contribution Gallons Per Day	
Residential		
Multifamily	(100 g/c/d) (2.5 c/u) * PHF	
Townhouses	(100 g/c/d) (3.0 c/u) PHF	Where: g/c/d=gal/capita/day
Apartments	(100 g/c/d) (2.5 c/u) PHF	and
Duplex	(100 g/c/d) (3.0 c/u) PHF	c/u=capita/unit
Single Family	(100 g/c/d) (3.5 c/u) PHF	
Commercial(1)		
Hotel-Motel	50 (No. employees + No. Beds) PHF	
Hospitals	200 (No. employees + No. Beds) PHF	
Restaurants	15 (No. employees) + 4 (meals/day)	
Offices	15 (No. employees)	
Service Station	15 (No. employees + 2 X No. pumps + 10 X No Bays)	
Schools	20 (No. employees + No. students)	
Self Service Laundry	50 (No. of machines)	
Theater	5 (No. of seats)	
Warehouses	15 (No. of employees)	
Industrial(1)		
Factories	15 (No. employees) + industrial and cafeteria waste	
Other	Evaluate separately	

Peak Hour Factor = PHF*

$PHF = 1 + (14/(4 + P^{0.5}))$ or $PHF = 1 + (14/(4 + lOQ)^{0.5})$

Where: P = saturation population in 1OOO's or fraction there of.
Where: Q = average day flow in cfs, to a point

Infiltration/Inflow

Pipe Diameter Inches	Pipe Type	I/I Gal/Day/Inch Dia./Mile
8-27	PVC (Polyvinyl Chloride)	50
24-54	RCP (Reinforced Concrete)	200

Design Flow Rate = Q = cfs = Summation of all Average Daily Contributions converted to cfs x PHF where applicable + I/I

(1) Average daily flow rates set forth in Appendix I, Table 1-3 of the Uniform Plumbing Code shall govern in case of discrepancies.

TABLE 110-II
SANITARY SEWER DESIGN DATA

Pipe Diameter Inches	Manhole Dia. Ft.	Manhole Max. Space Ft.	Type of Pipe	Manning's Coefficient (n)	Slope (Min.) %
4(1)			PVC	0.011	2.1
6(1)			PVC	0.011	0.64
8 (2) (3) (4)	4	400	PVC	0.011	0.40
10(3)(4)	4	400	PVC	0.011	0.30
12(3)(4)	4	400	PVC	0.011	0.23
					Velocity (3)
15	4	400	PVC	0.011	Note (3)
18	4	400	PVC	0.011	Note (3)
21	4	400	PVC	0.011	Note (3)
24	4	400	PVC	0.011	Note (3)
27	5	400	PVC	0.011	Note (3)
30	5	400	PVC/RCP	0.011/0.013	Note (3)
33	5	400	PVC/RCP	0.011/0.013	Note (3)
36	6	400	PVC/RCP	0.011/0.013	Note (3)
39	6	400	PVC/RCP	0.011/0.013	Note (3)
42	6	400	PVC/RCP	0.011/0.013	Note (3)
48	Special	400	PVC/RCP	0.011/0.013	Note (3)
54	Special	400	PVC/RCP	0.011/0.013	Note (3)

(1) Service Lines
(2) Minimum diameter for collector laterals and mains
(3) Maximum velocity, regardless of depth of flow = 10 fps. Minimum velocity, when flowing 75% full = 2 fps.
(4) The minimum slope of the sewer line shall be 0.5% within 200 linear feet both upstream and downstream of all manholes angled greater than 45 degrees.

110.3. MANHOLES

Manholes shall be provided at each change in slope, change in pipe diameters and at connections with other sewer lines. A manhole shall be installed at the end of a sewer line and provided plugged stub-outs, for future extensions. Cleanouts at the terminus of a sewer line will not be allowed.

Outside drop manholes will not be allowed, except by authorization of the City Engineer. If approved, the barrel and cone sections of the drop manhole and the adjacent upstream and downstream manholes shall be given two coats, each ten mil thick, of an approved epoxy type material that is inert to hydrogen sulfide (Aquatapoxy) or a ½" minimum thickness spray applied coating of Calcium Aluminate Cement (Sewpercoat).

110.4. COLLECTOR AND OUTFALL LINES

Sanitary sewer lines shall be eight (8) inches or larger in diameter. Lines shall be installed in a straight alignment and on a uniform slope between manholes. Curvilinear alignment between manholes will not be allowed.

Unless specifically approved for non-basement developments the minimum bury between finish grade and the crown of a lateral or main, on which services will be connected, shall be nine (9) feet. The bury on designated interceptor and trunk lines, where service lines enter only through manholes, need only sufficient cover to protect them from live loads crossing and/or paralleling the line.

Dead end lateral lines shall terminate in a manhole. Plugged outlets, set in the direction of future line expansion, shall be provided in the terminating manhole. Upstream terminating manholes shall be located within ten (10) feet of the most distant property line of the lot or building site being served or the perimeter line of a new development

A lateral or main sewer line shall be located five (5) feet west or south of the centerline of the local or collector street in which it is to be installed. In arterial streets, lateral or main sewer lines may be installed in the right-of-way between the property line and sidewalk or back of curb, if approved by the City Engineer. However service lines, to the lateral or main, will not be permitted to cross an arterial street. Sewer lines installed; along back or side lot lines; or in easements; shall be located in a manner that provides easy access for maintenance crews.

Easements and right-of-way: The minimum width right-of-way or easement for City use in which a sewer main will be installed is twenty (20) feet except as authorized for Planned Unit Developments (PUD).

110.5. SERVICE LINES

Domestic sanitary sewer service lines from each unit, townhouse or commercial tenant shall be four (4) inches or larger in diameter and connected, by means of a wye, watertight saddle or fused adaptor to a lateral or main in the street or common area. The wye saddle or adaptor shall be mounted such that the service line effluent enters at an angle of 45 degrees or more above the springline of the lateral or main.

Vertical risers shall be installed when the top elevation of the wye, installed through the

service saddle or adaptor, is more than twelve (12) feet below finish grade. Riser connections shall reach a grade of nine (9) feet below finish grade within a horizontal distance of two (2) feet from the vertical centerline of the lateral or main.

Industrial service lines (lines collecting waste from manufacturing or commercial processes as distinguished from sanitary or domestic waste) from each unit or tenant shall provide means of disposing or treating industrial waste prior to, the non-toxic effluent therefrom, entering a City maintained lateral or main. Domestic sewage from an industrial or commercial tenant shall be serviced independently from its industrial waste.

Individual service lines will not be allowed to connect or enter a City designated interceptor or trunk sewer line. Entrance to these designated lines shall be by means of a manhole. Service lines larger than six (6) inches in diameter must enter through a manhole.

110.6. MISCELLANEOUS

An approved cut off wall or plug shall be installed in the trench, around, under and over a sewer line that crosses under an open ditch, channel or stream. The wall or plug shall be constructed on the downstream or downhill side, parallel to the open flow so as to prevent water from following the sewer trench.

All sewer and service line pipe joints that are installed within ten (10) feet of a potable water line shall be concrete encased when the sewer line: crosses over a water line; crosses under and within two (2) feet of the water pipe invert; or parallels the waterline such that the sewer pipe crown elevation is less than two (2) feet below the water line pipe invert.

Where underdrain piping is to be installed below a sewer line, two-way cleanouts shall be installed in each manhole to provide access to the underdrain for flushing.

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PART III - MINIMUM DESIGN STANDARDS

SECTION 120.

WATER TRANSMISSION LINES

120.1. GENERAL

Water transmission lines twenty-four (24") inch and smaller in diameter shall be polyvinyl chloride (PVC), Glass Fiber Reinforced (FRP) or steel. Lines larger than twenty-four (24") inch diameter may be Steel (S), Concrete Cylinder (CCP) or Ductile Iron (DI). Steel and ductile iron pipe shall be cement mortar lined and coated with an 80 mil. Polykin YG-3 system. Concrete cylinder pipe exterior surface shall be primed and coated with a 30 mil. Polykin YG-3 wrap.

Except as herein modified, the pipe shall conform to the applicable AWWA Specification set forth in Section 30, Table 30-1. Metallic type pipe shall be designed, manufactured, tested, inspected and cathodically protected in accordance with these standard specifications.

Cylinder and metallic type pipe, harnesses and fittings shall be designed to withstand the simultaneous application of external loading and 210 psi internal pressure in accordance with the requirements set forth in Table 120-I, of this specification.

Unless modified in the special conditions all steel pipe, to be installed under a compacted backfill cover of 4 1/2 foot shall be furnished with the following minimum steel cylinder wall thickness.

Pipe Diameter Inches	Minimum Wall Thickness t_w = Inches
18 - 36	= 3/16" = 0.1875
42 - 54	= 0.005 Cylinder I.D.

An approved corrosion protection and monitoring system shall be designed and included as a part of the contract documents, prior to bidding.

120.2. CATHODIC PROTECTION SYSTEM

The cathodic protection system shall be designed by a firm having no less than ten (10) years experience, and proof of accreditation by the Nation Association of Corrosion Engineers (NACE), as a firm qualified in one or more areas of corrosion control. The on-the-job supervisor must be accredited by NACE as a Corrosive Specialist and all related work shall comply with the recommended practice set forth in NACE RP-01-69, "Control of External Corrosion on Underground or Submerged Metallic Systems."

The designing firm shall prepare and submit a design survey report, along with the cathodic protection plans and specifications, for both an impressed current and a sacrificial anode system. The corrosion protection and monitoring system shall be designed so as to provide an underground pipeline free of corrosion attack for a period of not less than thirty (30) years. The City reserves the right to select the system wherein its best interests will be served.

The submitted survey report and design calculations shall be based on field test data, taken at not less than 500 foot intervals along the centerline of the proposed pipe alignment,

indicating soil resistivity and stray currents to be encountered at and below the pipe centerline as well as the soil ph, chloride and sulfate content. Consideration shall also be given the protection of structures, the dielectric insulation of the pipe and fittings to be installed, current requirements, DC outputs, foreign line crossings, pipeline casings, etc.

Plans and specifications shall clearly state the size, quantity, type and locations where anodes, anode leads, ground beds, lead cables, test stations, terminal boxes, connecting devices, rectifiers, reference cells, meters, insulated mechanical and/or flanged joints, etc., are to be installed.

Specifications shall designate alternate types of materials to be installed. Specifying proprietary materials will not be allowed unless approved by the City, ten (10) days prior to bid opening.

120.3. PRE-MANUFACTURE OF STEEL AND CONCRETE CYLINDER TYPE PIPE REQUIREMENTS

Within twenty (20) calendar days following the "Notice of Award", the contractor shall obtain from the supplier and submit to the project engineer for approval four (4) complete sets of the following:

120.3.1. Design Calculations - Design calculations shall comprise concise, yet complete, stress analysis of each critical section of pipe wall, girth joints, harness system, specials, outlets and appurtenances, sufficient to ascertain conformance of the pipe and fittings with these specifications.

120.3.2. Shop Drawings - Shop drawings shall accurately indicate the Precise geometry; type, gauge, diameter, strength, manufacturing tolerance and thickness of the elements to be incorporated in manufacture of the pipe, joints, fittings and appurtenances.

120.3.3. Material Lists and Delivery Schedule - Copies of purchase requisitions for all materials (pipe, valves, etc.) showing names of supplier, material specification or description, quantity ordered and delivery schedule.

120.3.4. Pipe Laying Schedule and Marking Diagram - Laying schedule shall indicate by consecutive number the order and direction of installation of each pipe section, special fitting, valves, access manholes, nozzles, outlets, and other appurtenances. In addition, the laying schedule shall include:

A. The invert station and elevation to which the bell end of each pipe shall be laid and all changes in gradient or horizontal alignment.

B. All elements of curves and bends, both in horizontal and vertical alignment.

C. The limits of each reach of welded joints, closures and concrete encasements.

120.3.5. Submittal Revisions and Approvals - The project engineer will inspect and return two (2) copies of design calculations, working drawings and other submittals to the contractor properly executed and marked either "Approved as Corrected" or "Rejected" within twenty (20) calendar days after receipt thereof.

The contractor shall review and back check indicated revisions deemed necessary by the project engineer to correct defects. He shall revise submittals returned to him that have been marked "Approved as Corrected" or marked "Rejected", and shall resubmit in quadruplicate said revisions to the project engineer within fifteen (15) calendar days after the contractor's receipt thereof. Further revisions, if and when required, will be handled in accordance with the above procedure.

Only upon the contractor's receipt of submittals marked or designated "Approved" or "Approved as Corrected" shall the manufacturer of pipe commence: Provided that said drawings designated "Approved as Corrected" are corrected and resubmitted to the project engineer immediately. Upon receipt of duly executed "Approved" design calculations, laying diagrams and shop drawings, the contractor shall immediately forward to the project engineer eight (8) prints of each such approved submittals for use during construction.

Neither the inspection nor lack of inspection of any drawings, design calculation, material list, laying schedule, sample or piece of data (furnished to the project engineer for his approval) shall waive any of the requirements of these Specifications, Drawings and Contract Documents or relieve the contractor of any obligations thereunder; and defective workmanship, work, materials and finished product may be rejected notwithstanding conformance with Drawings and other submittals inspected by the Engineer.

TABLE 120-I

	STEEL PIPE	CONCRETE CYLINDER PIPE Pre-Stressed	Pre-Tensioned =< 42" Dia.	
AWWA Standard Specifications	C-200	C-301	C-303	
Cylinder Yield Strength	f_y - (max) =	42,000 psi*	42,000 psi*	36,000 psi*
Hoop Stress	f_s - (max) =	0.5 f_y@ P_s	Appendix "B"	16,500 psi @ P_s
Hoop Stress	f_s - (max) =	0.90 f_y @ $1.5(P_s+P_{wh})$	Appendix "B"	0.75 f_y @ (P_s+P_{wh})
Hoop Stress	f_s - (max) =		Appendix "B"	
Dead Load	W_D = lbs/ft =	$130\ C_d(B_c^2+3B_c)$	$130\ C_d(B_c+3)^2$	$130\ C_d(B_c^2+3B_c)$
Live Load	W_L = lbs/ft =	AASHTO HS-20	AASHTO HS-20	AASHTO HS-20
Design Load	W = lbs/ft =	$(W_D + W_L)$	$(W_D + W_L)$	$(W_D + W_L)$
Deflection	x = in. max =	0.02D' **	0	$(D^2/4000)$ @ W **
Cylinder Test Pressure	P = psi	0.75 f_y	@ f_s= 25,000	@ f_s= 25,000

Line Pipe Joint

Rubber gasket in Carnegie M 3516 rolled spigot and bell rings or in expanded bell and rolled spigot joints.

HS-20 LOADING

Height of Cover ft	Load lbs/ft^2
1	1800
2	800
3	600
4	400
5	250
6	200
7	175
8	100

* Carbon content of the steel shall not exceed 0.24%

** $x = D\ e\ \dfrac{K(W/12)\ r^3}{(EI + 0.061\ (E')\ r^3)}$

SOIL MODULUS Pipe 0 Inches	E' Kips/IN^2
24"	600
30"	650
36"	700
42"	750
48"	800
54"	850

WHERE:

B_c = Outside pipe diameter in inches
C_d = Load co-efficient
D = Finished inside dia. of pipe in inches
D' = Steel cylinder outside dia. in inches
De = Deflection lag factor - 1.2
E = Modulus of elasticity of steel = 30,000,000 lbs/in ^{2}
E' = Soil modulus
I = Moment of inertia of pipe walls in in^4/in = $t^3/12$
K = Bedding factor = 0.10
P_s = Working pressure = 150 psi
P_{wh}= Water hammer = 60 psi
r = Mean radius of cylinder in inches
t_w = Steel cylinder thickness in inches = .005D" (Min)

120.4. MATERIAL FABRICATION, TESTING AND CERTIFICATION

The project engineer or his designated representative shall be permitted to make inspections necessary during the manufacture of the pipe and appurtenances to determine compliance with the specifications.

120.4.1. Hydrostatic Testing - Each length of steel pipe or cylinder with joints attached, shall be hydrostatically tested to the hoop stress designated in Table 120-I. Those lengths that are found defective shall be repaired by welding and then retested to the designated stress until it is free from leakage.

120.4.2. Certification - The manufacturer, via the contractor, shall furnish the project engineer four (4) copies of the following certifications as to compliance with the specifications:

Mill analysis and test of steel. Hydrostatic test reports. Compliance of materials and application of linings and coating. Usage of Type V or modified Type II cement as required in mortar coatings on pipe, specials and fittings. Compression test results of concrete from cylinders made from concrete used in pipe core and/or wall.

120.4.3. Marking Pipe and Specials - The manufacturer shall legibly mark and number in sequence all pipe sections and specials in accordance with the laying schedule and pipe installation survey laying stations. All pipe specials shall be marked at each end with the top field centerline stations.

120.4.4. Lining and Coating Protection - It shall be the responsibility of the manufacturer to provide adequate strutting to prevent damage to the coating and lining caused by deflections beyond the specified allowable limits for the type of pipe supplied during handling, loading, transporting, unloading and storing. Any additional strutting or stulling required during installation to prevent damage to the coating and/or lining caused by deflections beyond the allowable limits shall be the responsibility of the contractor. The contractor shall be responsible to be sure that all strutting remains in place until after the pipe section, special or fitting has been properly backfilled.

The manufacturer shall provide a polyethylene or other suitable bulkhead on the ends of the pipe section and on all special openings to prevent drying out of the linings. The contractor shall be responsible to assure that the polyethylene or bulkheads remain intact on the pipe ends until the section or fitting is being installed in the trench.

120.4.5. Standard Joints - Standard joints for transmission line pipe shall be either an expanded bell and rolled spigot or the Carnegie bell and spigot end ring, each with rubber gasket. Mechanically coupled, flanged or welded joints may be required where called for on the drawings.

The joint construction shall be suitable for at least 250 psi water service and regardless of type shall be designed to be self-centering. The bells and spigots shall have a smooth close

sliding fit at the self-centering surface, and the joint shall be capable of either symmetrical or asymmetrical joint closure and shall remain water-tight under all conditions of water service.

The joint assemblies shall be so formed and accurately manufactured that when the pipes are drawn together in the trench, they shall form a continuous watertight conduit with smooth and uniform interior surface and shall provide for a slight movement of any pipe in the pipeline due to contraction, settlement or lateral displacement.

The maximum tolerances permitted in the construction of the joint shall be that stated in the pipe manufacturer's design as approved. Any fabrication performed prior to approval of details shall be at the contractor's risk. Approval by the engineer shall not be held to relieve the contractor of any part of the contractor's responsibility to meet all of the requirements of these specifications or of the responsibility for the correctness of the joint details.

120.4.6. Harnessed Joints - Harness joint designs shall be submitted to the project engineer for approval. On transmission lines twenty (20) inches and larger, the joint harness designs shall include considerations of stresses induced not only in the attachments, but also in joint rings and steel cylinder by thrust at bulkheads, bends, reducers, and valves resulting from the internal working pressure including the transient pressures. Design stresses shall not exceed fifty (50) percent of the specified minimum yield strength of the grade of steel utilized when longitudinal thrust is uniformly distributed around the circumference of the joint.

The manufacturer shall supply a mechanical method of joint restraint suitable to the engineer that will allow for expansion, contraction and deflection after assembly.

Proof-of-design tests need not be conducted specifically for a project. Certified reports covering tests of harnessed joints constructed in the identical fashion as that proposed may be found acceptable.

120.4.7. Flanges and Nozzles - Flanges in the line and for outlets of the size and at locations shown on the drawings shall meet the requirements of AWWA Standard C-207, Class "D", 150 psi working pressure. Flanges may be either ring type flanges or hub type flanges, but all flanges supplied must be of the same type and class. Blind flanges shall be designed in accordance with ASME Unfired Pressure Vessel Code, Section VIII. The design pressure for blind flanges shall be 150 psi.

Bolt holes in all flanges shall straddle field vertical centerline. Bolt holes for insulating flanges shall be 3/16" larger than the bolt diameter.

Gaskets for standard flanged outlets shall be 1/8" ring type Garlock #7021 compressed asbestos sheet packing or approved equal. Insulating flange gaskets shall be PSI - Pacific Seal gaskets with sleeves and double insulating washers.

Nozzles shall have 1/4" minimum wall thickness.

The machined faces of all flanges shall be shop coated with rust preventative compound, Dearborn Chemical "No-Ox-Ld", Houghton "Rust-Veto 344" or Rust-Oleum "R-9". Edges and back faces of attached flanges shall be shop coated with Koppers "Bitumastic Mill Undercoat". All surfaces of blind flanges, except the machines surfaces, shall be shop coated with Koppers "Bitumastic Mill Undercoat".

120.4.8. Mechanical Couplings - Where mechanical couplings are required, the ends of the pipe shall be prepared for flexible steel couplings, Dresser or approved equal. Plain ends for use with couplings shall be smooth and round for a distance of twelve (12) inches from the ends of the pipe, with pipe diameter not more than 1/64" smaller than the nominal 0.D. of the pipe. The middle ring of the coupling shall be truly round. After welding, all middle rings shall be tested by cold-expanding a minimum of one (1) percent beyond the yield point to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.

The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength, in the opinion of the engineer, to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket.

Gaskets shall be rubber-compounded material that will not deteriorate from age or exposure to air under normal storage or use conditions. The rubber in the gasket shall meet the following specifications:

Color - Jet Black	Tensile Strength - 1000 psi Minimum
Surface - Non-blooming	Elongation - 175% Minimum
Durometer Hardness - 74 $\pm$ 5	

The gaskets shall be immune to attack by impurities normally found in water. All gaskets shall meet the requirements of ASTM designation D2000 AA 709Z meeting Suffix B13 except as noted above.

In addition, where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.

Each coupling shall pass a resistance test of 10,000 ohms after being assembled on the pipe for 72 hours.

120.4.9. Closures and Correction Pieces - Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and that correction may be made to get the pipe laying on station. Closures and correction pieces shall be provided as required by the contractor and shall be approved by the engineer.

Closures shall be so constructed as to have not less than a minimum of eighteen (18) inches and maximum of two (2) times the pipe I.D. adjustment, which may be made in the field.

The correction piece shall be a nominal length of pipe with a length of bare pipe on the spigot end for a field trim. Linings shall be held back six (6) inches from the required length on the spigot end.

120.4.10. Specials and Fittings - Unless otherwise specified herein or on the plans, all specials and fittings for transmission lines shall conform to the dimensions of the applicable AWWA or ASTM Standards. Specials and fittings shall be designed and constructed to be of equal or greater strength than the transmission line and shall have the same type of lining and coating as the abutting pipe. Specials and fittings shall be made of segmentally welded sections from hydrostatically tested Pipe cylinders, with ends to mate the type of joint or coupling specified. The deflection angle between adjacent segmented bands shall not be greater than 22 1/2 degrees.

Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand, using the same materials as are used for the pipe and in accordance with the applicable AWWA Standards. Coatings and linings applied in this manner shall provide protection equal to that specified for the pipe. Fittings may be fabricated from pipe that has been mechanically lined and/or coated. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand applications in accordance with applicable AWWA Standards. Areas of cement-mortar linings repaired in this manner need not be reinforced with wire mesh.

Reinforcement for wyes, tees, and nozzles shall be designed in accordance with AWWA M-11 "Steel Pipe Manual". Reinforcement shall be designed for the working pressures indicated.

Access manholes with covers shall be 20" in diameter (0.D.) as detailed on the drawings. All threaded outlets shall be forged steel suitable for 3000 pound service.

Moderate deflections and long radius curves may be made by means of beveled joint rings, by deflecting a straight pipe, by using short lengths of pipe, or by a combination of any of these methods.

Unless specifically approved by the engineer, all curves must begin with a pipe joint or fabricated angle at the P.C. and end with a pipe joint or fabricated angle at the P.T. within station locations shown on the Drawings. All deflection angles shall fall on the curve. The laying schedule P.I.'s must meet the P.I.'s as shown on the Drawings in the horizontal direction. The laying schedule for vertical P.I.'s must meet the P.I.'s as shown on the Drawings where interference is critical.

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PART III - MINIMUM DESIGN STANDARDS

SECTION 115.

WATER DISTRIBUTION SYSTEM

115.0. WATER DISTRIBUTION

The water main distribution system shall be designed to connect with the City water system and make water available to each lot in the proposed subdivision. Fire hydrants shall be located to insure protection to each lot, but under no circumstances shall a lot be more than three hundred feet from the nearest hydrant based on front line distance. Design of the system shall be the responsibility of the subdivider with all plans subject to approval of the City Council through their designated representatives. Installations of the system shall be to specifications and at the direction of the City Council through their designated representatives. Financial responsibility for the water distribution system shall be subject to existing City regulations and agreement relating thereto between the City council and the subdivider, subject to provision to the City of Rifle Public Works Manual.

115.1. GENERAL

Distribution and/or lateral mains and service lines conveying water from transmission lines to fire protection systems and customers shall be laid out and designed according to the following minimum standards. Pipe and fittings shall be those specified in Part II Section 30, Table 30-I of these specifications. When installed, the top of distribution and lateral lines shall be buried a minimum of 4 1/2 feet under compacted backfill, below finished grade.

115.2. SIZING LINES

All lines shall be sized large enough to provide for domestic, commercial, irrigation, and fire protection flows to the area to be served.

The maximum acceptable head loss for eight (8) inches and larger mains is two (2) feet per 1000 feet of main at peak hour flows. The Hazen Williams friction coefficient of C-100 is to be used when sizing distribution lines sixteen (16) inches and larger. The velocity at maximum flow in any main shall not exceed ten (10) feet per second.

Pressure requirements to the area being served shall be between 250 feet (108 psi) and 116 feet (50 psi) static head. The system shall maintain a 20 psi minimum residual pressure during fire flow and a 50 psi minimum residual pressure during peak consumptive flow.

Peak consumptive flow shall be based on:

A. 880 gpd/capita in residential areas.
(Single Family: 3.5 persons/DU, Duplex 3.0 persons/DU, MultiFamily 2.5 persons/DU)

Residential Average Day: 100 gpd/capita
Residential Max Day: 250 gpd/capita

B. 500 gpd/acre for commercial and professional buildings.

C. 600 gpd/acre for industrial application.

Fire flow may be calculated from more than one hydrant providing the hydrants used are directly accessible to all possible fire locations in the area served. Minimum fire flow shall be as defined by the latest adopted version of the Uniform Fire Code or International Fire Code as adopted and/or recognized by the Rifle Fire Protection District.

The City reserves the right to size mains to provide service for future needs.

Developers are responsible to design new construction, located in previously established areas, such that the total demand fire flow does not exceed the available fire flow. This may require the developer to oversize existing or install additional mains to serve his project.

115.3. DISTRIBUTION SYSTEM

115.3.1. Layout - Distribution and lateral mains shall be installed in dedicated easements and public right-of-way. Pipe alignment shall be parallel to property lines and located five (5) feet north or east of the street centerline or in the easement. Water mains shall extend to the extremities of the subdivision served. A main serving one (1) lot shall extend across the entire frontage of the lot.

Distribution mains, sixteen (16) inches to twenty (20) inches in diameter, shall be grid spaced at one mile intervals. Secondary distribution mains, 12" to 14" in diameter, shall be intermediately spaced at one half (1/2) mile intervals and connected at each end to the larger distribution main. Lateral lines eight (8) inches to ten (10) inches in diameter, shall be looped to the distribution mains and used to deliver water to fire hydrants and the individual customer service and fire protection lines.

A. Laterals Six (6) Inches Diameter: Conditions under which six (6) inch secondary branch laterals will be approved to serve single family detached residences are where:

1. A six (6) inch branch lateral interconnects between two (2) eight (8) or ten (10) inch lateral lines no more than 600 feet apart.

2. A six (6) inch branch lateral ends in a cul-de-sac at a fire hydrant no more than 300 feet from its point of connection with an eight (8) inch or larger lateral.

3. A six (6) inch branch lateral ends in a cul-de-sac not more than 150 feet from its point of connection with an eight (8) inch or larger lateral and serves four (4) or less single family residences.

4. Where computations can justify adequate service and fire flow needs for existing and future conditions.

B. Temporary Lateral: Mains and laterals shall be interconnected or looped. However, when a main or lateral is allowed to temporarily terminate, such as between filings of a subdivision, a fire hydrant or blow-off shall be installed at the point of termination. Mains and laterals shall be extended to the boundaries of filings and completely across the frontage of individual lots.

C. Easements and right-of-way: The minimum width ROW or easement for City use, in which a water main will be installed is twenty (20) feet, except as authorized for Planned Unit Developments (PUD).

115.3.2. Planned Unit Developments - In planned unit developments, the City will allow the installation of lateral mains under the following conditions:

A. The main is installed in a non-exclusive easement which is no less than thirty (30) feet in width and the City is provided unobstructed use of twenty (20) feet thereof, except for right angle utility crossings.

B. The main is installed in a 50-foot minimum width dedicated street, which meets all the requirements for a subdivision filing.

C. See Section 115.6 below.

115.3.3. Line Valves - Line valves are required at approximately every 600 feet in all distribution and lateral lines. Where City blocks exceed 600 feet in length an intermediate line valve shall be installed such that no more than twenty (20) residential units nor more than one (1) commercial or industrial user will be out of service during maintenance.

Four-way and three-way street intersections require four (4) and (3) valves respectively, one on each extended property line. For a succession of short blocks perpendicular to the direction of major feed and without residential or commercial services between, one or more intersections may have the valve omitted in that direction, but should retain the 600 foot distance. Line valves shall also be placed:

A. Such that no more than one (1) fire hydrant is isolated at any one time.

B. At each end of a line running through an easement on private Property.

C. On each side of a major creek or channel crossing.

D. On each side and at property lines extended, of a service line that feeds a hospital, school or large industrial user.

E. On fire hydrant laterals.

115.3.4. Combination Air Vacuum Air Release Valves - Combination air vacuum air release valve shall be installed at the crown or high point elevation on distribution and lateral lines. Valves shall be installed in a manhole or vault specifically designed for the application. The use of a fire hydrant to relieve air from six (6) inch secondary lateral will only be allowed when the fire hydrant is installed at the end of a cul-de-sac which is also the high point in the lateral.

115.3.5. Blow-off Valves - Provision shall be included to allow flushing distribution and lateral lines at the sag or low point in the line, between line valves and at temporary dead ends, when approved. Fire hydrants located such that the pumper nozzle outlet elevation is no less than three (3) feet above and within 75 feet of the low point in the line, may be allowed to serve as a blow-off when installed on side property lines extended.

Blow-off gate valves shall be installed perpendicular to and on the downhill side of the main and drain to the nearest gutter line. See standard drawing. (W-9)

115.3.6 Water Sampling Stations – Water sampling stations shall be installed where directed by the City within dedicated easements or streets.

They shall be installed at right angles to the water main and placed on a 3 ft. by 3 ft. concrete slab at grade, as shown on drawing W-61.

115.4. FIRE PROTECTION SYSTEM

115.4.1. Fire Hydrants - Fire hydrants shall be installed within dedicated streets or easements. The number and location of fire hydrants in a given area is determined by the City Engineer and the governing fire protection district. Normal practice is to install fire hydrants on the northeast corner of the street intersections. If fire hydrants are to be installed at other than street intersections, they shall be located on one side of the street right-of-way on lines which are established by extending property lot side lines into the street or in easements.

The maximum spacing between fire hydrants, when measured along the street curb line or directly from the hydrant to the unit, for types of structure use and maximum floor areas being served shall not exceed the distances shown below:

STRUCTURE TYPE	FAMILY UNIT			MFG/IND/OFFICE	
	DETACHED		MULTI	MULTI STORY	SINGLE STORY
Unit Separation	15'+	0-15'			
Hydrant Spacing					
Along Curb	500'	350'	300'	300'	
From Unit	250'	225'	210'	180'	
From Exit Doors					200'
Fire Flow Range					
Rifle Fire Protection District (Per adopted edition of U.F.C. or I.F.C.)					

Fire hydrants shall be provided at not less than 1,000 ft. intervals, to provide for transportation hazards, along streets where hydrants are not needed for protection of structures.

Fire hydrants shall be connected to a valve in the main supply line with six (6) inch diameter Class 200 AWWA C900 PVC pipe lateral, perpendicular to the valve, and anchored with retainer glands and/or harness rods.

115.4.2. Fire Sprinkler Lines - Fire sprinkler lines shall be installed at right angles to the distribution main or lateral and be extended directly to the property line. No horizontal bends, off-sets or taps are to be installed in these lines. The size of the fire sprinkler lines shall be determined by the governing fire protection district who is served. A valve must be installed in the City right-of-way or easement.

115.4.3. Residential Standby Fire Protection - Single tap combination domestic water service and standby fire protection to a single family residence, may be used when the following conditions are met:

A. The combination system is approved by both the Rifle Fire Protection District and the Building Inspection Division of the Public Works Department.

B. The line is one continuous length of type "K" copper extending perpendicular from the corporation stop in the main to a curb-stop and box, located on the property side of the vertical curb or sidewalk.

C. The residential domestic service line is teed off the fire line, one (1) foot downstream of the curb stop.

D. A single meter and pit is installed at the property line to meter both the domestic and fire flow. The meter shall be sized for the maximum flow. The meter shall be the same size as tap and service line. The combined system shall be approved by the Public Works Department.

E. The fire protection service line shall be equipped with backflow prevention devices, and tested after installation and yearly thereafter.

115.5. SERVICE LINES

Service lines with appurtenances to convey water from a distribution or lateral main in a street or easement to a structure shall conform to the following minimum standards.

The corporation stop, the meter, and that portion of the service pipe between the outside meter pit and the corporation stop on the main, shall all be of the same size. This portion of the service line must be installed in public right of way or an easement and the portion between the main and the curb stop, and the meter will be maintained by the City.

115.5.1. Sizing Services - Service lines shall be adequate to supply the requirements of the property being served. The minimum size allowed for a water service line is 3/4".

The size of a service line from the City water main to any unit being served shall be selected such that the following design criteria are not exceeded during total peak demand flow:

A. Eighty (80) percent of the manufacturer's maximum meter capacity.

B. Service line pipe flow velocity does not exceed fifteen (8) fps.

C. The pressure drop from the City water main to any unit being served shall not be greater than 30 psi and the minimum residual pressure at the foundation at any unit shall not be less than 30 psi.

The water requirements of the property being served shall be defined as "total peak demand flow." Peak domestic water requirements shall be as calculated in the latest edition of the Uniform Plumbing Code.

The irrigation demand flow and continuous load demands (when applicable) shall be added to the peak domestic flow to obtain the total peak demand flow. The service lines and meter

shall be designed on the basis of the total peak demand flow. Consideration should be given to metering domestic and irrigation demand flows separately in some instances.

Peak demand flows for commercial, industrial or professional properties are to be approved by the City prior to sizing their service lines.

115.5.2. Layout of Service Line - That portion of the service pipe between the main and the property line shall be one continuous length of copper pipe, installed perpendicular from the main to a meter or curb stop and box at property line.

Service lines shall be installed at least ten (10) feet laterally, on the uphill side from any foreign non-potable conduit and a minimum of five (5) feet from the side property line of the lot being served.

When serving lots at the end of a cul-de-sac, the length of service line between the main and the meter at property line shall not exceed 50 feet. Meters and/or curb stops with boxes shall not be installed in driveways or sidewalks. In instances where this requirement cannot be met, the curb stop/meter pit and lid must be of ductile iron as approved by Public Works.

When approved by Public Works Director, a meter may be installed inside a building or structure. Provisions must be made for the installation of a remote read meter with curb stop and box at property line.

115.6. PLANNED UNIT DEVELOPMENT TOWNHOME COMPLEX

Each building, regardless of the number of units contained therein, in a P.U.D. shall be metered and the service line from the meter tapped directly to a main located in public right-of-way or to a lateral supply line in the common area. The service line to the meter shall be one continuous section of copper pipe installed perpendicular to the main or lateral supply line. Meter shall be installed at property line or at a point in the common area that is easily accessible and void of vehicular traffic at all times. The location of lateral supply lines and meter, to be installed in common areas, easements must be approved by the City Engineer.

In a townhome complex, each townhome unit shall have its own separate meter. The service line from each meter shall be directly tapped to a supply line, as set forth above for a P.U.D. building. In addition, the service line shall only cross the common area and the unit lot of the townhome being served. See section 115.3-2 of these specifications.

115.7. COMMERCIAL STANDBY FIRE PROTECTION LINE

A property requiring both a fire line and a domestic service line cannot be served from a single tap. The fire protection service line shall extend perpendicular from the main to the property line and shall have a gate valve located within two (2) feet from and on the street side of the property line. A separate tap shall be placed on the water main to serve a separate domestic service line. A domestic service tee may not be placed on an existing fire line.

115.8. COMMON TRENCH

Service lines shall be separated laterally from a foreign conduit by a minimum of ten (10) feet and shall not be installed in trenches containing any substance other than potable water, except when the following conditions are met:

A. The service line is one continuous length of copper pipe.

B. The foreign pipe is polyvinyl chloride (PVC) pipe in 20 foot sections with concrete encased joints.

C. The bottom of the service pipe is at least twelve (12) inches above the top of the foreign pipe and placed on a shelf excavation on one side of the common trench.

D. Specifically approved by the City in writing.

115.9. BACKFLOW PREVENTION DEVICES

115.9.1. General - An approved backflow prevention assembly shall be installed at the service connection to any premises where there are existing cross connections or where potential cross connections exist or where it is expected that the consumer may make piping or equipment changes which would result in the installation of cross connections. Installation of the assemblies shall be inspected and approved by the City of Rifle.

115.9.2. Degree of Hazard - The type of backflow prevention assembly required must be consistent with the "degree of hazard" existing in the facility. The term "degree of hazard" shall be derived from the evaluation of conditions within a system which can be classified as either a "pollutional" (non-health) or a "contamination" (health) hazard. The "degree of hazard" shall be determined by the City based on the following.

A. A Health Hazard is an actual or potential threat of contamination of a physical or toxic nature to the public potable water system or the consumer's potable water system that would be a danger to health. A health hazard requires the installation of an approved reduced pressure principle backflow assembly or an air gap.

B. An Aesthetically Objectionable Hazard is an actual or potential threat to the physical properties of the public or the consumer's potable water system or a pollution or contamination which would have a protracted effect on the quality of the potable water in the system. An aesthetically objectionable hazard requires as a minimum the installation of an approved double check valve assembly.

115.9.3. Approved Models - Only those models (FEBCO:825Y-BV sprinkler line or 825 Y-BY building service line) that have met completely the laboratory and field performance specifications of the Foundation for Cross Connection Control and Hydraulic Research, of the University of Southern California, will be permitted by the City. In addition, the design for installation of backflow prevention assemblies shall, where applicable, address the following:

A. Water service size and location; meter size and location; backflow prevention assembly size, type, and location.

B. Backflow prevention assemblies shall be installed in the horizontal plane and inside a building.

C. Vertical clearance between floor and the lowest point of the device shall be no less than twelve (12) inches or no more than thirty (30) inches.

D. Horizontal clearance between any wall and the device shall be no less than twenty-four (24) inches on the test cock side and no less than twelve (12) inches on the opposite side.

E. An underground drain line shall be provided to dispose of waste fluids developed during regular use and testing of the device. An air gap, no less than twice the diameter of the drain line, shall be provided between the relief valve outlet and the drain line.

F. Continuous service systems shall be provided with parallel backflow prevention assemblies. One device shall be operable while the other is being tested.

G. No installation of a backflow prevention device will be allowed above electrical or other equipment, where water could cause a hazard.

H. Backflow prevention devices are required on all sprinkler systems. A pressure vacuum breaker shall only be used where the device is never subjected to back pressure and installed a minimum of twelve (12) inches above the highest piping or outlet downstream of the device in a manner to preclude back pressure. An atmospheric vacuum breaker shall be used only where the device is: never subjected to continuous flow, installed on the discharge side of the last control valve and above the point of usage, and installed with the air inlet in a level position and a minimum of six (6) inches above the highest piping on the outlet it is protecting.

I. Backflow prevention assemblies, connecting lines, and drains shall be protected from freezing and thawing cycles.