SOMERS STATE PARK
PHASE 2 HOST PADS

SPECIFICATIONS

Prepared By:

A2Z Engineering PLLC
138 E Center St
Kalispell, MT 59901
(406) 755-7888

SOMERS STATE PARK
PHASE 2 HOST PADS PROJECT
SPECIFICATIONS
TABLE OF CONTENTS

DIVISION 1 – GENERAL REQUIREMENTS

DIVISION 2 – SITEWORK

MPW

Division 1
General Requirements

DIVISION 1 – GENERAL REQUIREMENTS

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.1 DESCRIPTION

A. The Invitation to Bid contains a general description of the project work to be performed under this Contract. The Supplemental Conditions and Special Provisions and other documents contain additional information necessary to perform the work.

1.2 CONTRACT DOCUMENTS

A. Portions of the Contract Documents are written in the imperative mode. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, "Furnish..." means "Contractor shall furnish...", "Provide" means Contractor shall provide...". For imperatives specifically addressing the Engineer/Owner, see paragraph 1.02, General Conditions.

B. Contract Documents are defined in Article 1, paragraph 1.01.A.12, General Conditions, as modified by Montana Public Works Standard Specifications, any supplemental conditions, and Article 9 of the Agreement Form.

C. The Contract Documents are intended to provide the basis for proper completion of the work suitable for the intended use of the Owner. Comply with Article 3, General Conditions. Specifications and Drawings included in these contract documents establish the performance, quality requirements, location and general arrangement of materials and equipment, and establish the minimum standards for quality of workmanship and appearance. Anything not expressly set forth but which is reasonably implied or necessary for proper performance of the project shall be included.

D. The various portions of the Contract Documents, of which these specifications are a part, are essential parts of the Agreement, and a requirement occurring in any portion or part is binding as though occurring in all. All portions are intended to be complementary and to describe and provide for a complete work as referenced in Article 3, General Conditions. Unless specifically noted otherwise, in the case of discrepancy the following hierarchy shall be observed:

1. Addenda, which will govern over;
2. Special Provisions, which will govern over;
3. Standard Modifications, which will govern over;
4. Supplementary Specifications, which will govern over;

5. Project Drawings, which will govern over;
6. These Specifications and Standard Drawings, which will govern over;
7. Montana Department of Transportation Standard Specifications for Road and Bridge Construction

E. The bound copy of the Montana Public Works Standard Specifications, as distributed by the Montana Contractor's Association, Inc., will govern as the legal set of these specifications over any unbound copy, or any CD-ROM or floppy disk versions

F. A requirement mentioned in one part/section of the Contract Documents shall be considered as having been mentioned in all parts/sections.

1.3 WORK SEQUENCE

A. Comply with paragraph 2.07 and 6.04 of the General Conditions and Milestones specified in the Contract Documents.

B. Submit detail schedules as specified in the Contract Documents.

C. Field verify dimensions indicated on drawings before fabricating or ordering materials. Do not scale drawings.

D. Notify Engineer/Owner of existing conditions differing from those indicated on the drawings. Comply with paragraph 4.03, of the General Conditions and any Supplementary Conditions. Verify the existence and location of underground utilities along the route of the proposed work. Omission of an existing or previous abandoned utility location on the Drawings is not to be considered as its nonexistence. Inclusion of existing utility locations on the Drawings is not to be considered as its definite location. Do not remove or alter existing utilities without prior written approval.

1.4 CONTRACTOR USE OF PREMISES:

A. Comply with paragraph 6.11, General Conditions, and as specified in the Contract Documents.

B. Do not park vehicles or equipment or store materials on private property without written permission from the property owner. Provide Engineer/Owner with copy of authorization.

1.5 OWNER-FURNISHED ITEMS

A. Owner-furnished items are listed in the Contract Documents.

PART 2 PRODUCT — NOT USED

PART 3 EXECUTION — NOT USED

PART 4 MEASUREMENT AND PAYMENT

4.1 PAYMENT

4.1.1 Unless specifically noted otherwise, the work of Division 1 shall be incidental to the work, and no separate payment shall be made.

END OF SECTION 01010

SECTION 01041

PROJECT COORDINATION

PART 1: GENERAL

1.1 DESCRIPTION

A. This section specifies the requirements for coordinating and sequencing the work under the Contract documents, and requirements regarding existing site conditions.

1.2 COORDINATION WITH PUBLIC AND PRIVATE AGENCIES

A. Comply with Article 7, General Conditions. Permit utility companies to repair or replace their lines in the project limits.

B. Contact the Montana one-call system for utility locations before starting work.

C. Comply with paragraph 6.20, General Conditions.

PART 2: PRODUCT — NOT USED

PART 3: EXECUTION — NOT USED

PART 4: MEASUREMENT AND PAYMENT — NOT USED

END OF SECTION

SECTION 01050

FIELD ENGINEERING

PART 1: GENERAL

1.1 ENGINEERING SURVEYS

A. Notify Engineer of required survey work at least 48 hours before starting work.

B. Preserve all benchmarks, control points and stakes.

C. Replace benchmarks, control points and stakes destroyed or disturbed by Contractor or subcontractor.

D. Comply with paragraph 4.04, General Conditions.

1.2 STREET MONUMENTS AND PROPERTY CORNERS

A. Mark and protect existing property pins and/or street monuments.

B. Use a licensed land surveyor to replace all property corners or other monuments marked or shown on the plans that are destroyed by the work.

PART 2: PRODUCT — NOT USED

PART 3: EXECUTION — NOT USED

PART 4: MEASUREMENT AND PAYMENT — NOT USED

END OF SECTION

SECTION 01090

REFERENCES

PART 1: GENERAL

1.1 COORDINATION OF CONTRACT DOCUMENTS

1.2 DEFINITIONS

A. These specifications use "Article 1 - Definitions" of the Standard General Conditions of the Construction Contract, Form No. C-700 prepared and issued by the Engineer's Joint Contract Documents Committee (EJCDC), for the definition of terms herein. Changes to definitions are by either substitution for the article or in Supplementary Conditions.

1.3 REFERECNCES

A. This section lists some of the construction industry organizations, professional and technical associations, societies and institutes, and government agencies issuing, promoting, or enforcing standards in the Contract Documents along with the abbreviations commonly used for those references. Also included are general requirements for using industry standards specified, and for applying quality control standards.

1.4 USE OF REFERENCE STANDARDS

A. Work specified by reference to a published standard or specification of a government agency, technical association, trade association, professional society or institute, testing agency, or other organization must meet or exceed the minimum quality standards for the material and workmanship in the designated standard or specification.

B. Where specified, assure products or workmanship meet the prescriptive or performance requirements in the Contract Documents when it is a more stringent standard than the referenced standard. Contract should reference only one specification to prevent argument as to which specification is most stringent.

C. Where the specific issue date of the standard is not identified in the standard, the edition and all published amendments available on the date of the Invitation to Bid applies.

D. If two or more standards are specified, provide the product and workmanship meeting or exceeding the requirements of the most stringent standard.

E. If a conflict exists between standards, meet the more stringent standard.

F. Where both a standard and a brand name are specified, assure the proprietary product names meet or exceed the specified reference standard. The listing of a trade name in a Contract Document does not warrant that the product meets the referenced standard.

G. Copies of Standards

1. Copies of applicable referenced standards are not bound in this Contract Document.

2. Where the contractor needs copies of standards for work superintendence and quality control, obtain a copy or copies directly from the publication sources and maintain copies at the job site, making them available to Contractor personnel, subcontractors, Owner, and Engineer.

1.5 ABBREVIATIONS

A. Abbreviations for Trade Organizations and Government Agencies: Following is a list of construction industry organizations and government agencies commonly referenced in the Contract Documents, with abbreviations used.

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturers' Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers' Association
AGA	American Gas Association
AGMA	American Gear Manufacturers' Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALS	American Lumber Standards
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
AREA	American Railway Engineering Association
ARI	Air Conditioning and Refrigeration Institute

ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers' Association
AWPB	American Wood Preservers' Bureau
AWPI	American Wood Preservers' Institute
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers' Association
CBMA	Certified Ballast Manufacturers' Association
CDA	Copper Development Association
CGA	Compressed Gas Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers' Association of America
CRSI	Concrete Reinforcing Steel Institute
FGMA	Flat Glass Marketing Association
FM	Factory Mutual
Fed Spec.	Federal Specifications
FS	Federal Specification
GA	Gypsum Association
HI	Hydraulic Institute
HMI	Hoist Manufacturers' Institute
ICBO	International Conference of Building Officials
ICEA	Insulated Cable Engineers' Association
IEEE	Institute of Electrical and Electronics Engineers, Inc.
IES	Illuminating Engineering Society of North America
ISA	Instrument Society of America
JIC	Joint Industry Conferences of Hydraulic Manufacturers
MIA	Marble Institute of America
Mil. Sp.	Military Specification
MS	Military Specifications
MMA	Monorail Manufacturers' Association
NAAMM	National Association of Architectural Metal Manufacturers
NBHA	National Builders' Hardware Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturers' Association
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NHLA	National Hardwood Lumber Association

NLMA	National Lumber Manufacturers' Association
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers' Association
OECI	Overhead Electrical Crane Institute
OSHA	Occupational Safety and Health Act (both Federal and State)
PEI	Porcelain Enamel Institute
PS	Product Standards Section - U.S. Department of Commerce
RLM	RLM Standards Institute, Inc.
RMA	Rubber Manufacturers' Association
SAE	Society of Automotive Engineers
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturing Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
SWI	Steel Window Institute
TEMA	Tubular Exchanger Manufacturers' Association
TCA	Tile Council of America
UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriters' Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WWPA	Western Wood Products Association

PART 2: PRODUCT — NOT USED

PART 3: EXECUTION — NOT USED

PART 4: MEASUREMENT AND PAYMENT — NOT USED

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1: GENERAL

1.1 CONSTRUCTION SCHEDULES:

A. Submit to the Engineer a progress schedule under Sections 2.05, 2.07, and 6.04 of the General Conditions.

B. Submit to the Engineer adjusted progress schedules under Section 6.04 of the General Conditions.

C. Submit to the Engineer, value schedules under Sections 2.05, 2.07 and 14.01 of the General Conditions.

1.2 SHOP DRAWINGS, PRODUCT DATE, AND SAMPLES:

A. Submit shop drawings to the Engineer under Sections 2.05 and 6.17 of the General Conditions. Submit all shop drawings for the Contractor, subcontractor(s) and supplier(s)

B. Review all shop drawings prior to submittal in accordance with Section 6.17 of the General Conditions.

C. Submit in writing any substitutions to previously approved items for review by the Engineer.

D. Within 15 days after Notice to Proceed, submit a complete list of products proposed for use, providing manufacturer's name, trade name, and model or catalog numbers, and manufacturer data.

Submit the number of copies needed by the Contractor, plus three copies for Engineer use.

E. Where specified, submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices.

Where specified, submit samples of finishes including colors, textures, and patterns.

PART 2: PRODUCT — NOT USED

PART 3: EXECUTION — NOT USED

PART 4: BASIS & METHOD OF PAYMENT — NOT USED

END OF SECTION

SECTION 01400

CONTRACTOR QUALITY CONTROL AND OWNER QUALITY ASSURANCE

PART 1: GENERAL

1.1 DESCRIPTION

A. This section describes the Contractor quality control testing requirements and Owner's quality assurance program.

1.2 References

A. The following ASTM publication is a part of this specification.

ASTM E 329 Evaluation of Testing and Inspection Agencies as Used in Construction

PART 2: PRODUCT — NOT USED

PART 3: EXECUTION

3.1 GENERAL

A. Be responsible for quality control tests and inspections to control contractor production and construction processes. Include in the Contractor quality control system an internal organization, plans, and procedures to produce the specified end product. Assure the system covers all construction operations, both on-site and off-site, and is keyed to the construction sequence. Quality control testing frequency is at Contractor discretion, except where tests are specifically required in the technical specifications for individual products.

B. Sampling and testing to assure specification conformance are performed by the Owner or the Owner's testing agency as quality assurance testing.

C. The Owner may select a testing agency to perform quality assurance testing. (ASTM E329 is referenced as a guide to the selection of a qualified testing agency.) The Owner will pay for (or provide) the quality assurance testing. Quality assurance testing frequency is at Owner discretion for individual products.

D. Quality assurance testing is performed following the standards in the technical specifications for individual products.

3.2 CONTRACTOR COOPERATION WITH QUALITY ASSURANCE AGENCY

A. Assure the Owner's personnel and quality assurance agency have access to all work areas at all times work is in progress. Provide any special facilities or equipment to access work areas at Contractor expense.

B. Notify the Engineer of the work ready for quality assurance testing. Establish and update as the construction schedule to provide the Engineer estimated sampling/testing dates and times.

PART 4: MEASUREMENT AND PAYMENT

4.1 PAYMENT FOR TESTING

A. Pay for all quality control testing as outlined in Subsection 3.1 above. Mix designs for Portland Cement Concrete and Flowable Fill, mix designs for Asphalt Concrete, and all initial aggregate quality tests are quality control tests and are at Contractor expense. Testing costs are incidental to the work and to be included in the unit price bid for the respective item.

B. Owner will pay all quality assurance testing costs.

4.2 RETESTING

A. Quality assurance re-testing due to failing initial tests will be performed by the Owner or the Owner's quality assurance testing agency, and the re-test costs deducted from the contract amount for the affected bid item.

END OF SECTION

SECTION 01500

CONSTRUCTION AND TEMPORARY FACILITIES

PART 1: GENERAL

1.1 CONSTRUCTION FACILITIES

A. Furnish temporary services and utilities, including use fees and operation costs for: potable and non-potable water; lighting and power; and, materials storage.

B. Furnish personnel support facilities including: sanitary facilities; drinking water; first aid supplies and facilities; and, trash removal.

C. Do not park vehicles or equipment or store materials on private property without written permission from the property owner under Section 01010.1.4.B.

1.2 SECURITY

A. Provide fencing, barricades, warning signs, and lights to secure all work areas, equipment, and materials.

1.3 DUST CONTROL

1.4 Be responsible for dust control, providing all equipment and personnel for the work. Furnish Engineer name(s) and telephone number(s) of the person(s) responsible for dust control during evenings and weekends. If this person cannot be contacted, Owner may at Contractor expense, perform the work or contract the work out.

1.5 HAUL ROUTES

A. Obtain Owner approval of haul routes.

PART 2: PRODUCTS — NOT USED

PART 3: EXECUTION — NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.1 PAYMENT

A. All items in Part 1 are incidental to the work and no separate payment is made for these items.

END OF SECTION

SECTION 01570

CONSTRUCTION TRAFFIC CONTROL

PART 1: GENERAL

1.1 DESCRIPTION

A. This work is the furnishing of labor, materials and equipment for installing, maintaining and operating traffic control devices to insure the safety of the general public and project personnel.

1.2 REQUIREMENTS

A. Perform work under this section meeting Manual of Uniform Traffic Control Services (MUTCD) and contract requirements.

1.3 NOTIFICATIONS

A. Coordinate all construction activities to reduce traffic conflicts at the work site, off-site events or other construction projects.

B. Furnish the Engineer, for Owner review, the construction traffic control plan at least one week before construction begins or before changes in segments or phases of the work on the project. The Owner will review and approve the Traffic Control Plan considering known off-site activities and may require modification to the plan or construction timing to coordinate events. Work shall not commence until said plan is approved.

C. For project sites involving a through street, provide the Engineer with a news release. Include in the news release, as a minimum, the work activity and duration. Once approved, furnish the news release to the local media at least three days before starting work. Notify all landowners or residents adjacent to the work of the type and duration of the construction.

PART 2: PRODUCT

2.1 TRAFFIC CONTROL DEVICES

A. Assure all signs and barricades are reflectorized. Assure all night time traffic control devices meet MUTCD lighting requirements.

B. Use traffic control devices meeting the "Manual of Uniform Traffic Control Devices" and the "Traffic Control Devices Handbook" requirements, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20492.

C. Assure all traffic control devices are clean, legible, reflective for night-time use, and operable.

PART 3 EXECUTION

3.1 WORK METHODS:

A. Place all traffic control devices as planned before permitting men or equipment on the traveled way. Install signs, cones and barricades in that order.

B. Inspect the work area at least twice each day during construction and maintain records of traffic control devices used and their location.

C. Assure traffic control is appropriate to the work. Assure traffic control devices are appropriate and clean before suspending work for the day.

D. Remove traffic control devices in reverse order of installation at the end of each shift.

E. Remove and store all unnecessary traffic control devices away from traffic's view.

3.2 NONCOMPLIANCE

A. Remove, repair or replace any traffic control device not providing its intended function.

B. Do not begin work until all required traffic control devices are placed.

C. The Engineer will periodically inspect the traffic control and inform the Contractor of any deficiencies.

D. Contractor failure to correct any deficiency in the traffic control within 4 hours of notification is cause to deduct monies from the contract payment on the next progress payment.

E. The Engineer may direct correcting traffic control deficiencies immediately. Failure to immediately correct the deficiency is cause for the Engineer to correct the deficiency at Contractor expense.

3.3 FLAGGING

A. Furnish competent and properly equipped flag persons as described in the booklet "Instructions for Flag persons" furnished by the Montana Department of Transportation.

PART 4: MEASUREMENT AND PAYMENT

4.1 PAYMENT

A. Separate measurement for each traffic control device is not made unless the on-site field traffic plan requirements differ materially from the original traffic control plan in the contract. Measurement and payment for the Contractor's off-site traffic control plan and the designed on-site traffic control plan is on a lump sum basis. The lump sum payment is full reimbursement for all costs of furnishing, installing, maintaining, replacing and operating the construction traffic control systems throughout the work period. The construction traffic control system includes but is not limited to, signs, barricades, pavement markings, watering, flag persons and pilot cars.

B. Progress payments are in proportion to total construction completed.

C. If changes in the approved Traffic Control Plan are directed by the Engineer, additional payment or reduction in payment is made for the additional or deleted items as agreed to between the Contractor and the Engineer.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1: GENERAL

1.1 CLEANUP

A. Before Final inspection (as outlined in Section 14.06 of the General Conditions) execute the following.

1. Where applicable, clean interior and exterior glass and surfaces exposed to view. Remove temporary labels.

2. Where applicable, clean equipment and fixtures to a sanitary condition.

3. Where applicable, clean debris from roof, gutters, and downspouts.

4. Remove debris, waste, surplus materials, and rubbish from right-of-way, easements (construction or permanent) and private property.

5. Where applicable, remove debris, dirt, and silt from storm drain basins, sanitary sewer and storm drain manholes, and water valve boxes.

6. Rake landscaped surfaces clean of debris.

7. Where applicable, remove temporary coverings from traffic control devices.

8. Clean traffic control devices and signs.

9. Where applicable, remove temporary traffic striping.

10. Sweep dirt and debris from all paved areas affected by the work.

1.2 RECORD DOCUMENTS

A. Submit record documents as outlined in the General Conditions. Final payment will not be processed until the documents are submitted to and approved by the Engineer.

1.3 OPERATION AND MAINTENANCE DATA

A. Where applicable, submit two sets, before final inspection, bound in three ring binders. Prepare a table of contents for each volume with each product or system identified.

B. Where applicable, prepare the following:

1. Directory, listing names, addresses and telephone numbers of Engineer, Contractor, Subcontractor, and Equipment Suppliers.

2. Operations and maintenance instructions, arranged by system. For each category, identify the applicable Contractor(s) or Subcontractor(s) and suppliers. Identify the following:

    1. Significant design criteria
    2. List of equipment
    3. Parts list for each component
    4. Operating instructions
    5. Maintenance instructions

1.4 WARRANTIES AND BONDS

A. Submit, with final payment request, all warranty certificates, lien releases, and consent of security forms.

PART 2: PRODUCTS — NOT USED

PART 3: EXECUTION — NOT USED

PART 4: MEASUREMENT AND PAYMENT — NOT USED

END OF SECTION

Division 2
Site Work

MPW

Section 02100
Site Preparation

SITE PREPARATION

SECTION 02113	Adjusting Existing Manholes, Lampholes, Inlets, Water Valve Boxes, Water Services, and Fire Hydrants to Grade
SECTION 02110	Geotextiles

SECTION 02113

ADJUSTING EXISTING MANHOLES, LAMPHOLES, INLETS, WATER VALVE BOXES, WATER SERVICES, AND FIRE HYDRANTS TO GRADE

PART 1: GENERAL

1.1 DESCRIPTION

A. This section consists of locating and adjusting to grade existing manholes, lampholes, inlets, water valve boxes or services, and fire hydrants as shown in the contract documents, staked in the field or as required in the Special Provisions.

1.2 STANDARD DRAWINGS

A. Standard drawings included in Appendix A of this specification book which are applicable to this section are as follows:

Standard Drawing No. 02213-1	Manhole Adjustment Detail
Standard Drawing No. 02213-2	Water Valve Adjustment Detail

PART 2: PRODUCTS

2.1 GENERAL

A. Provide all materials including concrete, brick and mortar, complying with the specification section for the particular material involved, or if the material is not covered in these specifications, the material used for adjusting shall be equal, and comparable to that in the existing structure. If extensions for water valve boxes or services and fire hydrants are required beyond the length found to exist, provide items comparable to those in the existing structure.

PART 3: EXECUTION

3.1 GENERAL

A. Bring to required grade all existing manholes, inlets, lampholes and water valve boxes by either lowering or raising in accordance with the details shown in the contract documents. Do not lower manholes, lampholes or inlets by removal of portions of the cones or barrel sections. Accomplish downward adjustments by replacement of existing sections with shorter sections. Assure that all structures have a minimum of one 2-inch (5cm) concrete adjusting ring and a maximum of

12 inches (30cm) of rings under the casting. Do not use brick and/or mortar for adjustment of castings.

B. On manholes requiring steps, assure that maximum spacing between steps is 16 inches (40cm) and that 10 inches (25cm) is the maximum distance from the top of the manhole cone section to the first step.

C. Excavate water valve boxes and services to readily determine whether height adjustment can be made without substituting a longer section. Adjust water valve boxes and services laterally so the valve stems can be operated by the extension. Adjust water services by raising or lowering the curb key stop and extension box.

D. Adjust manholes, lampholes and water valve boxes to final grade before placing the final pavement surface. If required, make preliminary adjustment to allow placement of base courses and paving adjacent to the manhole, lamphole or water valve.

E. Provide backfill material conforming to the requirements of Section 02235, 1 inch (25 cm) Minus Crushed Base Course, and compacted to at least 95 percent of the maximum dry density as determined by AASHTO T99 or ASTM D698.

F. If required, make minor adjustments 5 feet (1.5 meters) to 10 feet (3.0 meters) in the horizontal location of existing fire hydrants to insure that they are the required minimum distance behind the back of curb. At the time of construction staking, any hydrants which require horizontal adjustment will be located by the Engineer and the adjusted location will be staked by the Engineer.

G. Make any minor adjustments required as dimensioned in the contract documents to the height of existing fire hydrants to insure that they are at a reasonable height above the back of curb. At the time of construction staking, any hydrants which require vertical adjustment will be located by the Engineer and the adjusted height will be staked by the Engineer. Accomplish extension of fire hydrant height only by the use of standard extension spools provided by the hydrant manufacturer.

H. Before final acceptance, clean all manholes, lampholes, inlets and water valve boxes/services. Assure that all water valve boxes, services and fire hydrants are operational.

I. All requirements of this section shall apply to new, as well as to existing, manholes, lampholes, valve boxes, water services and fire hydrants.

PART 4: MEASUREMENT AND PAYMENT

4. 1 GENERAL

A. Payment indicated to include complete compensation for all labor, equipment, materials and incidentals required for the completion of the work.

4. 2 ADJUSTING EXISTING MANHOLES, LAMPHOLES, INLETS, WATER VALVE BOXES AND WATER SERVICES

A. These items are measured and paid for by the number of existing facilities adjusted, complete in place, at contract unit price bid for the item, constituting full compensation for all necessary materials, excavation, backfill, compaction, cleaning, labor, tools and incidentals.

B. Payment will be made under:

1. Existing Sewer Manholes to Adjust - Per Each
2. Existing Sewer Lampholes to Adjust - Per Each
3. Existing Storm Drain Inlets to Adjust - Per Each
4. Existing Water Valve Boxes to Adjust - Per Each
5. Existing Water Services to Adjust - Per Each

4. 3 LOCATION ADJUSTMENT FOR EXISTING FIRE HYDRANTS

A. This item is measured and paid for by the number of existing fire hydrants adjusted horizontally, complete in place, at the contract unit price bid for "Horizontal Adjustment for Existing Fire Hydrants", constituting full compensation for all material, excavation, backfill, compaction, labor, tools and incidentals.

B. Payment will be made under:

1. Horizontal Adjustment for Existing Fire Hydrant - Per Each

4. 4 VERTICAL ADJUSTMENT FOR EXISTING FIRE HYDRANTS

A. This item shall be measured and paid for by the vertical adjustment of existing fire hydrants, complete in place, as measured in the field to the nearest one-half foot, at the contract unit price bid for "Vertical Adjustment for Existing Fire Hydrants", materials, including any additional stem length, excavation, backfill, compaction, concrete, labor, tools and incidentals.

B. Payment will be made under:

1. Vertical Adjustment of Existing Fire Hydrant - Per Vertical Foot

END OF SECTION

SECTION 02110

GEOTEXTILES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work consists of furnishing, and placing a geotextile as a subsurface drainage fabric permeable separator between dissimilar materials (such as between subgrade and sub base/base), stabilization fabric, temporary and/or permanent erosion control measures or as waterproofing/stress releasing membrane within pavement structures.

1.2 REFERENCES

A. The current publications listed below form part of this specification.

B. ASTM Standards

D123	Standard Terminology Relating to Textiles
D276	Standard Test Methods for Identification of Fibers in Textiles
D4354	Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products for Testing
D4632	Standard Test Method for Grab Breaking Load and Elongation ofGeotextiles (Grab Method)
D4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles
D3786	Standard Test Method for Bursting of Textile Fabrics - Dia-phragm Bursting Strength Tester Method
D4833	Standard Test Method for Index Puncture Resistance of Ge-omembranes and Related Products
D4491	Standard Test Method for Water Permeability of Geo-textiles by Permeability
D4751	Standard Test Method for Determining the Number of Constrictions “m” of Non-Woven Geotextiles as a Complementary Filtration Property
D4354	Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products for Testing

D4759	Standard Practice for Determining the Specification Conformance of Geosynthetics
D276	Standard Test Methods for Identification of Fibers in Textiles
D4355	Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus
D4873	Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
D5141	Standard Test Method for Determining Filtering Efficiency and Flow Rate of the Filtration for Component of a Sediment Retention Device
D5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles
D1140	Standard Test Methods for Determining the Amount of Material Finer than 75-μm (No. 200) Sieve in Soils by Washing
D4318	Standard Test Methods for Liquid Limit, Plastic Limit,and Plasticity Index of Soils
D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)

C. AASHTO Specifications – Standard Specifications for Transportation Materials and Methods of Sampling and Testing
   1. Augmenting and prevailing over this specification section.

PART 2 - PRODUCTS

2.1 PHYSICAL AND CHEMICAL REQUIREMENTS

A. Assure that fibers used in the manufacture of geotextiles, and the threads used in joining geotextiles by sewing, consist of long-chain synthetic polymers, composed of at least 95 percent by weight polyolefins or polyesters. They must be formed into a network so the filaments on yarns retain dimensional stability relative to each other, including selvedges. Furnish materials meeting the physical requirements listed in Section 2.4 or as shown on the plans.

B. Provide moderate or high survivability non-woven polypropylene fabric that is inert to commonly encountered chemicals and soils and that remains stable over a temperature range of -50 degrees Fahrenheit (-46° C) to 150 degrees Fahrenheit (66° C) and at a pH range of 2 to 13.

2.2 CERTIFICATION

A. Assure the manufacturer furnishes the purchaser a certificate stating: the name of the manufacturer, the chemical composition of the filaments or yarns, and other information fully describing the geotextile. The manufacturer must include in the certificate, a guarantee stating that the geotextile furnished meets specifications. The certificate mustbe attested to by a person having a legal authority to bind the company. Mismarking, or misrepresentation by the manufacturer is reason to reject the geotextile under these specifications. Notice sent to the manufacturer by the purchaser regarding rejection of, will be considered to be notice to all wholesalers, jobbers, distributors, agents and other intermediaries handling the manufacturer's product.

B. Label the fabric and its container with the manufacturer's name and fabric type or trade name, lot number and quantity.

2.3 SHIPMENT AND STORAGE

A. During shipment and storage, protect the fabric from direct sunlight, ultra-violet rays, temperatures exceeding 160 degrees Fahrenheit (71^{o}C), mud, dust and debris. Keep the fabrics in the manufacturer's wrapping until just before use. Include with each shipping, a document, a certification showing that the geotextile meets the manufacturer's certificate and a guarantee that has been previously filed with the purchaser.

B. At the time of installation, the fabric will be rejected if it has defects, seams or weakness, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportationor storage.

2.4 MATERIALS

A. Stabilization Fabric

1. Furnish Class 1 fabric as specified in AASHTO M 288 – Geotextile Specifications for Highway Applications

PART 3 - EXECUTION

3.1 GENERAL

A. Where placing geotextiles on native ground, cut the trees and shrubs flush with the ground surface. Do not remove the topsoil and vegetation mat. Remove all sharp objectsand large rocks. Fill depressions or holes with a suitable material to provide a firm foundation.

B. Replace or repair all geotextile that is torn, punctured, or muddy. Remove the damaged area and place a patch of the same type of geotextile overlapping 3 feet, in all directions, (0.9m) beyond the damaged area.

3.2 DRAINAGE, SEPARATION AND STABILIZATION APPLICATIONS

A. Shape the subgrade to a smooth surface and to the cross section required. Shape slopes to gradually transition into slope adjustments without noticeable breaks. At the ends of cuts, the intersection of cuts, and embankments, adjust slopes in the horizontal and vertical planes to blend into each other or into the natural ground.

B. Remove all material larger than 6 inches (15 cm) within the top 6 inches (15 cm) of the roadbed. Remove unsuitable material from the roadbed and replace with suitable material. Finish the roadbed and ditches to the required elevation and cross-section.

C. Place the geotextile smooth and free of tension, stress, or wrinkles. Fold and cut the geotextile to conform to curves. Overlap in the direction of construction. Overlap the geotextile a minimum of 2 feet (0.6m) at the ends and sides of adjoining sheets or sew the geotextile joints according to the manufacturer's recommendations. Do not place longitudinal overlaps below anticipated wheel loads. Hold the geotextile in place with pins, staples, or piles of covermaterial.

D. End dump the cover material onto the geotextile from the edge of the geotextileor frompreviously placed cover material. Do not operate equipment directly on the geotextile. Spread the end-dumped pile of cover material maintaining a minimum lift thickness of 10inches (250mm). Compact the cover material with rubber-tired or nonvibratory smooth drum rollers. Avoid sudden stops, starts, or turns of the construction equipment. Fill all ruts from construction equipment with additional cover material. Do not regrade ruts with placement equipment.

E. Place subsequent lifts of cover material in the same manner as the initial lift. Vibratory compactors may be used for compacting subsequent lifts. If foundation failures occur, repair the damaged areas and revert to the use of nonvibratory compaction equipment.

PART 4 - MEASUREMENT AND PAYMENT

4.1 GENERAL

A. All geotextiles will be measured by the square yard on a plane parallel tothe ground surface, excluding overlaps. The accepted quantities, measured as providedabove, will be paid at the contract price per unit of measurement for the pay item that is shown in the bid schedule.

B. Payment indicated to include complete compensation for all labor, equipment, materialsand incidentals required for the completion of the work.

END OF SECTION

Section - 02200
Earthwork

EARTHWORK

SECTION 02221

TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES

PART 1: GENERAL

1.1 DESCRIPTION

A. This work is the excavation, trenching and backfilling for pipelines and appurtenances. It includes all clearing, grubbing, site preparation, removal and disposal of debris from the excavation, handling and storing materials for fill and backfill, all bracing, shoring and trench protection, construction dewatering, all backfill, subgrade preparation , final grading, site dressing and cleanup.

1.2 REFERENCES

A. The current publications listed below form a part of this specification.

AASHTO T99	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
ASTM D698	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5kg) Rammer and 12-inch (305mm) Drop
AASHTO T191 (ASTM D1556)	Density of Soil In-Place by the Sand-Cone Method
AASHTO T310 (ASTM D6938)	In-Place density and water content of the soil and soil aggregate by Nuclear Method (Shallow Depth)
AASHTO T11 (ASTM C117)	Materials Finer Than 0.075mm (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T27 (ASTM C136)	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
ASTM D4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

1.3 STANDARD DRAWINGS

A. Standard Drawings applicable to this section are as follows:

1. Standard Drawing No. 02221-1 - Typical Utility Trench Detail

1.4 TESTING

A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements in Section 01400, Contractor Quality Control and Owner Quality Assurance.

2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556), Sand Cone Method; or by AASHTO T310 (ASTM D6938) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the Engineer's discretion.

3. Re-testing failing areas is at the expense of the Contractor.

4. At the direction of the Engineer, provide necessary equipment and labor to excavate and replace materials for test holes up to 5 feet deep into the compacted backfill to allow testing below the surface of any layers covered without inspection and approval by the Engineer.

B. Laboratory Maximum Density and Optimum Moisture

1. Quality assurance tests will be made by the Engineer for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content according to AASHTO T-99 or ASTM D698.

C. Material Submittals

1. Submit to the Engineer material quality test results including Type 1 Bedding gradation and plasticity index; and Type 2 Bedding gradation.

2. Submit to the Engineer samples of on-site and off-site borrow soils for laboratory moisture-density relationship testing by the Engineer.

3. If applicable, submit a blasting plan to the Engineer.

PART 2: PRODUCTS

2.1 PIPE BEDDING MATERIALS

A. TYPE 1 PIPE BEDDING

1. Type 1 Pipe Bedding includes the material placed from 4 inches (100mm) below the bottom of the pipe, around the pipe, and up to the springline of the pipe.

2. Provide Type 1 Bedding consisting of sand, sandy gravel, or gravel having a maximum 3/4 inch size (19mm) and a maximum plasticity index of 6, determined by AASHTO T89 and T90 or by ASTM D4318.

3. Where trench excavation encounters wet or unstable material, Type 1 Pipe Bedding must be free draining and non-plastic

4. Refer to Standard Drawing 02221-1 and Special Provisions for other requirements.

B. SELECT TYPE 1 BEDDING

1. Select Type 1 Bedding includes the material placed from the springline of the pipe to 6 inches (15cm) over the pipe.

2. Select Type I Bedding shall consist of soil, sand or fine gravel, free from clods, lumps of frozen material, or rock exceeding 1-1/2 inches (38mm) in its greatest dimension.

3. Excavated trench material may be screened or sorted for use as backfill subject to approval of the Engineer.

4. Where trench excavation encounters wet or unstable material, Select Type 1 Bedding must be free draining and non-plastic.

C. TYPE 2 PIPE BEDDING

1. Type 2 Pipe Bedding is used as directed by the Engineer to replace unsuitable material encountered in the trench bottom.

2. Place Type 2 Pipe Bedding from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.

3. Type 2 Bedding shall consist of granular material meeting the following gradation.

Sieve Opening	% Passing
3 Inch	100
No. 4	0 - 25
No. 8	0 – 10

D. SEPARATION GEOTEXTILE

1. The plans may require, or the engineer may direct, the use of non-woven geo-textile fabric intended to provide materials separation. The fabric will wrap all or part of the Type 1 Pipe Bedding and Select Type 1 Pipe Bedding to prevent materials migrating into the trench bottom and trench walls as shown on the plans or as directed by the engineer. The fabric shall be AASHTO M288 Class 1, 2, or 3 as specified or determined by the Engineer and shall fully comply with MPW Section 2110.

2.2 TRENCH BACKFILL MATERIALS

A. Materials from Trench Excavation

1. Backfill material obtained from trench excavations must be free of cinders, ash, refuse, organic or frozen material, boulders, or other deleterious materials. Backfill materials and placement are further described in the Execution Section of this specification.

B. Imported Backfill Material

1. Imported backfill material is from borrow source(s) outside the project limits and is used when, in the opinion of the Engineer, an adequate volume of suitable backfill material is not available within the project limits. Imported Backfill Materials must comply with the requirements of Section 2.2.A, MATERIALS FROM TRENCH EXCAVATION.

2.3 FLOWABLE FILL

A. If used, Flowable Fill is to meet the requirements of Section 2225, Flowable Fill.

2.4 DETECTABLE BURIED WARNING TAPE

A. Detectable buried warning tape is to have a minimum 6 inch (15cm) width and 5 mil (0.12mm) thickness and a solid aluminum core running the full length and width of the tape enclosed in a color coded inert plastic jacket, impervious to alkalis, chemical reagents and solvents in the soil. The tape is to meet APWA/ULCC Color Code requirements and is to have a maximum 36 inch(90cm) imprint.

PART 3: EXECUTION

3.1 PROTECTION OF EXISTING PROPERTIES

A. General

1. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, and fences. Restore or replace all disturbed or damaged facilities to its original condition at Contractor's expense.

2. Contact utility owners using the Montana One Call System in accordance with Section 01041, PROJECT COORDINATION, Paragraph 1.2.B., for utility locates before starting work. Protect the utilities exposed during the work and prevent damaging underground utilities adjacent to excavations. Immediately notify the utility owner of any construction damage. Repairs of damage to marked utilities are at the expense of the Contractor.

3. Re-locate existing water mains, sanitary sewers and storm drains shown on the plans, that conflict with new pipelines or structures as indicated in the contract documents. No separate payment will be made for this work unless shown as a payment item. If the Owner authorizes the relocation of mains or sewers which are not indicated in the bid documents, and the Engineer determines the work was not included in the original contract, payment will be made under the applicable sections of the General Conditions.

4. Cut and replace existing service lines interfering with trenching operations only with the engineer's permission and at the contractor's expense. Show all repaired and/or adjusted water and sewer lines on the As-Built Plans.

5. Protect existing water and sewer mains and water and sewer services from freezing at all times during construction.

B. Privately Owned Utilities

1. If any existing private utility interferes with the work in either alignment or grade, and has to be moved, the work will be performed by the appropriate UTILITY Owner, unless otherwise specified in the contract documents. Such private utilities may include gas mains, underground electrical and telephone cables, telephone poles, light poles, etc.

2. If, however, such private utility relocation is performed by the Contractor, and the relocation is not a separate payment item, payment will be made under the Section 02221 conditions covering such changes.

3. Such payment will be made only if the work is determined by the Engineer to be a change from the original contract work scope.

C. Existing Structures

1. Prevent damage to existing buildings or structures in the work area. Repair all construction related damage to the satisfaction of the Owner.

D. Existing Overhead Utilities

1. Use extreme caution to avoid conflict, contact or damage to overhead utilities during the work.

E. Exploratory Excavation

1. The location of existing buried public utilities may need to be verified by exploratory excavation before construction.

2. Where authorized by the Engineer, the Contractor will be reimbursed for exploratory excavation work at the unit price bid per hour for a backhoe/excavator with operator and a laborer to assist. Use a backhoe/excavator having at least 60 horsepower (45kw), as rated by the manufacturer.

3. The unit price per hour includes the backhoe/excavator, operator and one laborer based upon the actual time, to the nearest one-half hour, that the equipment and personnel are used in actual excavating and backfilling operations including standby time between excavation and backfilling which allows the Engineer to make the necessary survey of the underground utilities.

4. Exercise care to prevent damaging all utilities and repair any utility damage caused by exploratory excavation.

F. Pavement Removal and Stripping

1. Where trench excavation or appurtenant structure excavation requires removing curb and gutter, concrete sidewalks, asphalt concrete pavement, or Portland cement concrete pavement, cut the concrete or pavement in a straight line parallel to the excavations edge using a spade-bitted air hammer, concrete saw or other suitable equipment to produce a straight, square and clean break. Re-cut edges broken during construction, before concrete or paving operations.

2. For trenches passing through existing pavement, cut the pavement along a neat vertical line at least 12 inches (30cm) from the trench edge. Where the neat line cut is less than 3 feet (0.9m) from the edge of the existing pavement, remove and replace the entire pavement section between trench and edge of pavement.

3. Dispose of the asphalt concrete and/or Portland cement concrete debris off-site according to applicable state and local regulations.

G. When excavating across existing gravel streets or other developed surfaces, remove the surfacing material full depth and stockpile for inclusion as trench backfill or legally dispose of the surfacing material.

H. When excavating across cultivated or sodded areas, remove topsoil full depth or to a maximum 12 inch (30cm) depth, whichever is less, and stockpile for possible project use.

I. Re-sod or reseed, as specified in the contract documents, all established lawn areas cut by trenching or damaged during the construction, in accordance with Section 2910, and/or 2920, to the satisfaction of the Engineer.

3.2 MAINTENANCE OF FLOWS

A. Maintain the flow of sewers, drains and water courses encountered during construction. Restore culverts, ditches, fences, crosswalks and structures disturbed by construction to their original condition upon completion of the work.

3.3 TRENCH EXCAVATION

A. General

1. Meet current OSHA Safety and Health Standards for all excavation, trenching, shoring, and related work.

2. Excavate at the specified locations for pipeline installations and appurtenant structures.

3. Crossings under sidewalks or curbs may be made by tunneling, if approved by the Engineer. If a portion of a sidewalk or curb is removed, use a concrete saw to make joints, compact the backfill as specified, and replace the removed section with new concrete sidewalk or curb.

4. During excavation, stockpile backfill materials away from the trench banks to assure trench wall stability. Stockpile excavated materials on only one side of the trench without obstructing existing fire hydrants,

valves, manholes and other appurtenances. Assure surface drainage of adjoining areas is unobstructed.

5. Remove and dispose of all excess or unsuitable excavated materials.

6. Prevent surface water from flowing into excavations. Promptly remove all water accumulating in trench excavations. Do not permit water to accumulate in any open trench. Remove and re-lay all pipe out of alignment or grade caused by trench flooding.

7. Grade the trench bottoms to the specified lines and grades. Assure bedding material provides uniform bearing and support for each pipe section along its entire length. Excavate for bell and joints after the trench bedding is graded, limiting the excavation to the required length, depth and width for making the particular type of joint used. Backfill over-excavations with Type 2 Bedding Material.

8. No differentiation between common and rock trench excavation is made, except when listed as separate bid items on the bid proposal or bid form. Excavation includes removing and subsequent handling of all earth, gravel, bedrock or other material encountered regardless of the type, character, composition or condition of the material.

9. The use of trench digging machinery is permitted, except in places where its operation is likely to cause damage to existing structures or features, in which case hand methods are to be employed.

B. Trench Dimensions

1. Excavate to the trench dimensions specified below.

2. Width

   a. Excavate to provide room to install and join the pipe as specified. The minimum trench width is 3'-6" (1.1m), for outside pipe diameters of 18 inches (0.5m) or less. The minimum trench width is 2'-0" (0.6m) plus the outside pipe diameter, for pipe sizes exceeding 18 inches (0.5m). Maximum trench width may be specified in the contract documents.

3. Depth

   a. Excavate the trench as required for the invert grade or pipe bury as specified in the contract documents, plus 4 inches (10cm) for the Type 1 Pipe Bedding. If bedrock, boulders or large stones are encountered at the bottom of the trench, excavate at least 6 inches

(15cm) below the bottom of the pipe for backfilling with Type 1 Pipe Bedding.

C. Soft or Unsuitable Trench Subgrade

1. When soft or unstable material is encountered at the trench subgrade which will not uniformly support the pipe, excavate the material to the depth directed by the Engineer and backfill to trench subgrade elevation with Type 2 Pipe Bedding.

D. Blasting

1. Obtain Engineer approval to blast for excavation. If approved, the Engineer will establish the time limits blasting will be permitted.

2. Use utmost care to protect life and property during blasting. Use only a licensed blaster with experience in the type of blasting required for the work.

3. Safely and securely store all blasting materials meeting local laws and ordinances and clearly mark all storage places "Dangerous Explosives". Do not leave any explosives where they could endanger persons or property.

4. Blasting Rock in Trenches

a. When blasting rock in trenches, cover the blasting area with earth backfill or approved blasting mats. Before blasting, station workers and provide danger signals to warn people and stop vehicles.

b. Assume responsibility for all damage to property and injury to persons resulting from blasting or accidental explosions during the work.

c. Furnish the following information to the Owner and Engineer at least 48 hours before the commencement of blasting operations: Name of the contractor's powder man, powder man's experience, type of shot, type of explosives and detonator being used, proof of insurance covering liability for such operation, traffic control plans and planned procedures for protecting the public.

5. Assure blasting plan meets federal, state and local ordinances. Obtain all required permits before blasting starts.

E. Pavement Damage Cause by Equipment

1. Equip all track mounted equipment operated on pavement surfacing with pads to prevent pavement damage.

2. Restore all pavement damaged by construction to its original condition.

F. Shoring, Bracing and Sheeting

1. Provide all shoring, bracing and tight sheeting required to prevent caving and protect workers, meeting current Occupational Safety and Health Act Requirements, and to protect adjacent property and structures. The cost of this work is included in the cost for trench excavation.

G. Excavation for Appurtenances

1. Make excavations for manholes, hydrants, structures and other appurtenances of the size and depth to permit compacting of backfill on all sides to the specified density. The requirements for removing water and other applicable portions of these specifications apply to excavation for appurtenances.

3.4 DEWATERING

A. Remove all ground water encountered in trench excavations. Do not place pipe, bedding or backfill materials below the groundwater elevation established by dewatering operations. The cost of dewatering operations is considered a part of the excavation cost.

3.5 EXCAVATION STABILITY AND SAFETY

A. The stability of construction excavations and associated worker safety, including slope geometry and shoring/bracing considerations, are the responsibility of the Contractor. Meet current OSHA regulations. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

3.6 TRENCH FILLING AND BACKFILLING

A. General

1. Backfill all trenches as specified immediately after grade, alignment and pipe jointing has been inspected and approved by the Engineer. Conduct any pipe testing as specified in the respective water distribution, sewerage/drainage sections. Correct all defects discovered by tests prior to backfilling.

B. Pipe Bedding Placement

1. Type 1 Bedding.

a. Place Type 1 Pipe Bedding material 4 inches (10cm) under the pipe, around the pipe, and up to the springline of the pipe. Place in maximum lifts of 6 inches (15cm), using hand operated or other compaction methods without damaging or disturbing the pipe. Thoroughly compact each layer. Use special care to assure compaction under the pipe haunches.

b. Place backfill material in equal lifts on both sides of the pipe for the full trench width. Take care to prevent migration of Type 1 Bedding into surrounding soils during placement and compaction

2. Select Type 1 Bedding.

a. Place Select Type 1 Bedding material from the springline to 6 inches (15cm) over the pipe. Where wet or unstable material exists, assure the material is free draining and non-plastic.

b. Place in maximum lifts of 6 inches (15cm) using hand or other compaction methods without damaging or disturbing the pipe. Thoroughly compact each layer.

c. Place backfill in equal lifts on both sides of the pipe for the full trench width. Take care to prevent migration of Select Type 1 Bedding into surrounding soils during placement and compaction.

3. Type 2 Pipe Bedding.

a. Use Type 2 Pipe Bedding described in PRODUCTS SECTION as specified or as directed by the Engineer to replace unsuitable material encountered in the trench bottom, placing it from the bottom of the Type 1 Bedding material to the depth required to adequately support the pipe.

4. SEPARATION GEOTEXTILE

a. Place Separation Geotextile where shown on the plans or where directed by the Engineer.

C. Trench Backfill

1. After the pipe bedding materials are placed and compacted as specified, backfill the trench. Use backfill material free of cinders, ash, refuse,

organic or frozen material, boulders, or other deleterious materials. From the top of the Select Type 1 Pipe Bedding to 6 inches (15cm) below the ground surface, or to the subgrade elevation, material containing rock up to 8 inches (20cm) in the greatest dimension may be used.

2. Trench backfill from the top of the pipe bedding to ground surface or to the street subgrade is separated into three classifications.

   a. Type A Trench Backfill is compacted backfill typically used in streets or paved areas.

   b. Type B Trench Backfill is typically used for unpaved alleys, cultivated areas, borrow pits, unimproved streets or other un-surfaced areas, and other areas where compaction is less critical.

   c. Type C Trench Backfill is typically used in open and unimproved areas outside of the public right-of-way.

3. Meet the backfill and compaction requirements for all of the backfill types described in the contract documents.

4. Watering

   a. Apply uncontaminated water, when required, at the locations and in the amounts required to compact the backfill material to the specified requirements. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.

   b. Apply water during the work to control dust and to maintain all embankment and base courses in a damp condition in accordance with these contract documents.

   c. Water required for compacting trench backfill may be obtained from the municipal system if approved by the Owner, or from other sources.

5. Remove, replace, and re-compact backfill in trenches where settlement has occurred as directed by the Engineer at the contractor's expense.

6. Trench backfill types are designated as follows:

   a. Type A Trench Backfill. Place trench backfill in maximum 8 inch compacted lifts within 3 percent of optimum moisture content, and compact to at least 95 percent of maximum dry density determined by AASHTO T99 or by ASTM D698.

b. Type B Trench Backfill. Place backfill in maximum 8 inch (205mm) lifts, within 3 percent of optimum moisture content, and compact to at least 90 percent of maximum dry density, as determined by AASHTO T99 or by ASTM D698.

c. Type C Trench Backfill. Place and compact Type C Trench Backfill in maximum 12 inch lifts at densities equal to or greater than the densities of adjoining undisturbed soil. Mound earth over the trench top, if so directed by the Engineer.

d. Flowable Fill. Place flowable fill as trench backfill as shown in the contract documents or as directed by the Engineer. Flowable fill may also be used as a construction expedient, substituting for any type of trench backfill, subject to approval by the Engineer and at the expense of the Contractor.

D. Replacement of Unsuitable Backfill Material

1. Remove and dispose of excavated soils that are saturated, contain deleterious materials or have characteristics that, in the opinion of the Engineer, render the soils unsuitable as backfill.

2. Replace unsuitable soils with material obtained from trench excavations within the project limits at the expense of the Contractor. If suitable replacement material is not available within project limits, obtain material from an approved borrow source, to be paid for as Imported Backfill Material.

3. Place and compact all imported material according to the applicable backfill specification requirements.

E. Backfill of Appurtances

1. Place and compact backfill for appurtenances to finished grade around manholes, inlets, valve boxes and other underground items without disturbing appurtenance alignments.

2. Meet the backfill material, placement, and compaction requirements specified for the adjoining trench.

F. Detectable Buried Warning Tape

1. The use of warning tape is optional and if used must not be relied on as the primary locating device. Provide warning tape as described in PRODUCTS Section 2.3. Bury tape a maximum 18 inches (45cm) below finish surface grade.

3.7 SURVEY MARKERS AND MONUMENTS

A. Protect all survey markers and monuments. Protection includes marking with flagged high lath and supervising work near markers and monuments. Do not disturb monuments without prior approval from the Engineer.

B. Replace all Contractor disturbed or destroyed survey markers or monuments, not approved during construction, using a licensed land surveyor. See Section 01050 for details on survey marker protection/disturbance.

3.8 CLEANUP

A. As work progresses, remove debris and complete to finish grade each portion of the work. Once the work is complete, clear debris and finish the entire site to smooth, uniform slopes presenting a neat and workmanlike appearance. Remove and dispose of all rocks brought to the surface during excavation or backfilling.

3.9 TIME AND DISTANCE OF OPEN TRENCHES

A. Perform the work so that trenches will remain open the minimum time required to accomplish the work.

B. Do not begin trench excavating until appropriate compaction equipment is at the excavation site.

C. The maximum permissible distance between backfilling/ compaction operations and the end of newly installed pipe is 200 feet (60m) in existing streets (and/or alleys) and 500 feet (150m) in all other areas.

D. The maximum distance between the newly installed pipe and the excavator is to be 100 feet (30m) in existing streets (and/or alleys) and 200 feet (60m) in all other areas.

E. For each work group consisting of a trench excavator, a pipe laying crew, and a backfilling/compacting crew, the maximum allowable open ditch at any time is 300 feet (90m) in existing streets (and/or alleys) and 700 feet (210m) in all other areas.

F. The maximum distance behind the end of the new pipe is 1,500 feet (460m) for gravel surfacing replacement, base placement or pavement replacement.

PART 4: MEASUREMENT AND PAYMENT

4. 1 GENERAL

A. The following items constitute pay items for the work covered under this section. Payment for these items is full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.

4. 2 TRENCH EXCAVATION AND BACKFILL

A. No separate measurement and payment is made for TRENCH EXCAVATION AND BACKFILL. Include all costs for this item in the unit price bid for pipe, complete in-place.

B. The upper limit of the TRENCH EXCAVATION AND BACKFILL item is defined as the top of subgrade. Details of the various types of surface restoration are found in the contract documents.

4. 3 TYPE 1 AND SELECT TYPE 1 PIPE BEDDING

A. Include approved material for Type 1 and Select Type 1 Pipe Bedding in the pipe installation price. No measurement or additional payment is made for furnishing or placing Type 1 and Select Type 1 Pipe Bedding materials.

4. 4 TYPE 2 PIPE BEDDING

A. Approved material for Type 2 Pipe Bedding to replace soft or unsuitable material, is measured in cubic yards (cubic meters) of material furnished, in-place, for the depth directed. No additional payment shall be made for this item as it shall be included in the unit price for pipe installation.

4. 5 IMPORTED BACKFILL MATERIAL

A. When satisfactory backfill material is not available within the project limits, backfill material imported from borrow sources outside the limits of the project site are measured in cubic yards of material furnished, in place (compacted), for the depth directed by the Engineer.

B. No separate measurement and payment is made for this item all costs for this item are to be included in the unit price bid for pipe, complete in-place.

4. 6 EXPLORATORY EXCAVATION

A. Measurement of this item is made for the actual time, to the nearest one-half hour, for which the equipment and personnel are used and authorized by the Engineer for actual exploratory excavation and backfilling operations, including standby time between excavation and backfilling, to allow the Engineer to survey the underground utility.

B. Payment for this item is made within the project costs and cannot be billed as additional or separately.

C. Surfacing repair will be paid separately, if required.

D. Payment will be made under: Exploratory Excavation - Per Hour.

4. 7 GEOTEXTILE FABRIC

A. Measurement and payment for geotextile fabric if required based on site conditions must be approved by the engineer prior to installation.

B. Payment for this item is full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.

END OF SECTION

SECTION 02230

STREET EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is the clearing and grubbing, excavation, filling or backfilling, and subgrade preparation to the specified lines, grades and cross sections as preparation for overlying base course or other courses as shown in the contract documents. Also included are the removal and disposal of debris and excess soil, the furnishing and placement of fill materials, and compaction.

1.2 REFERENCES

A. The current publications listed below are a part of this specification.

AASHTO T99	Moisture-Density Relations of Soils Using 5-lb (2.5kg) Rammerand 12-inch (305mm) Drop
ASTM D698	Laboratory Compaction Characteristics of Soils Using StandardEffort (12,400 ft-lbf/ft^3)(600 kN-m/m^3)
AASHTO T191	Density of Soil In-Place by the Sand-Cone Method(ASTM D1556)
AASHTO T310	In-Place density and water content of the soil and soil aggregate
(ASTM D6938)	by Nuclear Method (Shallow Depth)
AASHTO T11	Materials Finer Than No. 200 (0.075mm) Sieve in Mineral(ASTM C117) Aggregates by Washing
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregate(ASTM C136)
AASHTO T89	Determining the Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
	ASTM D4318 Test Method for Liquid Limit, Plastic Limit
	and Plasticity Index of Soils

1.3 DENSITY CONTROL TESTING

A. Field Density Testing
   1. Meet the quality control and quality assurance testing requirements in Section 01400, Contractor Quality Control and Owner Quality Assurance.
   2. In-place field density tests for quality assurance are at Owner expense meeting ASTM D1556A (ASHTO T191), Sand Cone Method; or ASTM D2922 and ASTM D3017 (AASHTO T238 and T239) Nuclear Densometer Methods. Quality assurance field density testing frequency is at the discretion of the Engineer.
   3. Retesting of failing areas is at the expense of the Contractor.

B. Laboratory Maximum Density and Optimum Moisture
   1. Quality assurance tests will be made by the Engineer for each on-site natural soil or each source of off-site material, including borrow material, to determine the laboratory maximum density values and optimum compaction moisture content under AASHTO T99 or ASTM D698.

C. Material Submittals
   1. Submit to the Engineer results of gradation tests for Sub-excavation/Replacement Below Subgrade pitrun gravel/sand.
   2. Submit to the Engineer samples of soils and/or aggregates for laboratory moisture-density relationship testing by the Engineer.

PART 2 - PRODUCTS

2.1 ON-SITE EMBANKMENT

A. Fill and backfill materials are to consist of natural soils free from organic matter, frozen material, refuse, construction debris or other man-made items. Obtain approval of the Engineer for all fill before placing and use only the fill from designated borrow areas.

2.2 IMPORTED BORROW MATERIALS (FOR EMBANKMENTS IN-PLACE)

A. If required, obtain borrow soil for embankments from areas off the project site. Furnish imported borrow at Contractor expense. Obtain Engineer approval of borrow areas. Imported borrow is to meet the requirements of Section 2.1, On-Site Embankment.

2.3 SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE

A. Sub-excavation consists of removing and disposing of unstable material from below planned subgrade elevation in cut sections or from below the natural ground line in embankment sections.

B. Replacement material for sub-excavations consists of either:

1. Suitable materials from within the project limits if suitable material is present within the project limits, or

2. Imported materials if suitable material is not present within the project limits. Where imported pitrun gravel is used, furnish replacementmaterial meeting the following gradation requirement:

Sieve Opening	% Passing
3 Inch	100
No. 4	25 - 60
No. 200	12 Max.

PART 3 - EXECUTION

3.1 CLEARING AND GRUBBING

A. Perform clearing and grubbing including the excavation, removal and disposal of roots, stumps, sod, or any organic material and buried debris from within construction limits. Construction limits are defined by all areas within the cut/fill limits and extending 1 foot (0.3 m) beyond the back of sidewalk and/or curb and gutter, or 2 feet (0.6 m) beyond the edge of pavement if no sidewalk or curb and gutter is present. Remove unsuitable material to at least 12 inches (30 cm) below subgrade elevation.

B. Stockpile for project use any topsoil removed by clearing andgrubbing.

C. Dispose of all clearing and grubbing material as specified.

3.2 EXCAVATION STABILITY AND SAFETY

A. Meet OSHA requirements for excavations and excavated material stockpiles. This may require design of temporary slopes and/or shoring by a licensed professional engineer.

3.3 PROTECTION OF PROPERTY

A. Take precautions to protect all adjoining private and public property and facilities, including underground and overhead utilities, curbs, sidewalks, driveways, structures, fences, and vegetation. Any disturbed or damaged facilities will be suitably restored or replaced consistent with condition(s) which existed prior to construction.

3.4 EXCAVATION

A. Excavate to the specified lines and grades or as directed by the Engineer. Excavate without causing rutting, pumping or other disturbance to underlying materials.

B. Excavation made outside the specified grade limits is not measured for paymentin the Excavation or Embankment In-Place quantities.

1. Restore sub-excavated areas as directed by the Engineer. Correct subgrade disturbance by removing the disturbed soil and replacing and compacting to reach at least 95 percent of the maximum laboratory dry density determined by AASHTO T99 or ASTM D698.

2. Correct subgrade disturbance before placing overlying fill, backfill, base course or other courses. Disturbed soils may be replaced with imported material approvedby the Engineer and compacted to 95% of maximum laboratory dry density determined by AASHTO T99 or ASTM D698.

C. Maintain the subgrade to drain at all times. Construct side ditches or gutters from cuts to embankments to prevent erosion damage to embankments.

D. Construct and maintain temporary drainage where existing surface drainage, sewers, or under-drainage are disturbed during the work until permanent drainage facilities are completed. Protect and preserve all existing drains, sewers, sub-surface drains, conduits, gas lines, and other underground structures which may be affected by the work. Repair all damage to these facilities or structures resulting from the work, to the satisfaction of the Engineer.

E. Excavate to minimize foundation soil and/or subgrade soil exposure to erosion, drying or infiltrating moisture. Perform excavation to provide drainage away from foundation/subgrade soils and minimize the potential for surface runoff to enter the foundation/subgrade soils.

F. Grade all intersecting streets and approaches within the project limits asspecified or as directed using suitable materials on the surfaces to produce smooth riding and satisfactory approaches to the intersections.

3.5 DISPOSAL OF EXCAVATED MATERIAL

A. Dispose of debris and unused excavated materials off the project site in accordance withall applicable state and local regulations. Locate and provide suitable disposal areas.

3.6 DUST CONTROL

A. Furnish dust control meeting Section 01500, Construction and Temporary Facilities, requirements.

3.7 SUBGRADE PREPARATION AND COMPACTION

A. General

1. Assure the subgrade beneath pavements, curb, or sidewalks is natural soil free of topsoil, organic material or refuse. Place pavement components, curb and sidewalk over the prepared subgrade as soon as practical. Donot place pavementcomponents on frozen subgrade. No separate payment is made for subgrade preparation since it is considered incidental to construction of overlying pavements/structures.

2. If the surface of a previous roadbed or pavement surface matches the surface ofthe finished subgrade scarify the top 6 inches (15cm) of the previous surface thefull width of the subgrade to permit uniform reshaping and compaction.

B. Fine Grading

1. Assure the finished surface does not deviate not more than 0.1 foot (3cm) at any point from the staked elevation; and that the sum of the deviations from true grade of any two points less than 30 feet (9m) apart does not exceed 0.1 foot (3cm).

C. Compaction

1. Compact the upper 8 inches (20cm) of the subgrade to at least 95% of the laboratory maximum, determined by AASHTO T99 or ASTM D698. Proof roll the subgrade surface for observation by the Engineer. Compact all soft, yielding or otherwise unstable areas to provide adequate support of construction equipmentas determined by the Engineer. Also compact the subgrade to meet the specified density requirements. Remove and replace any unstable or otherwise unsuitable subgrade as specified under Section 3.9, Sub-excavation/Replacement Below Subgrade.

3.8 EMBANKMENT PLACEMENT AND COMPACTION

A. General

1. Place fill materials (embankment) to the specified lines and grades. Place fill in uniform layers not exceeding 8 inches (20cm) in loose thickness. Once placed, moisten or aerate, mix, and compact each layer as specified. Work clay soils to maximum 2-inch (5cm) nominal size before compacting. Do not begin fill placement until the subgrade construction has been approved by the Engineer. Do not place fill on wet or frozen areas. Do not operate heavy equipment for spreading or compacting fill within 4 feet (1.2m) of structures.

2. If grading operations are suspended due to weather, blade the entire area until itis smooth, free of depressions and ruts, and crowned to drainwater.

B. Compaction

1. Control the fill moisture content to assist in obtaining the specified field density. Maintain the moisture content of fill soils within ± 3% of optimum moisture. Compact each fill layer and the top 8 inches (20cm) of subgrade soil to at least 95 percent of maximum laboratory density as determined by AASHTO T99 or ASTM D698. Compact areas within 4 feet (1.2m) of structures in maximum 8-inch (20cm) loose lifts using power-driven hand-held tampers.

2. Apply water, when required, at the locations and in the amounts required to compact the material to the specified requirements. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application. Apply water during the work to control dust and to maintain all embankment and base courses in a dampcondition in accordance with Section 1500. Water required for compacting subgrade and/or embankments may be obtained from the municipal system if approved by the Owner, or from other sources.

3. Do not place fill or embankment when moisture content prevents effective compaction or causes rutting. Dry all embankments having excessive moisture by scarifying and blading the affected areas before compacting or placing succeeding layers.

3.9 SUBEXCAVATION/REPLACEMENT BELOW SUBGRADE

A. Sub-excavation consists of removing and disposing of unsuitable material from below planned subgrade elevation in cut sections or from below the natural groundline in embankment sections.

B. Soil is unsuitable if, in the opinion of the Engineer, it contains excessive organics, refuse, construction debris, or other objectionable material; or if it unstable, rutting or yielding; or if it contains excessive moisture. Generally, soils will be sub-excavated and replaced only if they are unable to adequately support equipment typically used for excavation andsoil transport.

C. Assure the Engineer has measured the area where unstable materials have been removed before backfilling. Do not backfill any area where unstable foundation soils have been excavated until authorized by the Engineer. Backfill placed without approval may be ordered removed and replaced at Contractor expense.

D. Backfill with either suitable soils from within the project limits or imported pit run gravel complying with the requirements of Section 2.3, Sub-excavation/Replacement Below Subgrade. Different measurement and payment items are used for the on-site soil and pit run gravel replacements.

E. Compact the replacement material to 95% of the maximum laboratory density as determined by AASHTO T99 or ASTM D698.

3.10 PROTECTION OF THE WORK

A. Repair damaged embankments to the specified elevations and grades. Maintain ditches and drains along the subgrade to drain the subgrade. Assure the finished grade does notdeviate more than 0.1 (3cm) foot at any point from the staked elevation and the sum of the deviations from true grade of any two points not more than 30 feet (9m) apart does not exceed 0.1 foot (3cm). Do not place any surface course or pavement until the subgrade has been checked and approvedby the Engineer.

PART 4 - MEASUREMENT AND PAYMENT

4.1 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

A. Excavation Above Subgrade

1. The volume, based upon the plan quantity as specified above, is paid for at the contract unit price bid for Excavation Above Subgrade, and is full compensation for all labor, equipment, tools and incidentals necessary to accomplish all clearing, grubbing, old pavement removals, hauling, disposal, and excavating to prepare the subgrade shown in the contract.

B. Sub-excavation/Replacement Below Subgrade.

1. This item is field measured using the average end area method and paid for by the cubic yard in-place of material removed, measured in its original position, at the contract unit price bid for Sub-excavation/Replacement Below Subgrade, which price and payment constitutes full compensation for all labor, equipment, tools, and incidentals to complete the excavation and disposal of unsuitable material in the embankment foundation or in the subgrade. The cost of backfilling and compacting holes created by the removal of unsuitable materialwith the specified replacement material is also included in Sub- excavation/Replacement Below Subgrade Item.

2. Payment is made under:

a. Sub-excavation/Replacement Below Subgrade (Replacement with Imported Materials) - Per Cubic Yard.

C. Embankment In Place.

1. When specified in the contract as a bid item, Embankment In Place is paid for at the contract unit price per square yard for the actual field measured volume of embankment constructed and accepted in place to the specified lines and grades. Price and payment are full compensation for all labor, tools, equipment, and other incidentals necessary to secure borrow material, haul, place, level, manipulate, compact the embankment material, and perform other work for embankment construction.

2. When Embankment In Place is not specified in the contract, the cost of constructing embankments is incidental to and included in the unit prices bid for the associated bid items for the work.

3. Payment is made under: Embankment In Place - Per Square Yard.

END OF SECTION

SECTION 02234 SUB-BASE COURSE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is constructing a sub-base course of either crushed or uncrushed materials meeting the specified gradations and other quality criteria specified herein.

1.2 REFERENCES

AASHTO T11	Amount of Material Finer Than No. 200 (0.075 mm) Sieve in Aggregate
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T89	Determining Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T176	Plastic Fines in Graded Aggregates and Soils by the Use of the Sand Equivalent Test
AASHTO T96	Resistance to Degradation of Small-Size Course Aggregate By Abrasion and Impact in the Los Angeles Machine
AASHTO T99 (ASTM D698)	Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5kg) Rammer and 12-Inch (305mm) Drop
ASTM D5821	Determining the percentage of Fractured Particles in Coarse Aggregate
AASHTO T191 (ASTM D1556)	Density of Soil in-Place By Sand Cone Method
AASHTO T310 (ASTM D6938)	In-Place density and water content of the soil and soil aggregate by Nuclear Method (Shallow Depth)

1.3 DENSITY CONTROL TESTING

A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements in section 01400, Contractor Quality Control and Owner Quality Assurance.
2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556) Sand Cone method or AASHTO T310 (ASTM D 6938), Nuclear Densometer method. Quality assurance field density testing frequency is at the discretion of the Engineer.

3. Retesting of failing areas is at the expense of the Contractor.

B. Laboratory Maximum Density and Optimum Moisture
1. Moisture density curves will be provided by the Contractor for each base material supplied. These will be provided at the expense of the Contractor.

C. Materials Submittals
1. Submit to the Engineer gradations, moisture density curves and other preliminary test results for sources to be used for base materials prior to delivery to the site for approval by the Engineer. If recycled materials are proposed, CBR test data must be submitted to the Engineer to assure consistency with design requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish select sub-base material meeting the applicable aggregate quality.

2.2 CRUSHED SUBBASE

A. Furnish material having both fine and coarse crushed stone or crushed gravel, and/or natural gravel, and when approved, blended with soil, sand, screenings, recycled concrete and/or asphalt or other materials.

B. Furnish crushed gravel or stone consisting of hard, durable particles, not containing excessive flat, elongated, soft or disintegrated rock, dirt, or other deleterious matter, and having a wear not exceeding 50% at 500 revolutions as determined by AASHTO T96.

C. Use production methods that produce a percent of fractured rock in the finished product that is constant and uniform. Crush aggregate so that at least 25% of the material is retained on the No.4 sieve and has one or more mechanically fractured faces.

2.3 GRADATION

A. Produce material, including any added binder or filler, meeting the following Table of Gradations as determined by AASHTO Methods T11 and T27:

TABLE OF GRADATIONS PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVES

Passing	4” Minus	3" Minus	2" Minus	1-1/2" Minus	1" Minus
1-1/2 Inch	---	---	---	100	
1 Inch	---	---	---	---	100
No.4	25-60	25-60	25-60	25-60	25-70
No.40	10-30	10-30	10-30	10-30	10-30
No.200	2-10	2-10	2-10	2-10	2-10

B. Up to 5% "oversized" material is permitted provided that the "oversized" material passes the screen size immediately larger than the top size specified. The material between the maximum screen opening and the No.4 sieve shall be reasonably well graded.

C. Suitability of the aggregate is determined by the gradation testing of material placed in the project as required in the Contract documents, within the allowable limits described by the Table of Gradations for the particular grading specified.

D. Assure the liquid limit for the aggregate fraction passing a No.40 sieve does not exceed 25, nor the plasticity index exceed 6, as determined by AASHTO T89 and T90.

2.4 WATERING:

A. Use water from an approved source.

PART 3 - EXECUTION

3.1 PREPARATION

A. Immediately before placing the base course, blade smooth and shape the underlying subgrade, subbase or base course to the plan cross-section before the base course is placed on the street. Do not place sub-base course on wet or muddy subgrade or subbase course. Maintain at least 1 completed area of finished and accepted subgrade or sub-base course in advance of placing base course.

3.2 PLACEMENT AND SPREADING

A. Mix and place the material in maximum 6-inch (15 cm) horizontal layers loose thickness. Deposit and spread each load of material on the prepared subgrade, or on a completed sub-base course layer continuously without breaks. Assure hauling over the subgrade or over any completed subbase course does not damage the subgrade, sub-base or base course.

B. Spread using dump boards, spreader boxes, or moving vehicles equipped to distribute the material in a uniform layer or a windrow. Place and spread the material in a uniform layer to the specified depth without causing segregation. Once the base course is spread, blade-mix it the full depth by alternately blading the entire layer to the centerline and back to the roadway edge.

C. For multiple layers, mix each layer as specified above. Blade smooth and compact each layer before placing the succeeding layer.

D. Uniformly add water, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.

E. Apply water during the work to control dust and to maintain the base course in a damp condition.

F. Where crushed sub-base is specified, produce a product with at least 25% of the material retained on the No.4 sieve having one or more fractured faces.

G. Water required for compacting base gravel may be obtained from the municipal system if approved by the Owner, or from other sources.

H. Compact the material using appropriate tamping equipment or power rollers. Correct all irregularities or depressions that develop under rolling by scarifying the material and adding or removing material, as required, until the surface meets specifications.

I. Blade and compact alternately, as required to produce the specified surface until final inspection. Tamp the material along curbs, headers, manholes, and similar structures and all places inaccessible to rollers using approved mechanical tampers or hand tampers meet field density requirements.

3.3 FIELD DENSITY REQUIREMENTS

A. Furnish watering and rolling to obtain a minimum field density of 95% of the maximum dry density determined by AASHTO T99. No separate compensation is allowed for rolling and watering the sub-base course other than the sub-base course bid item or items listed on the Contract documents.

3.4 SURFACE TOLERANCES

A. Finish the sub-base course so that when tested using a 10-foot (3m) straight edge placed on the surface with its center line parallel to the street center, the maximum surface deviation from the straight edge does not exceed ½ inch (12.7mm). Additionally, the finished grade cannot deviate more than 0.1 foot (30mm) at any point from the staked elevation and the sum of the deviations from two points not more than 30 feet (9.14m) apart cannot exceed 0.1 feet (30mm).

B. Perform all sub-base course corrections to meet the above tolerances using approved methods and materials. Payment for patching aggregate is at the unit price bid for the sub-base course material.

PART 4 - MEASUREMENT AND PAYMENT

4.1 CUBIC YARD BASIS: SUB-BASECOURSE

A. This item is measured and paid for as part of the lump sum per the bid documents which constitutes full compensation for furnishing, loading, hauling, spreading, blending, shaping, watering, and compacting the sub-base course material, and for all tools, labor and incidentals necessary to complete this item.

END OF SECTION

SECTION 02235 CRUSHED BASE COURSE

PART 1 - GENERAL

1.1 DESCRIPTION

A. This work is the placing of one or more base courses composed of crushed gravel, stone or other similar materials meeting the gradation and other quality criteria specified herein.

1.2 REFERENCES

AASHTO T11	Materials Finer than No. 200 (0.075 mm) Sieve in Aggregate
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T89	Determining Liquid Limit of Soils
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T176 Equivalent Test	Plastic Fines in Graded Aggregates and Soils by Use of the Sand
AASHTO T96	Resistance to Degradation of Small-Size Coarse Aggregate By Abrasion and Impact in the Los Angeles Machine
AASHTO T99 (ASTM D698)	Moisture-density Relations of Soils and Soil-Aggregate Mixtures Using 5-lb (2.5 kg) Rammer and 12-Inch (305 mm) Drop
ASTM D5821	Determining the Percentage of Fractured Particles in Coarse Aggregate
AASHTO T191 (ASTM D1556)	Density of Soil In-Place By Sand Cone Method
AASHTO T310 (ASTM D6938)	In-Place density and water content of the soil and soil aggregate by Nuclear Method (Shallow Depth)

1.3 DENSITY CONTROL TESTING

A. Field Density Testing

1. Meet the quality control and quality assurance testing requirements in section 01400, Contractor Quality Control and Owner QualityAssurance.
2. In-place field density tests for quality assurance are at Owner expense meeting AASHTO T191 (ASTM D1556) Sand Cone method or AASHTO T310 (ASTM D6938) Nuclear Densometer method. Quality assurance field density testing frequency is at the discretion of the Engineer.

3. Retesting of failing areas is at the expense of the Contractor.

B. Laboratory Maximum Density and Optimum Moisture

1. Moisture density curves will be provided by the Contractor for each base material provided. These will be provided at the expense of the Contractor.

1.4 MATERIALS SUBMITTALS

A. Submit to the Engineer gradations, moisture density curves and other test results for sources to be used for base materials prior to delivery to the site for approval by the Engineer. If recycled materials are proposed, CBR test data must be submitted to the Engineer to assure consistency with design requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish aggregate base material meeting the applicable aggregate quality requirements.

2.2 CRUSHED BASE MATERIAL

A. Consists of both fine and coarse fragments of crushed stone or crushed gravel, and/or natural gravel, and when approved, blended with sand, finely crushed stone, crusher screenings, recycled concrete and/or asphalt or other similar materials. Where recycled materials are permitted, project specifications shall state the minimum required CBR value (design minimum) of the Crushed Base Course.

B. Use crushed stone or gravel consisting of hard, durable particles of fragments of stone, free of excess of flat, elongated, soft or disintegrated pieces, dirt, or other deleterious matter, and having a percent of wear of not exceeding 50 at 500 revolutions when tested under AASHTO T96.

C. Crush material so that the percentage of fractured particles in the finished product is as constant and uniform as practical. Crush to produce material where at least 50% of the material retained on the No. 4 sieve has at least one fractured face.

D. Incorporate all material produced in the crushing operation and passing the No. 4 mesh sieve into the base material necessary to meet the gradation requirements.

2.3 GRADATION

A. As determined by AASHTO Methods T11 and T27, furnish material for the grading specified in the contract documents including binder or filler, which may have been added at the plant or at the site, meeting the requirements of that grading in the Table of Gradations below:

TABLE OF GRADATIONS

PERCENTAGES BY WEIGHT PASSING SQUARE MESH SIEVE

Passing	1½" Minus	1" Minus	¾" Minus
1½ Inch	100		
1 Inch	—	100	
¾ Inch	—	—	100
½ Inch	—	—	—
No. 4 Sieve	25 - 60	40 - 70	40 - 70
No. 10 Sieve	—	25 - 55	25 - 55
No. 200 Sieve	0 - 8	2 - 10	2 - 10

B. Up to 5% "oversized" material is permitted provided that the "oversized" material passes the screen size immediately larger than the top size specified. The produced material between the maximum screen opening and the No.4 sieve shall be reasonably well graded.

C. Suitability of the aggregate is based on samples obtained during placement in the project within limits allowed in the table for the particular grading specified.

D. That portion of the fine aggregate passing the No. 200 sieve must be less than 60% of that portion passing the No. 40 sieve.

E. The liquid limit for that portion of the fine aggregate passing a No. 40 sieve cannot exceed 25, nor the plasticity index exceed 6, as determined by AASHTO T89 and T90.

2.4 WATERING:

A. Use water from an approved source.

PART 3 - EXECUTION

3.1 GENERAL

A. Before placing the base course, smooth and shape the surface of the underlying subgrade, sub-base or base course to the cross section shown on the plans before placing the base course.

B. Do not place base course on a wet or muddy subgrade or sub-basecourse. Complete at least one area of finished and accepted subgrade, sub-base or underlying base before the placing of any base course.

3.2 PLACEMENT AND SPREADING

A. Mix and place the material in maximum 8 inches compacted layers unless otherwise approved. Deposit and spread each load of material on the prepared subgrade, or on a completed sub-base or base course layer continuously without interruption. Discontinue operating haul units over subgrade, or over any sub-base or base course completed if the haul units damage the subgrade, sub-base or base course.

B. Deposit and spread the material in a uniform layer, without segregation, to a loose depth so that when compacted, and making allowance for any filler to be blended on the road, the layer has the specified thickness.

C. Spread material using dump boards, spreader boxes, or vehicles equipped to distribute the material in a uniform layer. The material may be deposited in windrows mixed and spread as described below.

D. Construct each layer meeting these requirements. Blade smooth and thoroughly compact each layer as specified before placing the succeeding layer.

E. If segregation or moisture problems exist, or if the material was placed on the road in windrows, thoroughly blade-mix the material of the affected layer by alternately blading to the center and back to the edges of the street.

F. Uniformly add water, when required, on site and place in amounts required to compact the material as necessary to aid in densification and to limit segregation. Maintain an adequate water supply during the work. Assure the equipment used for watering is of the capacity and design to provide uniform water application.

G. Apply water during the work to control dust and to maintain the base course in a damp condition in accordance with Section 01500 under Dust Control.

H. Uncontaminated water required for compacting base gravel may be obtained from the municipal system if approved by the owner, or from other sources.

3.3 FIELD DENSITY REQUIREMENTS

A. Compact placed material the full width by rolling with suitable tamping equipment or power rollers. Correct all irregularities or depressions that develop during rolling by loosening the material in these places and adding or removing material, as required.

B. Perform blading and compacting alternately as required or directed, to maintain a smooth, even, uniformly compacted surface until the final inspection. Along curbs, headers, manholes, and similar structures, and at all places not accessible to the roller, compact the base course material with suitable mechanical tampers or hand tampers to reach the compaction requirements.

C. Provide the watering and rolling required to obtain a minimum field density of 95% of maximum dry density as determined by AASHTO T99. No separate compensation is made

for rolling and watering the base course other than the base course bid item or itemslisted on the contract documents.

3.4 SURFACE TOLERANCES

D. The base course surface when finished and tested with a 10-foot (3.0 meter) straight edgeplaced on the surface with its center line parallel to the center line of the street, will not have a surface deviation from the straight edge exceeding 3/8- inch (1.0 centimeter). Additionally, the finished grade cannot deviate more than 0.05 feet (1.5 centimeters) at any point from the staked elevation, and further, the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.05 feet (1.5 centimeters).

E. For base course receiving asphalt concrete surfacing, the finished grade cannot deviate more than 0.02 feet (0.6 centimeters) at any point from the staked elevations, and the sum of the deviations from two points not more than 30 feet (9.0 meters) apart cannot exceed 0.02 feet (0.6 centimeters).

F. If patching of the base course is necessary to meet the tolerances, perform patching usingmethods and aggregates approved by the Engineer. Payment for patching aggregate is atthe unit price bid for the base course material.

PART 4 - MEASUREMENT AND PAYMENT

4.1 CUBIC YARD BASIS: CRUSHED BASE COURSE.

A. This is a lump sum item included in the bid totals which constitutes full compensation for furnishing, loading, hauling, spreading, blending, shaping, watering, and compacting the sub-base course material, and for all tools, labor and incidentals necessary to complete this item.

END OF SECTION

Sections - 2600
Water Distributions

WATER DISTRIBUTION

SECTION 02660 Water Distribution

SECTION 02660

WATER DISTRIBUTION

PART 1: GENERAL

1.1 DESCRIPTION

A. Furnish all water main pipe and fittings meeting the Contract documents or specified as follows.

B. Furnish and install valves and fire hydrants for water mains, together with related appurtenances.

C. Construct water services, including water service piping, tapping mains, corporation stops, curb stops and related items.

1.2 CERTIFICATION BY MANUFACTURER:

A. Furnish a manufacturer's certification covering all pipe and fittings furnished, certifying that the pipe and fittings meet applicable specifications.

1.3 REFERENCES

ANSI B16.1	Tapping Sleeves
ASTM B88-62	Copper Pipe
ASTM PE3406-3408	Polyethylene Pressure Pipe
AWWA B300	Hypochlorite for Disinfecting
AWWA B301	Liquid Chlorine for Disinfecting
AWWA C104	Ductile Iron Cement-Mortar Lining
AWWA C110	Ductile Iron Fittings
AWWA C111	Ductile Iron Joints
AWWA C151	Ductile Iron Pipe
AWWA C153	Ductile Iron Compact Fittings
AWWA C301	Concrete Cylinder Pipe
AWWA C500	Gate Valves
AWWA C502	Fire Hydrants
AWWA C504	Butterfly Valves
AWWA C509	Gate Valves
AWWA C651	Disinfecting Water Mains
AWWA C900	PVC Water Main Pipe

1.4 STANDARD DRAWINGS:

A. Standard Drawings in Appendix A applicable to this section are as follows:

Standard Drawing No. 02660-1	Thrust Blocking for Water Main Fittings
Standard Drawing No. 02660-2	Water and Sewer Main Separation
Standard Drawing No. 02660-3	Thrust Blocking for Water Main Valves
Standard Drawing No. 02660-4	Fire Hydrant Setting
Standard Drawing No. 02660-5	Hydrant Location Detail
Standard Drawing No. 02660-6	Water Service Line
Standard Drawing No. 02660-7	Blowoff Valve

PART 2: PRODUCTS

2.1 GENERAL

A. Furnish Water Main pipe and fittings as specified in the Contract Documents and meeting the material and testing requirements of this Section. Furnish fittings and service line piping of the same material and design as the water main pipe unless specified otherwise. Pipe strength classifications are shown on plan drawings and/or are listed in the Contract Documents.

B. References made to ASTM, ANSI, AWWA, USASI or AASHTO designations are the latest revision at the time of call for bids.

2.2 PIPE MATERIALS

A. General

1. Furnish the pipe specified in the contract documents meeting the materials and testing requirements as outlined in this section.

2. Assure all pipe is clearly marked showing type, class and/or thickness.

1. Lettering must be legible and permanent under normal handling and storage conditions.

B. Ductile Iron Pipe

1. Furnish Class 51 wall thickness meeting AWWA C151, American National Standard for Ductile Iron Pipe.

2. Use underground pipe and fittings having mechanical or push-on joints meeting AWWA C 111.

3. Assure the pipe interior is cement mortar lined meeting AWWA C104 requirements. Assure the outside pipe surface for underground service is bituminous coal tar base coated 1 mil thick.

4. Fittings

   a. Furnish fittings meeting one of the following;

      1) Class 250 fittings meeting AWWA C110, latest edition, Gray-Iron and Ductile Iron Fittings For Water And Other Liquids

      2) Compact fittings meeting AWWA C153.

5. Joints

   a. Assure joints are mechanical or push-on joints meeting AWWA C111. Assure the fitting interior is cement mortar lined meeting AWWA C104. Assure the fitting exterior is bituminous tar coated 1 mil thick. Use compact fittings having a rated working pressure of 350 psi (2410 kPa) following manufacturer recommended laying lengths.

6. Couplings

   a. Use pipe couplings meeting one of the following:

      1) Cast type with cast iron or ductile iron sleeves and malleable or ductile iron flanges.

      2) Gray iron or ductile iron, mechanical joint solid sleeves, with a minimum 12 inch length (30 cm).

      3) Limit use of the first type to a maximum 16 inch (40 cm) diameter. Use the manufacturers' standard gasket for use in potable water systems. Use stainless steel bolts and nuts. Coating to be "manufacturers' standard".

C. Polyvinyl Chloride (PVC) Pressure Pipe

1. Furnish PVC water main pipe meeting AWWA C900 requirements, made to ductile iron O.D.'s for "Push-On" joints. Assure pipe joints are bell and spigot having an elastomeric gasket. Use DR 25 Class 165 pipe.

D. Concrete Cylinder Pipe

1. Furnish prestressed, reinforced concrete water pipe, steel cylinder type meeting AWWA C301 and having rubber gasketed bell and spigot joints. Furnish the pipe class, marking, lengths, etc. specified in the Contract Documents.

E. Water Service Pipe

1. Use copper or polyethylene pipe in water service line construction as specified in the contract documents and meeting the following specifications.

a. Furnish service pipe of the size or sizes specified. Service lines are considered 2-inch (51mm) size and under. Service lines over 2-inch (51 mm) size are considered as water mains and are specified under the applicable sections.

b. Furnish and install the service pipe from the main to the property line installing a curb stop and curb box at the property line. Meet the water service installation requirements of Standard Drawing 02660-6.

c. Copper Service Pipe

1) Use copper, type K, meeting Federal Specification WW-T-799 or ASTM B88-62.

d. Polyethylene Service Pipe

1) Use pipe meeting AWWA SpecificationC901, "Polyethylene (PE) Pressure Pipe, Tubing and Fittings, 1/2 inch through 3 inch for Water" and ASTM PE3406-3408. PE pipe to be pressure tubing meeting Table 6 requirements of said specification. Use class 200 with a DR of 7 Polyethylene pipe.

2.3 TAPPING SLEEVES AND VALVES:

A. Use tapping sleeves meeting either:

1. Gray iron or ductile iron, split-sleeve, mechanical joint type with end and side gaskets,

2. Split-body type with circular gasket forming a seal around the circumference of the outlet.

3. Assure both types have a class 125, ANSI B16.1 outlet flange, are rated for a minimum 150 psi (1030 kPa) working pressure and contain a threaded test plug on the neck or body of the tapping sleeve. Assure gaskets are manufacturers' standard for use in potable water systems. Use stainless steel bolts and nuts. Assure mechanical joint type is fusion-bonded, 12-mil thickness, and epoxy coated. Limit the use of mechanical joint type to metal pipe. Assure tapping valves meet the applicable requirements for gate valves, as outlined in this section, with flanged inlets compatible with the flange of the tapping sleeve and mechanical joint outlet.

2.4 CORPORATION STOPS

A. Furnish brass corporation stops with inlet end to meet tapping requirements and flared outlet for copper tubing or pressure coupling for polyethylene tubing.

2.5 SERVICE CLAMPS

A. Furnish flat, double strap, bronze metal service clamps with Neoprene gaskets and corporation stop threads. Assure service clamps for PVC provide full support around the pipe circumference with a bearing area of the width along the axis of the pipe so the pipe is not distorted when the clamp is tightened.

2.6 CURB STOPS

A. Furnish curb stops with bronze plug, tee head key with Minneapolis pattern and screw box mount.

2.7 CURB BOXES

A. Furnish extension type curb boxes having a 6- 1/2 foot (2 meters) extended length.

2.8 VALVES

A. Gate Valves

1. Furnish iron body gate valves, resilient seat or double disc gate valves with non-rising stems with design, construction and pressure rating meeting AWWA C500 or AWWA C509 requirements and the following.

2. Assure stem seals are double "O" ring seals capable of replacing the seal above the stem collar with the valve under pressure in full open position.

3. Furnish gate valves for underground installation equipped with a 2-inch (31 mm) square operating nut for key operation. All valves to open counterclockwise. Valves to be equipped with push-on joints or mechanical joints for pipe connections.

B. Butterfly Valves

1. Furnish Class 150, rubber seated, butterfly valves for water distribution systems meeting AWWA C504 requirements. Valves to be equipped with mechanical joint ends and lubricated screw type operators designed for underground service.

2. Rubber valve seats to be replaceable without disassembling the valve and not interrupted by the shafting. Rubber seats may be retained on the disc edge by stainless steel clamping instead of bonding to the valve body. Assure shaft packing is the self-adjusting, permanent type.

3. Assure underground service operators are permanently lubricated, screw type, totally enclosed and watertight constructed. Assure overload protection is incorporated in the operator allowing 450 foot-pounds (610 j) input torque at full-open and full-closed positions without damaging the operator or valve. Provide a 2-inch (51mm) square operating nut and valve box for operating the valve. Valves to open counter clockwise. Furnish performance certification, leakage and hydrostatic tests as specified in AWWA C504. Assure valve manufacturer has at least five years experience manufacturing waterworks and distribution valves.

2.9 VALVE BOXES

A. Furnish cast iron valve boxes, 5-1/4-inch (13 cm) diameter, adjustable valve boxes with the required base for the valve size used. Assure valve boxes are screw type and of the specified length for the pipe bury. Assure the valve box cast iron cover has an arrow indicating the opening direction and stamped with the word "Water".

2.10 FIRE HYDRANTS

A. Furnish fire hydrants meeting AWWA C502; "Standard Specifications for Fire Hydrants for Ordinary Water Works Service", and the Contract requirements.

B. Furnish hydrants with 5-1/4-inch (13 cm) valve openings, 6-inch (15 cm) mechanical joint, flanged or push-on inlet, one pumper connection and two, 2-1/2 inch (63 cm) hose connections. Assure hose nozzle threads meet ASA

Specification B26 for National Standard Fire Hose Coupling Screw Threads, 7 1/2 threads per inch. Assure pumper nozzle size and threads match owners existing pattern. Furnish National Standard operating nut. Furnish hydrants opening counter clockwise and having an arrow on the hydrant top designating the opening direction.

C. Furnish "Compression" type hydrants with safety flange and safety stem coupling above the ground line permitting repair without shutting off the water. Assure hydrants are of the dry top design with two or more "O" rings sealing the water from the operating mechanism. Assure the operating mechanism is automatically lubricated from a sealed, self-contained lubricating reservoir.

D. Paint the hydrant portion above the ground line meeting the owner's standards. Furnish hydrants for 6.5 foot (2 meters) bury.

2.11 SPECIAL FITTINGS

A. Furnish special fittings meeting the Contract Documents. The Engineer will specify gasket materials for contaminated soil or special groundwater situations.

2.12 POLYETHYLENE ENCASEMENT

A. Furnish polyethylene encasement in accordance with AWWA C105, "Polyethylene Encasement for Fray and Ductile Cast – Iron Pipe for Water and other Liquids".

PART 3: EXECUTION

3.1 TRENCH EXCAVATION AND BACKFILL FOR WATER MAINS

A. This work includes all excavation, backfilling, disposal of surplus and unsuitable material, and all other work incidental to trench construction, including excavation for valves, fittings, hydrants, thrust blocks or other pipeline structures and not classified as "Structural Excavation."

B. Perform this work in accordance with Section 02221: TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES.

3.2 PIPE INSTALLATION FOR WATER MAINS

A. General

1. Install pipe following the manufacturer's specifications and instructions. Provide all tools and equipment required to install each type of pipe used.

2. The Contractor is responsible for all contractor furnished material. Replace all defective material or material damaged by handling after delivery by the manufacturer. This includes the furnishing of all materials and labor required to replace installed material discovered damaged or defective before final acceptance of the work, or during the guarantee period.

3. Store all material safely and to prevent damage. Keep pipe interior and other accessories free from dirt and foreign matter at all times.

4. Deliver and distribute all Contractor furnished pipe at the site. Load and unload pipe, fittings, specials, valves and accessories to prevent damage. Do not permit pipe handled on skidways to skid or roll against pipe already on the ground.

5. When distributing material at the work site, lay each piece adjacent to its installation point. Repair or replace all damaged pipe at Contractor's expense on the jobsite.

B. Dewatering of Trench

1. Remove all water in the trench during pipe laying and maintain a dry trench until the pipe ends are sealed. Do not permit the pipe to float. Do not allow any trench water to enter the pipe at any time.

C. Laying of Pipe

1. Inspect the pipe and pipe coating for damage or defects before installation. Lay pipe without damaging the pipe coating. Repair all pipe coating damage following the manufacturer's instructions before laying the pipe. When using belt slings to lower the pipe into the trench, remove the slings without damaging the pipe coating.

2. Lay pipe to the specified lines and grades with fittings and valves at the required locations. Plumb all valve stems.

3. Grade and alignment on un-graded streets will be provided using hubs

set parallel to the pipe line, and on graded streets from established points on the existing curbs or sidewalks, when directed by the Engineer. Excavate pipe trenches to the lines and grades given or to the standard cover depth specified. Transfer lines and grades to the pipe from hubs or from existing concrete curbs or sidewalks as an incidental part of this work.

4. Use implements, tools and facilities satisfactory to the Engineer for the safe and convenient prosecution of the work. Carefully lower all pipe, fittings and valves into the trench using a derrick, rope or other tools or equipment, without damaging pipe materials and protective coatings and linings. Do not drop or dump materials into the trench.

5. Take every precaution to prevent foreign material from entering the pipe as it is placed in the line. During laying operations, do not permit debris, tools, clothing or other materials to be placed in the pipe. At times when pipe laying is not in progress, close the open ends of the pipe using a watertight plug or other approved methods to prevent material entering the pipe.

6. Place pipe bedding in the bottom of the trench meeting Section 02221; TRENCH EXCAVATION AND BACKFILL FOR PIPELINES & APPURTENANT STRUCTURES. Voids may be left in the bedding material to remove pipe slings and for pipe bells to allow support along the full length of the pipe barrel.

7. Long radius curves, either horizontal or vertical, may be laid with standard pipe with deflections at the joints where approved. If the pipe is shown curved on the plans and no special fittings are shown, assume that the curves can be made by deflection of the joints with standard lengths of pipe. If shorter lengths are required, the plan will indicate maximum lengths that can be used.

8. The Engineer will determine the method of deflection or curving where required but not specified. No additional payment will be made for laying pipe on planned curves, nor for field changes involving standard pipe lengths deflected at the joints.

9. Do not exceed the applicable material and joint specifications of AWWA or the pipe manufacturer's recommendations at pipe joints for various types of pipe. When rubber gasketed pipe is laid on a curve, joint the pipe in a straight alignment and then deflect to the curved alignment. Excavate trenches to accommodate deflections and curves.

10. Construct reaction or thrust blocks at all tees, plugs, valves, reducers, caps and at bends deflecting 22-1/2 degrees or more. Construct thrust blocks at tapping sleeves where the outlet diameter exceeds one-half the diameter of the main being tapped. Limit using metal rods or straps for thrust restraint to those specified on the plans, or where the use of concrete thrust blocks would be impractical. Do not use metal rods or straps without the Engineer's approval. Construct reaction blocks from concrete having a minimum compressive strength of 2,000 pounds per square inch (14,000 kPa) at 28 days. Place blocking between undisturbed ground and the fitting to be anchored, as shown on Standard Drawing 02660-1. Place the blocking so that the pipe and fitting joints are accessible for repair.

11. Cut pipe for inserting valves, fittings or closure pieces in a neat and workmanlike manner without damaging the pipe or coating and leaving a smooth end at right angles to the pipe axis. Do not cut pipe using an oxyacetylene torch.

D. Pipe Jointing

1. Rubber Gasket, "Push-On" Joints

a. Follow the manufacturer's recommendations for jointing of pipe and fittings with a rubber gasket, "push-on" type. Wipe the rubber gasket and gasket seat inside the bell clean with a cloth. Wipe the plain end of the adjoining pipe clean, lubricate and insert into the bell to make contact with the gasket. Force the plain end "home" using a crow bar, fork tool, or jack assembly.

2. Mechanical Joints

a. Thoroughly brush the bell and the outside of the spigot of the mechanical joint fitting with a wire brush to remove all loose rust or other foreign material just before assembly. Brush the cleaned surfaces with soapy water just before slipping the gasket over the spigot end and into the bell.

b. Center the spigot end of the pipe or fitting in the bell before jointing is begun. Once the gasket is in place, bring the gland up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. Partially tighten the bolts, alternately around the socket, maintaining approximately equal tension until the final tension is reached.

c. Use the following bolt torque range for the joints:

Bolt Size Inch	(millimeters)	Range of Torque Ft.-Lb.	(joules)
5/8	(16)	40 - 60	(54-81)
3/4	(19)	60 – 90	(81-122)
1	(25)	70 – 100	(95-135)
1-1/4	(32)	90 – 120	(122-163)

d. Apply the torque loads with torque measuring or indicating wrenches, or apply using regular socket wrenches, checked with torque wrenches.

e. If the joint is not sealed using the maximum torque indicated above, disassemble and re assemble the joint after thorough cleaning. Do not overstress bolts to provide the seal.

3. Connections to Existing Mains

a. Make all connections to existing water mains in use unless otherwise specified. Furnish the special fittings, as shown on the plans, and all other material required. Make all necessary excavations to assure gradual transition between the new and existing water main, and perform all necessary backfilling.

b. Where the connection of new work to old requires a service interruption and customer notification, the Engineer and the Contractor are to mutually agree upon a date for connections to permit adequate time to assemble labor and materials, and to notify all affected customers. All notifications are the Contractor's responsibility.

3.3 POLYETHYLENE ENCASEMENT

A. Wrap all direct bury cast iron or ductile iron pipe and fittings including hydrants, valve boxes, curb boxes, and all other metal parts and surfaces, in polyethylene encasement.

3.4 TESTING, CLEANING & DISINFECTING WATER MAINS, VALVES & FITTINGS:

A. Hydrostatic and Leakage Testing

1. Perform hydrostatic and leakage testing in accordance with AWWA

C600. Once the pipe is laid and backfilled, test for at least 2 hours, all newly laid pipe, or any valved section, to a hydrostatic pressure of at least 1.5 times the normal operating pressure at the test point or 1.25 times the normal operating pressure at the highest point along the test section.

2. Slowly fill the pipe with water, purging all air, and apply the test pressure using a pump hooked up so that the pressure and leakage can be measured. To purge the pipe of air during the test, it is necessary to tap the pipe at its highest points if permanent air vents, water services, hydrants, etc. are not located at the high points. Use corporation stops for this purpose. Furnish the pump connections, gauges, stops, and all necessary apparatus for testing.

3. Disassemble and reassemble all joints showing leakage after thorough cleaning. Remove and replace all cracked or defective pipes or fittings discovered in during the pressure test with sound material and repeat the test.

4. Conduct the leakage test concurrently with the pressure test for 2 hours. Leakage is defined as the quantity of water supplied into the pipe, or any valved section thereof, necessary to maintain pressure within 5 PSI of the pressure test after the pipe has been filled with water and purged of air.

5. The pipe installation will be rejected if the leakage exceeds that determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{GGG.\ 148{,}000}$$

6. In which L equals the allowable leakage in gallons per hour; S is the length of pipe tested, in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gauge.

7. Should any test of pipe laid disclose leakage exceeding that specified above, locate and repair the defective joints until the leakage is within the specified allowance.

8. Conduct the pressure and leakage tests with the Engineer present.

9. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallon per hour per inch of nominal valve size is allowed. Repair all visible leaks regardless of the amount of leakage.

10. Pressure test tapping sleeves after installation and before tapping.

B. Cleaning Water Mains

1. Before chlorination, except when hypochlorite tablets are used, flush the mains thoroughly after the pressure and leakage test are completed.

2. It is understood that such flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed to get into the main during laying. Use a minimum flushing velocity in the main of 2.5 feet per second (0.7 meters/second). If no hydrant is installed at the end of the main, provide a tap of the size to produce a velocity in the main of at least 2.5 feet per second (0.7 meters/second). Table 2 shows the rates of flow required to produce a velocity of 2.5 feet per second (0.7 meters/second) in various size pipes.

TABLE 1
REQUIRED FLOW AND OPENINGS TO FLUSH PIPELINES[1]
(40 psi (276 kPa) Residual Pressure in Water Main)

Pipe Diameter Inches (cm)	Flow Required to Produce 2.5 fps (approx.) Velocity in Main gpm (epm)	Size of Tap Inch (mm) Number of Taps on Pipe[2]			Hydrant Outlet	
		1 (25)	1-1/2 (38)	2(51)	Number	Size Inches (mm)
4 (10)	100 (380)	1			1	2-1/2 (63)
6 (15)	200 (760)		1		1	2-1/2 (63)
8 (20)	400 (1510)		2	1	1	2-1/2 (63)
10 (25)	600 (2270)		3	2	1	2-1/2 (63)
12 (30)	900 (3400)			2	2	2-1/2 (63)
16 (41)	1600 (6060)			4	2	2-1/2 (63)

[1]With a 40 psi (267 kPa) pressure in the main with the hydrant flowing to atmosphere, a 2-1/2-inch (63mm) hydrant outlet will discharge approximately 1000 gpm (3786 epm) and a 4-1/2-inch (114mm) hydrant nozzle will discharge approximately 2500 gpm (9463 epm).

[2]Number of taps on pipe based on discharge through 5 feet (1.5 meters) of galvanized iron (GI) pipe with one 90° elbow.

3. Exercise extreme care and conduct a thorough inspection during the water main laying to prevent and detect small stones, pieces of concrete, particles of material, or other foreign material that may have entered the mains. To remove this material, flush and inspect all hydrants on the lines to assure that the entire valve operating mechanism of each hydrant is in good condition.
4. In 24-inch (61 cm) or larger diameter mains, in addition to flushing, broom-sweep the main, removing all sweepings before chlorinating the main.

C. Disinfecting Water Mains

1. General

a. Disinfect the water mains subject to the Engineer's approval in accordance with AWWA C651, "Disinfecting Water Mains", and these specifications, before placing the main in service. Keep the interior of all pipe, fittings and appurtenances free from dirt, heavy and foreign particles.

2. Forms of Chlorine

a. The forms of chlorine that may be used, subject to the approval of the Engineer, are:

1) Liquid chlorine containing 100 percent available chlorine under pressure in steel containers. Meet AWWA B301 requirements and use only in combination with appropriate gas-flow chlorinators and ejectors.

2) Sodium hypochlorite in liquid form containing approximately 5 to 15 percent available chlorine. Meet AWWA B300 requirements.

3) Calcium hypochlorite in granular form or in 5g tablets containing approximately 65 percent available chlorine by weight. Meet AWWA B300 requirements.

3. Methods of Chlorination

a. Three (3) methods of chlorination may be used. The tablet method gives an average chlorine dose of approximately 25 mg./L; the continuous feed method gives a 24 hour chlorine residual of not less than 10 mg./L; and the slug method provides a three hour exposure of not less than 50 mg./L free chlorine.

1) Tablet Method

a) This method may be used if the pipes and appurtenances are kept clean and dry during construction.

b) During construction, place calcium hypochlorite granules at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-foot (150 meter) intervals. Use the quantity of granules shown in Table 2.

c) Warning: Do not use this procedure on solvent welded plastic or on screwed joint steel pipe because of fire or explosion hazard from the reaction of the joint compounds with the calcium hypochlorite.

d) During construction, place 5g calcium hypochlorite tablets in each section of pipe and also place one tablet in each hydrant, hydrant branch and other appurtenance. Use the number of 5g tablets for each pipe section required to provide a minimum
chlorine concentration of 25 mg/L. Appendix B provides information on the number of tablets required for commonly used sizes of pipe. Attach tablets to the inside of the pipe using an adhesive such as Permatex No.1 or equal. Assure no adhesive is on the tablet except on the broad side attached to the surface of the pipe. Attach all the tablets at the inside top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, mark their position on the section so it can be readily determined that the pipe is installed with the tablets at the top.

e) When installation has been completed, fill the main with water at a velocity not exceeding 1 fps(0.3 mps). Take precautions to assure that air pockets are eliminated. Leave this water in the pipe for at least 24 hours. If the water temperature is less than 41° F (5°C), leave the water in the pipe for at least 48 hours. Position valves so that the chlorine solution in the main being treated will not flow into water mains in active service.

2) Continuous Feed Method

a) Before chlorinating, fill the main with water to eliminate air pockets and flush as specified above.

b) Use water from the existing distribution system or other approved source of supply to flow at a constant, measured rate into the newly laid water main. At a point not more than 10 feet (3 meters) downstream from the beginning of the new main, assure water entering the new main receives chlorine fed at a minimum 25 mg/L free chlorine. To assure that this concentration is provided, measure the chlorine concentration at regular intervals.

c) Appendix B provides information on the amounts of chlorine compound required for various pipe sizes. During chlorine application, position valves so that the chlorine solution in the main being treated does not flow into water mains in active service. Do not stop chlorine application until the entire main is filled with chlorinated water. Retain the chlorinated water in the main for at least 24 hours, operating all valves and hydrants in the section treated to disinfect the appurtenances. At the end of the 24- hour period, the treated water in all portions of the main must have a minimum free chlorine residual of 10 mg/L free chlorine.

d) The preferred equipment for applying liquid chlorine is a solution feed vacuum operated chlorinator to mix the chlorine gas in solution water, in combination with a booster pump for injecting the chlorine gas solution water into the main to be disinfected. It is recommended that direct feed chlorinators not be used. Hypochlorite solutions may be applied to the water main with a chemical feed pump designed for feeding chlorine solutions.

e) If approved, an optional continuous feed method utilizing calcium hypochlorite granules may be used. Place the granules in the pipe sections as specified under the Tablet Method.

3) Slug Method

a) Before chlorinating, preliminary flush the main as specified herein.

b) Use water from the existing distribution system or other approved source of supply to flow at a constant measured rate into the newly laid water main.

c) Not more than 10 feet (3 meters) downstream from the beginning of the new main, add chlorine to the water entering the new main at a constant rate that the water will have a minimum 100 mg/L free chlorine. Measure this concentration at regular intervals. Apply the chlorine continuously and for the time required to develop a solid column or "slug" of chlorinated water that will, as it moves through the main, expose all interior surfaces to a 100 mg/L for at least 3 hours.

d) Measure the free chlorine residual in the slug as it moves through the main. If at any time it drops below 50 mg/L stop the flow and relocate the chlorination equipment at the head of the slug, and as flow is resumed, add chlorine to restore the free chlorine in the slug to not less than 100 mg/L.

e) As the chlorinated water flows past fittings and valves, operate related valves and hydrants to disinfect appurtenances and pipe branches.

4. Final Flushing

a. After the retention period, flush the chlorinated water from the main until chlorine measurements show that the concentration in the water leaving the main is no higher than that in the system, or is acceptable for domestic use.

D. Bacteriological Tests

1. After final flushing and before the water main is placed in service, test a sample, or samples, collected from the main(s) for turbidity and organisms. Collect at least one sample from the new main and one from each branch.

2. Redisinfection

a. If the initial disinfection fails to produce approved bacteriological or turbidity samples, re-flush and resample the main. If check samples show bacterial contamination, re-chlorinate the main until approved results are obtained.

3. Swabbing

a. Where connections are made to existing piping and the connections are not disinfected along with the newly installed main, swab or spray the interior of all pipe and fittings used in making the connections with a 1 percent hypochlorite solution before installation.

3.5 WATER AND SEWER MAIN SEPARATION

A. Maintain horizontal and vertical separation between water mains and sewer mains in accordance with Standard Drawing No. 02660-2.

3.6 VALVES

A. Set and joint gate valves and butterfly valves to the pipe as specified for pipe laying and jointing. Set valves with operating nut vertical. Center and plumb valve boxes over the operating nut to prevent shock or stress being transmitted to the valve.

B. Valve Boxes

1. Center and plumb valve boxes over the valve operating nut. Set valve box tops flush with the ground surface or street surfacing.

2. Place bedding gravel around all water main valves and under the valve box bottom to drain any water entering the valve box.

C. Valve Thrust Blocks

1. When specified, install valves with thrust blocks and anchor rods meeting Standard Drawing 02660-3 requirements.

3.7 FIRE HYDRANTS

A. Set all hydrants plumb with the pumper nozzle facing the street. Set the hydrant with the ground line at the location indicated by the hydrant manufacturer.

B. Provide drainage at the hydrant base by placing clean gravel under and around it. Place gravel at least 1 foot (30 cm) on all sides from the base of the hydrant to at least 6 inches (15 cm) above the drain opening. Brace the hydrant against unexcavated earth at the trench end with concrete backing as detailed on the plans. Furnish hydrants with the specified gate valves. Install hydrants meeting Standard Drawing No.02660-4 or 02660-5 as specified by the Owner.

3.8 SERVICE LINE INSTALLATION

A. Provide all work and materials for the complete service line installation, including trench excavation and backfill; making the water main tap; furnishing and installing the corporation stop, curb stop and box, service clamp where necessary, and service line with fittings to make the connections to the stops. Bend the service line adjacent to the water main into a figure "S" in a horizontal or vertical plane to avoid a rigid connection. Assure all services have a minimum 6-1/2 feet (2 meters) of cover measured as specified in Standard Drawing No. 02660-6.

B. Mark the water service line end at the property line using a steel fence post, 5 feet long (1.5 meters), buried in 3 feet (1 meter) in the ground. Paint the post blue. Where applicable, mark the concrete curb to identify the service locations.

3.9 TAPPING:

A. Tap the newly installed water mains unless specified otherwise. The Owner will tap any existing water mains not installed by the Contractor. If owner tapped, be responsible for scheduling and coordinating with the Owner. The Contractor will be charged a fee for each Owner made tap.

B. Perform tapping using an approved tapping machine using clean, sharp drill taps and/or shell cutters. Do not tap directly into AWWA C900 PVC pipe. 3/4-Inch (19 mm) and 1-inch (25 mm) taps may be made directly into the barrel of ductile iron pipe without using service saddles. Direct tap into the pipe barrel to the depth

exposing a maximum three threads of the corporation stop. Use maximum direct tap sizes of 1-1/2-inch (38 mm) for 6-inch (15 cm) diameter mains and 2-inch (51 mm) for larger mains.

PART 4: MEASUREMENT AND PAYMENT

4.1 GENERAL

A. The following items are pay items for the work covered under this section. Payment for these items is full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.

4.2 WATER MAINS

A. Measurement of water mains is made in lineal feet (meters) along the centerline of pipe through all valves, fittings and appurtenances. Payment for water main will be made at the contract unit price bid per lineal foot (meters) of the various sizes called for, which includes furnishing and installing pipe, furnishing and placing Type 1 pipe bedding, trench excavation and backfill, cleaning, testing and disinfecting the water main and all other work necessary or incidental for completion of the item.

4.3 FITTINGS

A. Measurement of water main fittings is by numerical count of the various types and sizes listed in the Contract Documents. Payment for fittings is made at the contract unit price bid for each fitting, and includes furnishing and installing the fittings as required, thrust blocking and any other work necessary or incidental for completion of the item.

4.4 WATER SERVICE CONNECTIONS

A. This item is measured by numerical count of water services of the various sizes listed in the Contract Documents. Payment for water service connections is made at the contract unit price bid per each, which includes furnishing and installing the water service line from the main to the property line, tapping the main, furnishing and installing all fittings, corporation stops, curb stops and boxes and tapping saddles if required, trench excavation, backfill, pipe bedding, shoring, and dewatering, cleanup and all other work necessary or incidental to complete the item.

4.5 WATER SERVICE LINE

A. Payment for water service line is made at the contract unit price bid per each, which includes furnishing and installing the water service line from the main to the property line, trench excavation, backfill, pipe bedding, shoring, and dewatering, cleanup and all other work necessary or incidental to complete the item. No separate measurement and payment is made for trench excavation and backfill for water service lines. Include the cost of this work in the price bid for service lines.

4.6 VALVES

A. Measurement of water valves is made by numerical count of the sizes and types of valves listed in the Contract Documents. Payment for water valves is made at the contract unit price bid each; which includes furnishing and installing the valve and valve box, all excavation, backfill, and special compaction required for the installation, thrust and anchor blocking (if required), and all other work necessary or incidental for completion of the item.

4.7 FIRE HYDRANTS

A. Measurement of fire hydrant assemblies is by numerical count. Payment is made at the contract unit price bid each; which includes furnishing and installing the fire hydrant and auxiliary gate valve, piping from main waterline to hydrant, all excavation, backfill, and special compaction required for the installation, thrust and anchor blocking, drain gravel, and all other work necessary or incidental for completion of the item.

END OF SECTION

Sections - 2700 Sewerage and Drainage

SEWERAGE AND DRAINAGE

SECTION 02730 Sanitary Sewer Collection System

SECTION 02730

SANITARY SEWER COLLECTION SYSTEMS

PART I: GENERAL

1.1 DESCRIPTION

A. Furnish and install sewer pipe and fittings including manholes, service lines and other appurtenant structures as specified in the Contract and this section. Pipe strength classifications are shown on the plans, listed in the Contract Documents or specified herein.

1.2 CERTIFICATION BY MANUFACTURER

A. Furnish a manufacturer's certification for all pipe and fittings, certifying that the pipe and fittings meet the contract requirements.

1.3 REFERENCES

ASTM C76	Reinforced Concrete Pipe
ASTM C361	Low Head Pressure RCP
ASTM C443	O-ring Rubber Gaskets
ASTM C478	Precast Reinforced Concrete Manhole Sections
ASTM C655	D-Load RCP
ASTM D1784	Rigid Polyvinyl Chloride Compounds
ASTM D2241	PVC Pressure Pipe
ASTM D3034	Polyvinyl Chloride Sewer Pipe and Fittings
ASTM F679	Large Diameter PVC Pipe
ASTM F714	HDPE Pipe-Dimensions
ASTM 3350	High Density Polyethylene Pipe
ASTM F949	PVC Open Profile Pipe

1.4 STANDARD DRAWINGS

A. Standard drawings in Appendix A applicable to this section are as follows:

Standard Drawing No. 02660-2	Water and Sewer Main Separation
Standard Drawing No. 02720-3	Sanitary Sewer and Storm Drain Manhole
Standard Drawing No. 02720-4	Standard Straight Manhole
Standard Drawing No. 02720-5	48" (122 cm) Standard Manhole Showing Two Types of Cone Sections
Standard Drawing No. 02720-6	Precast Manhole Bases
Standard Drawing No. 02720-7	Typical Manhole Channel Details

Standard Drawing No. 02720-8	Standard Cast Iron Cover
Standard Drawing No. 02720-9	Standard 24" (61 cm) Cast Iron Ring Manhole Frame
Standard Drawing No. 02730-1	Nomograph for Air Testing Gravity Sewer Mains
Standard Drawing No. 02730-2	Sanitary Sewer Service Line
Standard Drawing No. 02730-3	Deep Sanitary Sewer Service Line

PART 2: PRODUCTS

2.1 GENERAL

A. Furnish sewer pipe and fittings as specified in the Contract Documents and meeting the materials and testing requirements of this Section. Furnish wye or tee branches and service line piping of the same material and design as the sewer pipe unless specified otherwise. Pipe strength classifications are shown on the plans and/or are listed in the Contract Documents.

B. References made to ASTM, ANSI or AASHTO designation are the latest revision at the time of call for bids.

C. Assure all pipe is clearly marked with type, class and/or thickness as applicable. Assure lettering is legible and permanent under normal conditions of handling and storage.

D. Furnish the joint type, class, thickness designation, castings, lining, marking, testing, etc. as specified.

2.2 PIPE MATERIALS

A. Polyvinyl Chloride (PVC) Pipe

1. General

a. Furnish PVC pipe produced by a continuous extrusion process, employing a prime grade of un-plasticized polyvinyl chloride. Assure the grade used is highly resistant to hydrogen sulfide, sulfuric acid, gasoline, oil, detergents and other chemicals found in sewage and industrial wastes. Assure the material meets “Rigid Polyvinyl Chloride Compounds” - ASTM Designation D-1784 requirements. Assure the pipe has self-extinguishing flammability characteristics.

2. Gravity Sewer Pipe

a. Furnish gravity sewer pipe meeting one of the following requirements:

1) ASTM D-3034, “Standard Specifications for Polyvinyl Chloride Sewer Pipe and Fittings”, with an SDR of 35 4"-15" (10 cm - 38 cm).

2) ASTM F679, “Standard Specifications for PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings” 18"-36"(46 cm - 76 cm).

3) ASTM F949, “Standard Specification for PVC Corrugated (Open Profile) Sewer Pipe with a Smooth Interior and Fittings” larger than 12” (10cm).

b. Furnish pipe having nominal 12.5 feet (3.8 meters), laying lengths, except shorter lengths may be used adjacent to manholes, lampholes or other appurtenances. Assure each pipe section is marked, as a minimum, with size, SDR, “Sewer Pipe” and Code Number.

3. Pressure Sewer Pipe

a. Furnish pressure sewer pipe meeting ASTM D2241, “Standard Specification for Polyvinyl Chloride Plastic Pipe (SDR-PR), with an SDR of 26 and a pressure rating of 160.

b. Use a nominal laying length of 20 feet (6.1 meters), except shorter lengths may be used adjacent to bends or other appurtenances. Assure each pipe length is marked, as a minimum, with size, SDR, pressure rating or both, ASTM designation and manufacturer’s name and code.

4. Pipe Jointing

a. Furnish each pipe length with a bell designed to provide a watertight joint when jointing the bell and spigot with a rubber ring.

b. Make a rubber gasket joint for PVC pipe and fittings using a rubber gasket compressed between the outer surface of the spigot

and the inner surface of the bell. Assure the joint is completely sealed by the gasket so that the assembly remains watertight under all service conditions, including expansion, contraction, settlement and pipe deformation. Follow the manufacturer's recommendations when assembling the rubber ring joint.

5. Fittings

a. Assure wye or tee fittings for connecting service lines are of the same material, construction and joint design as the main sewer pipe.

B. Concrete Pipe

1. General

a. Furnish concrete sewer pipe meeting ASTM Specifications C76 or C655, latest revision, except as noted herein. Assure cement used to make concrete pipe is Type II A Modified, Type V or other approved cement containing less than 5 percent Tricalcium Aluminate. The pipe strength classifications for C76 or C655 specification pipe is listed in the plans or Contract Documents.

b. Furnish pipe meeting the referenced ASTM specifications on permissible variations in pipe dimensions. Assure the barrel thickness is uniform to providing a constant flow area without projections across joints.

2. Fittings

a. Use wye or tee fittings for connecting service lines of the same material, construction and joint design as the main sewer pipe.

3. Jointing Material

a. Make joints for concrete pipe using flexible, watertight, rubber-type gaskets meeting to ASTM C443, with an O-ring gasket confined in the pipe tongue groove.

4. Pipe Jointing

a. Thoroughly clean the spigot and bell ends of the pipe before joint assembly. Follow the pipe and joint manufacturer's recommendations for pipe jointing. Check the position of the rubber gaskets and pipe assembly using a feeler gauge before

backfilling the trench. Visually inspect and gauge pipe and joints from inside the pipe where pipe size permits to assure proper gasket position and joint gap tolerances.

5. Material Testing

a. When the pipe supplier is not an American Concrete Pipe Association Certified plant, the pipe supplier shall furnish the Engineer with certified test results from an independent testing laboratory on the following: (a) crushing strength (3-edge bearing method), (b) absorption, and (c) hydrostatic test. Furnish test results for each pipe as specified in ASTM C76 or C655, or a minimum two percent of the number of pipe supplied, whichever is greater. Cost of these tests to be borne by the pipe supplier. The engineer retains the option to witness all testing completed at the production facility.

C. High Density Polyethylene (HDPE) Pipe

1. Pipe

a. Furnish non-profile wall HDPE pipe meeting ASTM D3350, having a cell classification of PE 34-5434C. Assure dimensions and workmanship meet ASTM F714 requirements.

2. Fittings

a. Use wye or tee fittings for connecting service lines of the same material construction and joint design as the main sewer pipe.

3. Pipe Jointing

a. Heat fusion weld all field joints to meet the manufacturer's recommendations.

D. Other Pipe Materials

1. Other pipe materials may be specified at the discretion of the Engineer and Owner.

2.3 MANHOLES

A. General

1. Construct manholes from precast concrete sections having frames, covers, and steps meeting Standard Drawings.

B. Precast Concrete Sections

1. Furnish manholes meeting ASTM C478; "Precast Reinforced Concrete Manhole Sections", specifically including mandatory rejection requirements.

C. Steps

1. Furnish non-corrosive steps, 12-inches (30 cm) in width, of 1/2-inch (13 mm) steel rod encased with polypropylene. Assure steps withstand 400 pound (180 kg) vertical loads and 1,000 pound (450 kg) pull-out resistance.

D. Frames and Covers

1. Furnish frames and covers meeting Standard Drawing Nos.02720-8 and 02720-9. Furnish 2-hole type covers unless specified otherwise.

E. Concrete Base

1. Furnish precast concrete bases or field poured on undisturbed earth. Use concrete meeting Section 03310: STRUCTURAL CONCRETE.

PART 3: EXECUTION

3.1 PIPE AND SERVICE LINE INSTALLATION

A. Excavation and Backfill

1. Perform pipeline excavation and backfill meeting the applicable requirements of Section 02221: TRENCH EXCAVATION AND BACKFILL FOR PIPELINES AND APPURTENANT STRUCTURES.

B. Responsibility for Materials

1. Be responsible for all material furnished. Replace all material found defective in manufacture or damaged in handling after delivery. This includes furnishing all material and labor required for the replacement of installed material discovered defective before final acceptance of the work or during the guarantee period.

2. Be responsible for the safe storage of material intended for the work until it has been incorporated in the completed project.

C. Handling of Pipe

1. Deliver and distribute all pipe to the site. Load and unload pipe, fittings and accessories by lifting with hoists or skidding to avoid shock or damage. Do not drop any materials. Do not roll or skid pipe handled on skidways against pipe already on the ground.

2. In distributing the material at the site of the work, unload each piece opposite or near the place where it is to be laid in the trench. Keep the interior of all pipe and other accessories free from dirt and foreign matter at all times.

3. Handle pipe to prevent damaging coating or lining. If any part of the coating or lining is damaged, make all repairs in a manner satisfactory to the Engineer.

D. Laying Pipe

1. Lay and maintain all pipe to the specified lines and grades with fittings, tees and manholes at the required locations. Establish line and grade using batter boards and string line, laser equipment or other approved methods. When batter boards and string line are used, use a minimum of three batterboards at all times.

2. Install wye or tee fittings in the mainline sewer for service line connections. Furnish wye or tee fittings of the same material, design and specifications as the sewer main pipe. Joint service pipe to tee branches or main line pipe other than PVC using special joint adapters manufactured specifically for jointing the two types of pipe.

3. Use tools and equipment, satisfactory to the Engineer, for the safe and convenient prosecution of the work. Carefully lower all pipe and fittings into the trench to prevent damage to pipe materials and protective coatings and linings. Do not drop or dump any materials into the trench.

4. Take every precaution to prevent foreign material from entering the pipe while it is being installed. At times when pipe laying is not in progress, close the open ends of pipe using a plug or other means approved by the Engineer. Clean and remove all sand, gravel, concrete and cement grout that has entered the lines during construction.

E. Tolerances

1. Install the pipe within 1/2-inch (13 mm) of the specified alignment and within 1/4-inch (6 mm) of the specified grade.

3.2 MANHOLES

A. Construction

1. Construct manholes to the specified dimensions. Make invert channels smooth and semi circular in shape conforming to the inside of the adjacent sewer section. Make changes in flow direction with a smooth curve of as large a radius as the manhole size will permit. Make changes in channel grade and size gradually and evenly. The invert channels may be formed directly in the manhole base concrete or by laying half-pipe in the concrete. Make the floor of the manhole outside the channel smooth and slope toward the channel at one inch per foot (8 cm per meter).

2. Joint all connections between manhole walls and base and between wall sections adjusting rings and frame making the manhole watertight. For all horizontal joints located below the established high groundwater elevation, install a preformed rubber gasket joint. The established high groundwater level is shown on the plans or noted in the Special Provisions. For all sewer pipe to manhole joints, use gasketed, flexible, watertight connections that will accommodate differential settlement. Acceptable options for these connections to the manhole are as follows:

a. Adjacent Joints: Bell and spigot pipe joints with rubber sealing rings located within 12 inches (30 cm) of the manhole wall.

b. Compression-Type Flexible Connector: A resilient, flexible connection, cast into manhole wall, providing 10 degrees deflection.

c. Boot-Type Flexible Connector: A flexible, watertight connection consisting of a rubber gasket or boot, metal expansion ring and a metal take-up clamp. Assure the expansion ring holds the gasket in the manhole wall, with the take-up clamp holding the gasket to the pipe.

d. Options (b) and (c) are limited to precast manhole base inverts and other installations where the flexibility of the connection is not compromised.

e. Construct manholes meeting ASTM C478, and the rejection criteria stated therein.

f. Keep manhole construction within one manhole distant behind sewer pipeline construction.

3. Install adjusting rings on each manhole to bring the manhole top elevation to match the existing or specified ground elevations. Use manhole rings with a 2-inch minimum (5 cm) and 12-inch (30 cm) maximum height. Furnish adjusting rings reinforced with the same percentage of steel as the riser and top.

3.3 SANITARY SEWER SERVICE LINES

A. Construct service lines meeting Standard Drawing 02730-2. Install the service line to the property line. Plug the end of the service line with a stopper and gasket, using a gasket of the same type used for pipe jointing. Do not grout the plugs.

B. Mark the sanitary sewer and storm drain service line ends at the property line using a steel fence post 5 feet (1.5 m) long, buried at least 2 feet (0.6 m). Place a 2" X 2" (5cm X 5 cm) wood marker extending from the pipe invert to ground line. Wire the 2" X 2" (5cm X 5 cm) marker to the steel fence post. Where applicable, mark the concrete curb to identify the service locations. Paint sanitary sewer service markers green and storm drain service markers gray.

3.4 TESTS

A. Make all tests after backfill is completed, but before any surface restoration or street surfacing. Be responsible for finding and repairing all breaks and leaks revealed by the tests. Additionally, perform all tests in the presence of the Engineer, resident inspector, or the Owner's other designated representative.

B. Light Test (Visual)

1. After the trench has been backfilled and compacted as specified in Section 02221, perform a light test between manholes to check alignment and grade for pipe displacement. Excluding curved alignments shown on the plans, the completed pipeline is to permit a true circle of light to be visible from one manhole to the next. If alignment or grade is not that specified and displacement of pipe is found, remedy all defects.

C. Leakage Test

1. New sewer line will not be finally accepted until leakage tests are made assuring the Engineer that pipe laying and jointing are satisfactory.

D. Water Test

1. Where groundwater is at least 2 feet (0.6 m) above the sewer line, make tests by sealing off the section of lines between manholes and measuring the actual flow by collecting or pumping the discharge into barrels or other approved methods. Continue tests at a minimum of 4 hours for each section tested. Allow time to soak lines and manholes in advance of performing tests.

2. When groundwater is not 2 feet (0.6 m) above the pipe, test as follows: On flat slopes where the depth over the centerline of the pipe in the lower manhole of the section being tested will be not more than 10 feet (3 m), fill the upper manhole to 2 feet (0.6 m) over the top of the pipe or 2 feet (0.6 m) above the groundwater elevation (whichever is higher), and block the lower manhole. When the above conditions cannot be met, the Engineer may order testing the line in sections between manholes. Measure the leakage by checking the water level drop in the manhole over a 4 hour period.

3. The allowable infiltration or exfiltration, including manholes, cannot exceed 200 gallons per day per mile of sewer per inch of pipe diameter (185 liters per day per kilometer of sewer per centimeter of pipe diameter). This does not exclude obvious and concentrated leaks and physical defects, such as open joints, pinched gaskets, cracked barrels or bells, etc. Make repairs on concentrated leaks, and as required to reduce infiltration or exfiltration leakage below the specified rate.

E. Air Test (Alternative)

1. As an alternate method to water testing, the Contractor may utilize low pressure air to test the sewer mains. Use the test procedure described below: Plug both ends of the pipe under test with airtight plugs and brace to prevent slippage and blowout. Furnish one plug with an inlet tap or other provision for connecting an air hose.

2. Equip the air supply hose, connected between the air compressor and the plug, with a throttling valve, an air bleed valve and a high pressure shutoff valve for control. Equip the low pressure side of the throttling valve with a tee for a monitoring pressure gauge, protected by a gauge cock. This cock is kept closed except when the pressure loss is being timed.

3. If the pipeline is submerged under groundwater, the back pressure, caused by the water head, is measured and added to the standard test pressures to compensate for the groundwater effect on the air test.

4. Apply air slowly to the pipeline until the pressure reaches 4.0 psig(27.6 j). Throttle the air supply to maintain the internal pressure between 4.0 and 3.5 psig (27.6 -24.1 j) for at least 2 minutes. During this time check the plugs with soap solution to detect any plug leakage.

5. When the pressure reaches exactly 3.5 psig (24.1 j), disconnect the air supply, start a stop watch and record the time for the pressure to drop to 2.5 psig (17.2 j). The minimum time allowed for the pressure drop is computed on an air loss rate of 3.5 cfm (5.9m 3 /min) or an air loss rate of 0.0030 cubic feet per minute (cfm) per square foot (0.055 m 3 /min per square meter) of inner pipe surface area under test, whichever rate yields the least time for the pressure drop. Should the time of the pressure drop between 3.5 and 2.5 psig (24.1 - 17.2 j) be less than the allowable specified time, make the necessary leakage repairs and repeat the air test.

6. Standard Drawing 02730-1 provides a nomograph which may be used to compute testing times for air testing. The nomograph computes results based upon English (U.S. Customary) units.

7. For single pipe size test sections, the length limits for minimum test times obtained from Standard Drawing No.02730-1 entitled "Nomograph for Air Testing Gravity Sewer Mains" are contained in the following table.

TABLE 3.1
LENGTH LIMIT FOR MINIMUM TEST TIMES

Pipe Diameter, Inches (cm)	Test Section Length, Foot (m)	
	Minimum	Maximum
4 (10)	642(196)	1124(343)
6 (15)	429(131)	751 (229)
8 (20)	322(98)	564 (172)
10(25)	257(78)	450 (137)
12(30)	215(66)	376 (115)
15(38)	172(52)	300 (91)
18(46)	43(44)	1250 (76)
21(53)	123(37)	215 (66)
24(61)	107(33)	188 (57)

8. For test sections that are shorter than the minimum lengths, new test times must be calculated. This is done by multiplying the test time from the nomograph by the actual length of the test section (in feet) and then dividing the resultant product by the minimum test section length from the preceding table.

9. For test sections exceeding the maximum lengths, either shorten the test section to an allowable length or use the water test.

F. Number of Tests

1. Perform the number of leakage tests directed by the Engineer to assure that materials and workmanship are acceptable. Repair defective joints using only approved methods. Replace pipe having cracked or broken barrels. Do not exceed 800 feet (240 m) of sewer line per test unless otherwise approved.

G. T.V. Inspection

1. All sewer mains shall be inspected using a television camera before final acceptance. A sewer line is deficient and unacceptable if (1) the alignment is outside the specified limits, (2) water ponds in any section are equal to or greater than 2 times the grade tolerance specified herein under Section 02730.3.E.1, or (3) the pipe has visible defects such as open joints, pinched gaskets, cracked barrels or bell, or similar defects.

2. Pay all costs incurred in any television inspection performed solely for Contractor benefit.

3. Record all television inspections in a format acceptable to the Owner. Pull the camera through the sewer at 30 feet per minute (9 meters per minute maximum). If the camera is pulled by attaching to the hose of a hydraulic sewer cleaner, assure the hose is not active during the pulling process.

H. Deflection Testing

1. The Engineer may require deflection testing of all or any portion of a flexible pipe installation to assure the construction quality. Flexible pipe is pipe that will deflect at least 2 percent without any sign of structural distress.

2. Conduct deflection tests, when performed on PVC pipe, meeting ASTM D3034 and satisfy either of the following deflection limitations:

TABLE 3.2
DEFLECTION TESTING LIMITATIONS

Minimum Period Between Trench Backfilling & Testing	Minimum Mandrel Diameter as a Percent of Inside Pipe Diameter
7 Days	95.0
30 Days	92.5

3. Mandrels must have at least nine arms. Perform the mandrel test without mechanical pulling devices.

I. Material and Equipment for Testing

1. Furnish all labor, equipment and materials (including water) necessary for performing the sewer line tests at Contractor expense.

3.5 WATER AND SEWER MAIN SEPARATION

A. Horizontal and vertical separation between water and sewer mains is dictated by Montana Department of Environmental Quality.

PART 4: MEASUREMENT AND PAYMENT

4.1 GENERAL

A. The following items are the pay items for the work covered under this section. Payment for these items is full compensation for providing all materials, tools, labor and equipment necessary to complete the item and all incidental work related thereto, whether specifically mentioned herein or not.

4.2 SEWER MAINS

A. All sewer main and service line installation shall be included in the bid price for system improvements and is not billed on a per foot basis for the scope of this project.

4.3 MANHOLES

A. All manhole installation shall be included in the bid price for system improvements and is not billed seperately for the scope of this project.

4.4 SANITARY SEWER SERVICE LINES

A. All sewer main and service line installation shall be included in the bid price for system improvements and is not billed on a per foot basis for the scope of this project.

4.5 GENERAL

A. The contract bid prices are full payment for all labor, materials, tools and other incidentals as maybe required to complete the items of work in the Contract.

END OF SECTION

Sections - 2900 Landscaping

LANDSCAPING

SECTION 02910 Seeding

SECTION 02910

SEEDING

PART 1: GENERAL

1.1 DESCRIPTION

A. This section includes ground surface preparation; furnishing and applying fertilizer; and furnishing and planting seed in areas described in the contract documents or directed by the Engineer.

B. Hydraulic seeding is not included in this section. Hydraulic seeding is covered in Section 02920, Hydraulic Seeding.

1.2 SUBMITTALS

A. Submit to the Engineer applicable seed mixture certifications, fertilizer descriptions and mulch certifications. Furnish duplicate signed copies of the vendors statement certifying that each seed lot has been tested by a recognized seed testing laboratory within 6 months of date of delivery. Assure the statement includes: Name and address of laboratory, date of test, lot number for each seed species and the test results including name, percentages of purity and of germination, percentage of weed content for each kind of seed furnished and, for seed mixes, the proportions of each kind of seed.

PART 2: PRODUCTS

2.1 SEED

A. Furnish seed and seed mixture, free of all prohibited noxious weed seed or any other weed seed prohibited by state or local ordinance.

B. Seal and label all seed containers to comply with Montana Seed Law and Regulations or meeting U.S. Department of Agriculture and Regulations under the Federal Seed Act, if shipped in interstate commerce.

C. Do not use wet, moldy, or otherwise damaged seed in the work.

D. Furnish seed mixture of the species described in the contract documents. Furnish seed in standard containers labeled with the seed name, lot number, net weight,

percentages of purity, germination, hard seed, and percentage of maximum weed seed content for each seed species.

2.2 TOPSOIL

A. Use topsoil that is loose, friable, loamy soil, free of excess acid and alkali. Assure topsoil does not contain objectionable amounts of sod, hard lumps, gravel, sub-soil or other undesirable material that would form a poor seedbed. Before striping topsoil, assure it has supported the growth of healthy crops, grass or other vegetable growth.

2.3 LIME

A. Furnish ground limestone or other material deemed suitable by the Engineer containing a minimum 85 percent of total carbonate equivalent ground so that 90 percent will pass through a No. 100 mesh sieve. Coarser material may be acceptable, if the application rates are increased to provide at least the minimum quantities and depth specified using an approved Dolomitic lime or a high magnesium lime containing at least 10 percent magnesium oxide.

2.4 FERTILIZER

A. Furnish standard commercial fertilizers supplied separately or in mixtures containing the specified percentages of total nitrogen, available phosphoric acid, and water soluble potash. Apply fertilizer at the specified rate and depth meeting the applicable State and Federal laws. Furnish fertilizer in standard containers clearly labeled with name, weight, and guaranteed analysis of contents. No cyanamide compounds of hydrated lime are permitted in mixed fertilizers.

B. Fertilizers may be supplied in one of the following forms:

1. A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader;

2. A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or

3. A granular or pellet form suitable for application by blower equipment.

2.5 SOILS FOR REPAIRS

A. Use soil for filling and topsoiling repair areas of equal quality to the existing topsoil being repaired. Assure the soil is free of large stones, roots, stumps, or other

materials that interfere with sowing, compacting, and establishing turf. Obtain approval from the Engineer before placing topsoil.

PART 3: EXECUTION

3.1 TOPSOIL

A. Place at least 6 inches (15 cm) of topsoil in all areas to be seeded. Import topsoil if sufficient topsoil is not available from excavated areas of the project.

3.2 ALLOWABLE SEEDING MONTHS

A. Perform seeding when the temperature and moisture are favorable to germination and plant growth. Seed preferably before June 1st and after October 1st of each year. Seeding dates must be approved by the Engineer.

3.3 SEEDBED PREPARATION AND SOWING

A. Clear the areas to be seeded of all debris, vegetation, and other material determined by the Engineer to be detrimental to the preparation of a seedbed. Once the area is cleared, disc, harrow, rake, or work the area by other suitable methods, into a smooth, even seedbed. Assure the prepared seedbed surface is firm enough to prevent seed loss from high winds or normal rainfall. If rolling is required, perform rolling before seeding using a suitable roller, of a weight appropriate to the soil conditions.

B. Sow seed in the areas described in the contract documents at the specified application rates.

C. Sow seed using a force feed drill having a grass seed attachment, except of slopes steeper than three to one or on areas too small to be seeded with a force feed drill. In these areas, seed may be sown by power sprayers, blowers or other effective methods. Use equipment in good working order.

D. Seed a Native Grass mix as approved by the Montana FWP staff.

E. Do not sow seed in winds that prevent proper imbedment into the surface.

3.4 FERTILIZER

A. Spread and work fertilizer into the soil during the final seedbed preparation. Apply fertilizer at the rate described in the contract documents.

3.5 CARE OF SEEDED AREAS

A. Keep the seeded area moist until it has germinated and it's continued growth is assured. Prevent erosion during watering. Water is incidental to the item "Seeding".

B. Protect all seeded areas from traffic or pedestrian use with warning barricades or other Engineer approved methods.

C. Maintain the seeded area, performing any required watering and mowing until the seed is firmly established. Prevent weeds and other undesirable vegetation from establishing in the seeded area. Mow weeds and rake and remove the clippings from the areas.

D. Replace any seeded areas failing to germinate which have died or been damaged by construction activities. Replace such areas to meet the contract requirements. The contract warranty period applies to this item.

PART 4: MEASUREMENT AND PAYMENT

4. 1 GENERAL

A. Seeding is a lump sum item in the bid for all disturbed areas in the project and shall be done including topsoil salvage and/or importing, topsoil placement, seedbed preparation, and seeding, complete in place and accepted by the Engineer.

B. Payment indicated to include complete compensation for all labor, equipment, materials and incidentals required for the completion of the work.

END OF SECTION