

DEVELOPMENT STANDARDS AND CONSTRUCTION SPECIFICATIONS
FOR
KREMMLING SANITATION DISTRICT

FEBRUARY 2026

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ATTACHMENTS

- KREMMLING SANITATION DISTRICT DEVELOPMENT AND CONSTRUCTION CHECKLIST
- SEWER AND OTHER UTILITIES CONSTRUCTION PLAN REQUIREMENT CHECKLIST
- COST AGREEMENT
- EASEMENT DEDICATION

1 GENERAL REQUIREMENTS

1.1 SCOPE

The purpose of the Kremmling Sanitation District (District) Development Standards and Construction Specifications, hereafter referred to as the “Standards”, is to present the minimum design and technical criteria for the analysis and design of sanitary sewer collection systems for which the District acceptance is required. The Standards may be amended as new technology is developed or a need for revision is demonstrated and proven through experience and use. The Design Engineer shall be responsible for compliance with these Standards as well as other applicable design and construction standards in the preparation of engineering reports, construction drawings, and specifications for District review and acceptance.

1.2 DEFINITIONS AND ABBREVIATIONS

Wherever the following words, phrases, and abbreviations appear in these specifications, they shall have the following meaning:

- A. ac – acre
- B. ac-ft – acre-feet
- C. ANSI – American National Standards Institute
- D. APPROVED PLAN – The latest revised Construction Drawing(s) accepted by the Kremmling Sanitation District
- E. APWA – American Public Works Association
- F. AS-CONSTRUCTED DRAWINGS – Drawings reflecting actual conditions and information for the project after construction is completed.
- G. ASME – American Society of Mechanical Engineers
- H. ASTM – American Society for Testing Materials
- I. AWWA – American Water Works Association
- J. CDOT – Colorado Department of Transportation
- K. CDPHE – Colorado Department of Public Health and Environment
- L. cfs – cubic feet per second
- M. CONSTRUCTION DRAWINGS – Engineered working drawings including plan, profile, and detail sheets of proposed development and utility improvements accepted by the District.
- N. CONTRACTOR – The individual, firm, partnership, corporation, or combination thereof, private, municipal, or public including joint ventures, which, as an independent contractor, has entered into a contract with the Developer/Owner.
- O. ENGINEER – The partnership, corporation, or individual who is registered as a Professional Engineer, according to Colorado statutes, who is hired by the Developer/Owner to conduct engineering design services and may be empowered by the Developer/Owner to act as his agent for the project.
- P. DEVELOPER – The owner, corporation, association, partnership, agency, or individual who or which shall participate in development, has entered into a development agreement with the District and has entered into an agreement with the Design Engineer and Contractor to perform the development work.
- Q. DEVELOPMENT – Any construction or activity which changes the basic characteristic or use of land on which construction or activity occurs, including but not limited to, any non-natural change to improved or unimproved real estate, substantial improvements to buildings or other structures, installation of utilities, mining, dredging, filling, grading, paving, extraction, or drilling operations.

- R. DISTRICT – The Kremmling Sanitation District, a quasi-municipal corporation and political subdivision of the State of Colorado, duly organized pursuant to the Colorado Special District Act.
- S. DIP – Ductile-iron pipe.
- T. EASEMENT – A right granted by the property owner permitting a designated part or interest of the property to be used by others for specific use or purpose.
- U. EPA – Environmental Protection Agency
- V. ft² – square feet
- W. ft/s – feet per second
- X. GEOTECHNICAL ENGINEER – A partnership, corporation, or individual who is registered as a Professional Engineer, according to Colorado statutes, proficient in the area of soil mechanics, and who is hired by the Developer/Owner to conduct subsurface soils investigations and evaluations, ground water assessments, and other related engineering services.
- Y. gpcd – gallons per capita per day
- Z. gpd – gallons per day
- AA. gpm – gallons per minute
- BB. HP – horsepower
- CC. INSPECTOR – Representative of the Kremmling Sanitation District designated to conduct construction/field observation.
- DD. LAND SURVEYOR – A registered Professional Land Surveyor, according to State of Colorado statutes, who is hired by the Developer/Owner to determine the boundaries and elevations of land and/or structures and other related surveying services.
- EE. MAY – A permissive condition. Where the word “may” is used, no requirement for design or application is intended.
- FF. NEC – National Electric Code
- GG. NWCCOG – Northwest Colorado Council of Governments (regional 208 agency)
- HH. NON-POTABLE – Water that is not treated to approved drinking water standards and is not suitable or intended for human consumption, but is produced and delivered for irrigation use.
- II. OSHA – Occupational Safety and Health Administration
- JJ. OWNER – Any person having title or right of ownership in the surface estate of real property or leasehold interest within.
- KK. PGI – PVC Geomembrane Institute
- LL. PLANS – See CONSTRUCTION DRAWINGS.
- MM. PLC – Programmable Logic Controller
- NN. PROFESSIONAL ENGINEER – An engineer registered with the State of Colorado according to State of Colorado statutes.
- OO. PROFESSIONAL LAND SURVEYOR – A land surveyor registered with the State of Colorado according to State of Colorado statutes.
- PP. psi – pounds per square inch
- QQ. PVC – Polyvinyl chloride
- RR. SDC – Kremmling Sanitation District Development Standards and Construction Specifications.
- SS. SDR – Standard Dimension Ratio (pipe outside diameter over minimum pipe wall thickness).
- TT. SHALL – A mandatory condition. Where certain requirements in the design or application are described with the “shall” stipulation, it is mandatory that these requirements be met.
- UU. SHOULD – An advisory condition. Where the word “should” is used, it is considered to be advisable usage, but not mandatory. Deviations may be allowed when reasons are given which show that the intent of the standard is met.
- VV. SPECIFICATIONS – The construction specifications portion of the Kremmling Sanitation District *Design Criteria and Construction Specifications, Volume I, Sanitary Sewer Collection*.

- WW. STRUCTURE - Anything constructed or erected on or in the ground, the use of which requires a more or less permanent location on or in the ground, and, including, but not limited to, walls, retaining walls, fences, parking lots, parking slabs and oil and gas production facilities.
- XX. STANDARDS – STANDARDS – Kremmling Sanitation District Development Standards and Construction Specifications.
- YY. SUBCONTRACTOR – Any person, firm or corporation, other than the employees of the Contractor, who enters into contract with the Contractor, to furnish labor, materials, or labor and materials.
- ZZ. SUBDIVISION – A tract of land legally divided into lots for a planned residential or commercial area.
- AAA. UNCC – Utility Notification Center of Colorado.
- BBB. UNDERDRAINS – Private line or system that controls or manages any subsurface water on individual foundation lot or lots. No private underdrain systems shall be allowed in Sewer easements.
- CCC. UTILITY – Kremmling Sanitation District.
- DDD. UTILITIES – Shall mean all utilities, wet and dry, on site prior to the time of any design and development and all utilities proposed with design. Wet utilities shall include, but are not limited to potable water lines, sanitary sewer lines, non-potable irrigation lines, transmission gas lines, storm water lines, ditches and other runoff conveyance elements. Dry utilities shall include, but are not limited to electric lines, telephone lines, gas service lines, fiber optic lines, and cable television lines.
- EEE. VFD – Variable Frequency Drive
- FFF. District Manager – Shall mean the Manager of the Kremmling Sanitation District Sewer Department or their designated representative.
- GGG. WQCD – Water Quality Control Division of CDPHE

1.3 PRE-DEVELOPMENT MEETING

- A. Developers shall notify the District to request a Pre-Development conference prior to planning any developments.
- A. The developer should provide 2 weeks prior to the meeting a general plan layout/sketch of their proposed development along with proposed uses. And estimated sewer flow data.
- B. During this meeting the developer will present their plan and the District will determine if the project is feasible for the District to service and explain the District requirements.
- C. Detailed notes from this meeting will be distributed to all parties who attended.

1.4 MINIMUM STANDARDS

- A. The District’s review and acceptance will only be to determine if the plans and specifications conform to the District’s requirements. The District’s review and acceptance will not relieve the Developer, Design Engineer and Contractor from responsibility for any variation from the District requirements or adequate design standards. The District’s review and acceptance shall not constitute any assumption of responsibility or liability for the design or construction. It is the intent and purpose of these standards and specifications to obtain high-quality construction throughout, with the completed work complying with the District standards and specifications.

- B. All vertical and horizontal survey control and monumentation shall be approved by the District prior to survey.

1.5 RELATIONSHIP TO OTHER STANDARDS

- A. Whenever a provision of these Standards and any other provision in any law, ordinance, resolution, rule, policy, or regulation of any kind contain any restrictions covering any subject matter within these Criteria, the most restrictive standard shall apply.
- B. The provisions of these Standards and standards are minimum requirements that do not preclude the use of more restrictive standards by the Design Engineer or District.
- C. Adherence to these Standards does not remove the Developer's responsibility to investigate and obtain any other regulatory permits or approvals, from either local, regional, state, or federal authorities, that may be required for a particular project.

1.6 REVIEW AND ACCEPTANCE

- A. All sanitary sewer construction plans and specifications submitted to the District for review and comment, and acceptance shall be prepared by, or under the direct supervision of a Professional Engineer. Said Professional Engineer shall be responsible for the design, preparation of the construction drawings and reports, determining material specifications, and reviewing the field survey for accuracy.
- B. The review process for all development shall be as follows:
 - 1. The preliminary plan set shall be reviewed by the District for general compliance with these Criteria and the District shall provide comments to the Developer or their agents regarding corrections, additions, and omissions.
 - 2. It is the responsibility of the Design Engineer to confirm that submittals are in conformance with these current standards. Any preliminary or final submittal not meeting these criteria may be rejected without review.
 - 3. After final corrections are made and the plans are accepted, the plans set shall be signed by the District Engineer. The signing of the plans will constitute acceptance. The acceptance is qualified in that: The plans are reviewed and accepted for concept only, and the plan acceptance does not imply responsibility by the District for accuracy and correctness. The plan's acceptance does not imply that the quantities of items indicated on the plans are the final quantities required. The plans acceptance shall not be construed for any reason as acceptance of financial responsibility by the District for additional items not shown that may be required during the planning or engineering phase and the construction phase.
- C. If the Design Engineer responsible for the plans disagrees with any requested changes to the submitted plans that may be required by the District for acceptance, such disagreement shall be brought to the attention of the District, and if required by the District, in writing.

- D. The Seal of the Design Engineer on plans so corrected and accepted for construction will signify that the Professional Engineer has reviewed, approved, and authorized said corrected plans for construction.

- E. No construction shall be undertaken without a District accepted and signed set of Construction Drawings or required sanitary sewer easements.

2 SUBMITTAL REQUIREMENTS

2.1 GENERAL

- A. Requirements discussed in this section are the minimum for sanitary sewer collection systems and are not meant to be all-inclusive. Other requirements may be needed for a complete design. The Design Engineer shall consider the maintenance and operational aspects of the sanitary sewer collection systems' infrastructure, as well as constructability in their design.
- B. All construction drawings shall be legible and submitted on 22" x 34" or 24" x 36" sheets as a PDF. Additional sizes may be accepted with prior approval.
- C. A legend describing all line types, symbols, and abbreviations shall be shown either on the cover sheet or each individual sheet.
- D. Each sheet in the Construction Drawings shall be marked "PRELIMINARY, NOT FOR CONSTRUCTION" with the date of submittal. This statement shall be removed on the final District-accepted Construction Drawings.
- E. District-accepted and signed construction plans are required prior to the start of any construction.

2.2 PRELIMINARY CONSTRUCTION PLAN REQUIREMENTS

- A. For preliminary subdivisions, plans shall be submitted to the District for review and acceptance prior to the preparation of final Construction Drawings. Acceptance of the preliminary submittal shall constitute only conceptual acceptance and shall not be construed as acceptance of specific design details. The preliminary plans' submittal requirements are outlined below:
- B. Utility Sheet
 - 1. A general overview of the entire project, including, but not limited to, streets (complete with names), alleys, lot and block numbers, all proposed and existing utilities on and within 100 feet of the project site, all existing and proposed easements, rights-of-way on and adjacent to the project site, and storm water facilities.
 - 2. The entire project shall be shown on one (1) sheet unless the project is too large to show sufficient detail. District acceptance must be granted to show the project on more than one sheet, and a key map to aid in drawing orientation and locating the sheet construction in relation to the overall project will be required on each sheet.
 - 3. Proposed project phasing for utilities and structures.
 - 4. Proposed point(s) of connection for sanitary sewer mains to the existing system(s). All existing sanitary sewer lines shall show existing manholes, complete with rim and invert elevations, and pipe diameter.
 - 5. Geotechnical bore locations shall be shown in plain view within the utility plans.
 - 6. Any other information deemed necessary by the Design Engineer or District.

2.3 FINAL CONSTRUCTION PLAN REQUIREMENTS

- A. Final Construction Plans shall contain the same information as indicated in the Preliminary Construction Plan Requirements section 2.02 of these Standards with additional requirements as outlined below and in the Kremmling Sanitation District Construction Plan checklist. After one (1) year from the original acceptance date, the District may require resubmittal of the plans for review and acceptance due to revised or updated Standards .
- B. District accepted easements or a District accepted final plat must be executed before final Construction Plan acceptance.
- C. One set of 22" x 34" or 24" x 36" plans shall be submitted to the District for acceptance signatures when all known issues have been addressed to the satisfaction of the District. Additional sizes may be accepted with prior approval. Once the plans receive District signatures, the Developer or their agents shall make copies of the signed plans and provide 3 copies to the District.
- D. An electronic version, in a format acceptable to the District, of the final Construction Drawings shall be provided to the District at the time of plan signatures.
- E. Sanitary sewer main designs shall be provided on separate plan and profile sheets specific to sanitary sewer.
- F. The Cover Sheet shall contain a signature line for various utility companies to be determined at the time of design if their facilities may be impacted or modified by the project.
- G. All utility verifications shall be in compliance with Section 9-1.5 C.R.S. as amended.
- H. "Call Utility Notification Center of Colorado (UNCC) at 1-800-922-1987 or dial 811 for utility locates 72 hours prior to any excavation work" shall be put on all drawing sheets.
- I. Conduit Plan
 1. The conduit plan serves to show all proposed utility conduits crossing public rights-of-way and easements. The conduit plan may be a separate sheet from the utility plan as requested by the District.
 2. Provide a general overview of the project, including but not limited to street names, street rights-of-way, all proposed and existing utilities, all proposed and existing easements, and lot and block numbers.
 3. Show all utility conduits crossing the public rights-of-way and easements and indicate the utility conduit diameter, number of conduits, depth of installation, and name of utility using the conduit.
 4. Add the following note to the conduit plan: "All utility conduit crossings of sanitary sewer lines shall be encased in High-Density Polyethylene (HDPE) or fusible C900-16 PVC Pipe, with

minimum Standard Dimension Ratio (SDR) 11 across the entire easement or right-of-way width. The encasement joint shall be butt fused. Flexible joints are not allowed.”

J. Construction Plan View

1. Clear distance between utilities shall be outside wall to outside wall.
2. Show and label proposed and existing easements, rights-of-way, and property lines.
3. Indicate the proposed method of connection to existing sanitary sewer collection systems.
4. Show all proposed and existing potable water, sanitary sewer, and non-potable irrigation services. Indicate the station of service locations on the potable water, sanitary sewer, and non-potable irrigation mains or include a tabular list of stations.

K. Pothole information of all water or sewer mainlines and impacted services. At critical locations and as determined by the District, with date including month and year, elevation, depth, and datum.

L. Construction Profile View

1. Show all existing and proposed utility crossings in compliance with Colorado Revised Statute 9-1.5 as updated. Existing utility crossing locations and elevations shall be obtained from the current project design field survey. Existing utilities shall be potholed as required to perform a complete and accurate design prior to construction plan acceptance. Field obtained elevations shall be provided on the Construction Drawings, complete with when the field information was gathered, the exact location where it was collected, the Firm that performed the potholing and surveying, and the date the survey was conducted.
 - a. Clear distance between utilities shall be outside wall to outside wall.
2. Where the potable water and sanitary sewer mains are within two feet vertically of each other, all water and sewer services that cross a main shall be shown.
3. Provide all pertinent information for existing utilities.
4. Provide pipe slope, manhole inverts in and inverts out (main and service line), and rim elevations and manhole stationing for proposed sanitary sewer lines.
5. Any other information deemed necessary by the Design Engineer or District.

M. Standard Drawing (Detail) Sheets

1. Include all project-applicable District Standard Drawings as part of the construction plans set. Sewer District Standard Drawings are provided in these Standards .
2. All District Standard Drawings shall contain the District name in the bottom corner. If any standard District detail is modified, the District name shall be removed from the detail and placed on a separate sheet before standard details. All modified detail shall be stamped by the Design engineer and approved by the District.
3. Where Standard Drawings are not applicable to the work, provide project-specific construction details. These shall include construction details of critical connections, atypical crossings, special fittings and appurtenances, and any other details deemed necessary by the Design Engineer or District.

- N. Requirements for Changes to Final Accepted Plans
 - 1. Should circumstances warrant changes from the District-accepted Construction Plans, acceptance of the changes shall be obtained from the District prior to construction.
 - 2. All modified drawings shall be on 22" x 34" or 24" x 36" sheets. Depending on the extent of the changes, the District will decide if revised plans are required.
- O. Wastewater Pumping Station (Lift Station) Final Construction Plans
 - 1. Lift station final construction plan requirements are specific to the design requirements of the lift station in addition to state and regional guidelines. Refer to Section 3.15 for lift station requirements.
 - 2. All lift stations shall be privately owned and maintained.
- P. Geotechnical bore logs and groundwater data shall be shown in the Construction Plans.

2.4 EASEMENTS

- A. When it is not feasible for sanitary sewer main installation to be in a dedicated street or alley right-of-way, the installation shall be made within a dedicated easement. The conditions for allowance of such an exception shall be determined for each individual case. The minimum easement width acceptable to the District is as follows:
 - 1. For a dedicated sanitary sewer main easement containing just one (1) main, the width shall be a minimum of twenty-five (25) feet or twice the depth to the invert of the pipe, whichever is greater. This easement shall be for the exclusive use by the District sanitary sewer mains. The easement name, which shall be "PERMANENT SANITARY SEWER EASEMENT", and the easement width shall be labeled on the Construction Drawings and plat.
 - 2. For any combination with two utilities, the total width shall be thirty-five (35) feet or twice the maximum depth to the invert of each utility, whichever is greater. This easement shall be for the exclusive use by the District. The easement name and the easement width shall be labeled on the Construction Drawings and plat.
 - 3. Where pipes of diameters greater than sixteen inches (16") are installed, additional easement width may be required to account for pipe width.
- B. The mains within the easement shall be located as centrally as feasible within the easement while maintaining required separation from other mains and accounting for the depths of mains where necessary.
- C. There shall be no detention ponds, berms greater than three (3) feet, trees, and/or shrubs with mature height greater than three (3) feet, permanent structures or fences allowed, or other obstructions that will impede the ability of the District to adequately maintain and service the main(s) located within the easement.
- D. Easements not dedicated with a plat shall be dedicated by separate document and recorded prior to District acceptance of the Construction Drawings. Easement dedication by separate document shall include:

1. Easement Dedication Agreement. An easement dedication agreement shall be completed by the Developer. The completed easement dedication agreement must be signed by the property Owner and notarized.
2. Exhibit Map. An exhibit map (8 ½" x 11") with sufficient description information to establish the legal boundary of the easement shall be provided. The exhibit map shall show and label all existing easements, property lines, and public rights-of-way. The District may request additional information, not listed here, for the exhibit at the Districts discretion.
3. A Written Legal Description of the dedicated easement boundary.
4. Funds for Recording. The Developer shall provide cash or a check made out to the Kremmling Sanitation District for the easement recording fees. The District shall provide the recording fee sum once all easement documents are finalized. The District does not provide the funds for recording easement documents.
5. Once the easement dedication documents are accepted by the District and the recording fees have been paid to the District in the appropriate amount, the District shall have the easement documents recorded in the real property records of Grand County, Colorado.

2.5 HYDRAULIC REPORT

- A. A hydraulic analysis for the sanitary sewer collection system for a given project shall be submitted by the Design Engineer, as a report, to the District for review and acceptance. The report shall be accepted by the District prior to final Construction Drawing acceptance. The hydraulic analysis report will be reviewed by the District, along with the Construction Drawings, in the same review and acceptance process as outlined in Section 1 of these Criteria. Projects that move forward to final design without a District-accepted sanitary sewer collection system hydraulic analysis report are subject to possible design changes, including but not limited to, pipe re-alignment, upsizing, extensions, and additional stub outs.
- B. The objective of the hydraulic analysis report is to assist the Design Engineer with designing a project's sanitary sewer collection system to adequately serve peak demands while adhering to the design requirements set forth in these Criteria. For the sanitary sewer collection system, the hydraulic analysis report evaluates peak flow quantities, flow type, pipe capacity, and flow velocity, and establishes appropriate pipe sizing.
- C. The written hydraulic report shall include the following information:
- D. Title Page
 1. Report title.
 2. Project name and location.
 3. The name, address, and phone number of the Owner, Developer, and Design Engineer that prepared the report.
 4. Report preparation date.

E. Engineer Certification Sheet

1. The report shall be prepared by or under the supervision of a Professional Engineer, licensed to practice in the State of Colorado, possessing adequate experience in the design of sanitary sewer collection systems. The report shall contain a certification sheet with the following statement to be signed and sealed by the Design Engineer:

“I understand the District’s acceptance does not relieve the Design Engineer’s responsibility for errors, omissions, or design deficiencies for which the District is held harmless.

Registered Professional Engineer
(Affix Seal)

F. Table of Contents

G. Project Description and Location

1. Clearly state the location of the project. Provide a site vicinity map specifying the project’s geographical location and the project area in acres. The project acreage shall be the same as on the project plat.
2. Clearly state the land use zoning, estimated number of residential lots or living units, commercial square footage, and the irrigated acreages.
3. Indicate if the project will be phased. Elaborate on the anticipated timing for each project phase and the phase’s associated building and infrastructure construction.
4. Identify the locations of all sanitary sewer connection points to the existing systems.
5. Provide the pipe diameter, pipe material, and year of installation for the existing sanitary sewer lines.

H. References and Appendices

1. Provide a page referencing all design criteria, resources, and modeling software used in preparing the hydraulic report.
2. Provide appendices as necessary to include modeling result printouts, copies of demand assumption data, and fire flow test results.

I. Sanitary Sewer System Design Requirements and Assumptions

1. Provide all used equations, demand assumptions, and essential design requirements, parameters, and constraints.
2. If a model is required, the model must be provided to the District upon request.
3. Provide calculations for estimated population, design flows, peaking factor(s), hydraulic design, infiltration, flow type, and any other necessary design calculations.

J. Sanitary Sewer Systems Analysis and Modeling

1. If the development is phased, the sanitary sewer system shall be analyzed for full build-out. This evaluation shall include the development’s sanitary sewer flows and anticipated offsite sanitary sewer flows impacting the sanitary sewer system within the development.
2. Evaluate the development’s sanitary sewer sizing capacity to convey offsite flows.

3. Undeveloped areas shall have sanitary sewer flows calculated based on the higher of the current or anticipated land use or zoning of the property.
 4. If determined by the District, existing downstream sewer main lines shall be flow tested at the expense of the developer to assure existing capacity is available in the existing main lines. Flow testing must be performed by a certified flow testing agency. Flow measuring devices shall be placed in manholes as determined by the District for a minimum of a 2-week period. The District must be present during the temporary installation of the monitoring devices. The district shall have access to the flow readings on a daily basis, and a final report shall be submitted to the District for review.
 5. If upsizing the District's existing infrastructure is necessary, it shall be constructed at the expense of the Developer.
 6. The District may require additional analysis, such as existing sewer main line videoing in order to further verify that the proposed sanitary sewer system will meet the design requirements and needs of the development and the District. The District will evaluate sanitary sewer system hydraulic evaluations on a case-by-case basis.
- K. Sanitary Sewer System Report Results
1. Provide a schematic layout of the sanitary sewer collection system showing and labeling all manholes, design points used for analysis, pipe slopes, and pipe sections.
 2. Provide written calculations or printouts of software analysis results for each pipe evaluation including the following information:
 - a. Pipe Diameter (in)
 - b. Material
 - c. Date of installation
 - d. Pipe Slope (%)
 - e. Sub and Super Critical Calculations, when a model is required
 - f. Manning's n Value
 - g. Pipe Discharge-(gpm)
 - h. Pipe Flow Velocity (ft/s)
 - i. Pipe Flow Depth (in)
 - j. d/D (depth of flow/diameter of pipe)
 - k. Maximum Capacity at d/D of 50% and/or 80% – (gpm) dependent on date of installation
- L. Sanitary Sewer System Conclusions
1. Discuss analysis results for all pipe evaluations.
 2. Confirm that acceptable pipe velocities and flow depth criteria are met.
 3. If design constraints arise and pipe velocity, flow depth, minimum allowable slope per pipe diameter, or any other Criteria requirements cannot be maintained, the Design Engineer shall provide the District written explanation as to why the Criteria is violated, why the non-standard sewer system design should be accepted, and request a variance to the Criteria. District acceptance is required for the variance.

4. Discuss any sanitary sewer main oversizing required over and above what is necessary for the development needs.
5. Discuss potential impacts that future upstream developments may have on the sanitary sewer capacity through the proposed development. Explain the capacity issues within the development and the proposed solutions for resolving them.

M. Supplemental Engineering Calculations

1. Any calculations deemed necessary by the Design Engineer or District.

N. Wastewater Pumping Stations (Lift Station) Design Report

1. Refer to Section 3.15 of these Standards and CDPHE for lift station design and approval guidelines and lift station design report requirements.

2.6 GEOTECHNICAL SAMPLING/TESTING, COMPACTION, AND SOILS REPORT

A. A geotechnical soils evaluation, prepared by or under the supervision of a Geotechnical Engineer, licensed in the State of Colorado, shall be submitted to the District for review and shall be accepted by the District prior to final Construction Drawing acceptance.

1. The geotechnical soils report shall describe the classifications and characteristics of the soils encountered on the project and include recommended methods of backfilling and compaction.
2. The Geotechnical Engineer shall evaluate groundwater conditions for the site and provide recommendations for sanitary sewer main groundwater barriers.
3. The geotechnical soils evaluations shall include information required to determine potentially corrosive soils.

B. Soil sampling/testing and compaction testing shall be performed by a licensed Geotechnical Firm with certified, qualified technicians.

1. Native materials are compacted to 95% of maximum dry density, as determined by Standard Proctor tests. Structural materials, like road base, require compaction to 95% of the Modified Proctor.
2. Compaction Test shall be performed every 200' of mainline trench section, one test at every service line at the edge of right-of-way and at every manhole. Test depths shall start 2' above pipe bedding and continue at 2' vertical intervals with one test at final grade. All test results shall be provided to the District weekly.

2.7 VERIFICATION SURVEY DRAWING REQUIREMENTS

A. Prior to paving, the Design Engineer shall provide the District with a survey of the installed sanitary sewer system. The purpose of this survey is to verify that the mains and appurtenances were installed per design and within allowable construction tolerances. Once the District has accepted the verification survey, the District shall give the Contractor written notice to proceed with paving construction. Verification Survey plans are not As-Constructed Record drawings. See section 2.8 of these Standards for As-Constructed Record Drawing requirements.

- B. The Verification Survey drawing(s) shall be prepared for easy modification and transition to final As-Constructed Record drawings.
- C. The Verification Survey drawings shall be modified from the original construction plan and profile sheets showing the design information as well as the surveyed information. The original design information shall be shown as “lined through” if as constructed conditions differs from approved construction plans. The surveyed information shall be located in the same area as the design information and shall be either “clouded” or made with a heavier line weight than the design information for clear differentiation.
- D. Verifications Survey drawings shall be prepared by a Professional Engineer. Surveyed elevations for the Verification Survey shall be obtained by a Colorado Registered Land Surveyor. The Surveyor shall obtain horizontal locations, surveyed elevations and information to the same precision and datum as design drawings.
 - 1. Sanitary sewer – Horizontal locations of manholes, diameter of manholes, sizes of installed pipe, invert elevations of all mainline pipes and services entering and exiting a manhole, distances between manholes, pipe slopes based on the surveyed invert elevations, and proposed manhole rim elevations.
 - 2. Utilities – Provide horizontal and vertical location of all existing and proposed utility crossings. Surveyed top of valve nut and valve nut key extension elevations. This information must be used to calculate top of pipe elevation based on the height of the installed valve bonnet, which varies due to pipe diameter and valve manufacturer.
 - 3. Any other surveyed information as required by the District.
- E. Construction tolerances shall be:
 - 1. Water System - Horizontal locations: ± 0.30 feet and Elevations: ± 0.30 feet
 - 2. Sanitary System - Horizontal locations: ± 0.30 feet and Elevations: ± 0.02 feet
- F. Survey measurement accuracy shall be:
 - 1. Horizontal locations: ± 0.10 feet
 - 2. Elevations: ± 0.01 feet

2.8 AS-CONSTRUCTED RECORD DRAWING REQUIREMENTS

- A. The Contractor and Design Engineer shall be responsible for recording As-Constructed information on a set of Record Drawings kept at the construction site. A representative of the Developer shall monitor construction to assure that changes in construction (as approved in writing) and other pertinent details, such as horizontal location of fittings and manholes, valves, top of pipe elevations, manhole inverts, service tap locations, pipe sizes, and depths are kept current on the As-Constructed Record Drawings.

- B. Where the construction is phased with a more than 30-day lapse between phases, As-Constructed Record Drawings shall be submitted to the District after each completed phase. The Construction Drawings for all future phases shall also reflect the “As-Constructed” conditions of the previous phases.

- C. At a minimum, the As-Constructed Record Drawings set shall include the following sheets from the original accepted Construction Drawings:
 - 1. Cover Sheet
 - 2. Utility Plan
 - 3. All sanitary sewer plan and profile sheets.
 - 4. All construction details and Kremmling Sanitation District Standard Drawings that were used in the construction of the sanitary sewer collection system.
 - 5. Landscape plans.

- D. The As-Constructed Record Drawings shall show the original design information as well as the As-Constructed information. The original design information shall be shown as “lined through”. The As-Constructed information shall be located in the same areas as the design information and shall be either “clouded” and/or made with a heavier line weight as the design information for clear differentiation. The month and year of the construction shall also be noted.

- E. A Colorado Registered Land Surveyor shall certify the As-Constructed horizontal locations and surveyed elevations of all items listed in section 2.7 of these Criteria in addition to:
 - 1. Final sanitary sewer manhole rim elevations and Inverts.
 - 2. Final top of water valve box elevations, top of pipe.
 - 3. Construction tolerances shall be evaluated based on the original design and District Standards
 - 4. Measurement tolerances shall be:
 - a. Horizontal locations: ± 0.10 feet
 - b. Elevations: ± 0.01 feet

- F. The project responsible Design Engineer and Land Surveyor shall observe construction, as required, in order to certify that the conditions and information recorded on the As-Constructed Record drawings is true and correct.

- G. The General Contractor for the project shall sign each drawing sheet of the As-Constructed Record plans set with the following statement:

I, _____, hereby state that this project was constructed to Kremmling Sanitation District accepted Construction Drawings and standards, as designed by the project Design Engineer, and as field staked by the project Land Surveyor. All deviations to the approved Construction Drawings, standards, design, or survey were so noted on field drawings and these were provided to the projects engineer for acceptance and inclusion in the As-Constructed Record Drawings.

Construction Company

Address

Authorized Representative

Title

Date

- H. A Professional Land Surveyor shall perform or directly supervise all field survey data collection to verify the As-Constructed conditions and shall stamp and seal each drawing sheet in the As-Constructed Record Drawing set with the following statement:

I, _____, hereby state that this project was field staked for construction per Kremmling Sanitation District accepted Construction Drawings and standards and in accordance with the project design. I certify that the field survey information obtained for the As-Constructed Drawings was obtained in accordance with the District current standards and is accurately represented on these As-Constructed Record Drawings.

Registered Professional Land Surveyor
(Affix Seal)

- I. A Professional Engineer shall review all the As-Constructed information for compliance with the original approved design and standards and shall stamp and seal each drawing sheet in the As-Constructed Record plan set with the following statement:

I, _____, hereby state that I have reviewed the As-Constructed information provided by the project Contractor and project Land Surveyor. I certify that, according to the information provided, the As-Constructed Record Drawings are in compliance with the Kremmling Sanitation District accepted Construction Drawings and standards and will function as designed.

Registered Professional Engineer
(Affix Seal)

- J. As-Constructed Record signed and sealed drawings shall be submitted to and accepted by the District prior to issuance of Substantial Completion, in the form of one electronic PDF version and one file package containing GIS spatial data. The two (2) year warranty period for the installed sanitary sewer system will begin after the Certificate of Substantial Completion has been issued by the District. The request for the Substantial Completion Certificate may be initiated by the District or requested by the Developer, but in all cases is the sole responsibility of the Developer.

- K. The District will compare the certified As-Constructed Record Drawing information with the approved Construction Drawings, previously submitted Verification Survey, and information the

District may be aware of during the construction process. Any corrections, additions, or omissions to the As-Constructed Record Drawings shall be provided to the Design Engineer who prepared the As-Constructed Drawings for changes.

- L. The Certificate of Substantial Completion will NOT be granted until the As-Constructed Drawings for sanitary sewer systems are accepted by the District.
- M. The Certificate of Final Acceptance occurs at the end of the two-year warranty period and final walk-through of the project, by a District representative and District Engineer.

2.9 REIMBURSEMENT FOR PUBLIC INFRASTRUCTURE DESIGN AND INSTALLATION COSTS

- A. The District reserves the right to require oversized mains to provide service for future needs. Reimbursement agreements may be entered into so that the developer can recover costs from future developments that would contribute flows to the oversized main.

2.10 SUBSURFACE UTILITY ENGINEERING

- A. All development and underground facilities shall meet or exceed the requirements of the Section 9-1.5-102 and 103, C.R.S..
- B. All sanitary sewer services must be locatable up to the structure using tracer wire. See standard details for the required tracer wire specifications.
- C. Sanitary sewer mains do not require tracer wire as they are electronically locatable by other means, including robots, sonde, and camera systems.

3 SANITARY SEWER COLLECTION SYSTEM DESIGN CRITERIA

3.1 GENERAL

- A. The purpose of this section is to provide information for the design and layout of a sanitary sewer collection system. Sanitary sewer collection system design shall be in accordance with the Standards .

- B. This section is not intended to be inclusive of all situations, and the Design Engineer may be required to use additional engineering judgment to meet the overall design intent for constructability and long-term operations and maintenance. These Standards typically apply to sanitary sewer mains twelve inches (12”) in diameter and smaller. The District Manager, reserves the right to make final determinations of the system design based on the best interests of the District’s system. Refer to standard detail drawings for additional design information.

3.2 DEFINITIONS

- A. SANITARY SEWER COLLECTION MAINS
 - 1. A sanitary sewer collection main is a sanitary sewer pipe that gathers wastewater flows directly from individual sanitary sewer services or private sewer mains and transports.

- B. SANITARY SEWER INTERCEPTOR LINES
 - 1. A sanitary sewer interceptor line is a sanitary sewer pipe that collects sewage flows from the collection mains and carries those flows to the wastewater treatment facility.

- C. SANITARY SEWER SERVICES
 - 1. Sanitary sewer services include all piping, fittings, and appurtenances used to convey sanitary sewage from the plumbing system of a structure to a sanitary sewer collection main.
 - 2. Sanitary sewer services are typically four inches (4”) or six inches (6”) in diameter.

3.3 DESIGN FLOW

- A. The sanitary sewer collection system shall be designed to carry peak wastewater flows plus infiltration/inflow in accordance with these Standards .
 - 1. Depending on a development’s location, consideration of upstream and offsite flow contributions may be required by the District to ensure proper sizing of the sanitary sewer collection mains within the development. This will be determined by the District on a case-by-case basis.

 - 2. Depending on the existing capacity and condition of the downstream sanitary sewer collection system, the District may require verification that the downstream sewer system can convey the development’s peak flows and require a videoing of the downstream system to verify condition. If the downstream capacity is inadequate, the Developer may be required to make appropriate

downstream sewer system upgrades. This will be determined by the District on a case-by-case basis.

3. Any infill or redevelopment project that is an intensification of use shall require the Developer to verify that the downstream sewer system can convey the development's peak flows. If the downstream capacity is inadequate, the Developer will be required to make appropriate downstream sewer system upgrades.

B. Design Flow

1. The wastewater flows presented in the following table are minimum criteria and the District reserves the right to modify these Standards, at any time, for the design of specific projects. Wastewater flows for uses not provided in the table shall be determined during system design.

Table 1: Sanitary Sewer Design Flow

Residential			
Use	Units Per Acre	Occupancy	Average Day Wastewater Flows
Single Family Large Lots	3	3.1 persons	0.13 gpm/unit
Single Family	5	3.1 persons	0.13 gpm/unit
Duplexes, Townhouses, Small Apartments	10	2.7 persons	0.11 gpm/unit
Multi Family Housing	20	1.7 persons	0.07 gpm/unit
Commercial			
Use	Average Day Wastewater Flows		
Commercial Low Density Retail	1,500 gpd/acre (minimum)		
Highway Commercial	3,000 gpd/acre (minimum)		
Retail/Offices	200 gpd/1,000 SF		
Hotels/Motels	350 gpd/1,000 SF		
Restaurants	500 gpd/1,000 SF		
Bars and Lounges	300 gpd/1,000 SF		
Department Stores	200 gpd/1,000 SF		
Laundry and Dry Cleaning	1,000 gpd/1,000 SF		
Banks	300 gpd/1,000 SF		
Nursing Homes	350 gpd/1,000 SF		
Warehouses	25 gpd/1,000 SF		
Car Washes with Water Reuse	1,500 gpd/1,000 SF		
Auto Dealer/Repair/Service	115 gpd/1,000 SF		
Grocery Stores	430 gpd/1,000 SF		
Religious Buildings	300 gpd/1,000 SF		
Factories	800 gpd/1,000 SF		
Hospitals	380 gpd/1,000 SF		
Schools (without showers)	12 gpd/student		
Schools (with showers)	36 gpd/student		
Industrial use determined on a case by case basis			

2. All flows used in the design of sanitary sewer collection systems are subject to approval by the District.

C. Peaking Factor

1. A domestic peaking factor shall be obtained from ASCE Peak Flow Curve G:

$$P_f = \frac{18 + \sqrt{P}}{4 + \sqrt{p}}$$

Where P = Population in thousands (example: P = 2 for population of 2,000)

$$P_f = \frac{18 + \sqrt{\frac{F}{60,000}}}{4 + \sqrt{\frac{F}{60,000}}}$$

Where F = Flow in gallons per day (average day wastewater flow per capita)

3.4 INFLOW AND INFILTRATION (I&I)

- A. Inflow and Infiltration (I&I) is extraneous water flow that enters the sanitary sewer collection system.
 1. Infiltration is water entering the sanitary sewer collection system from the ground through service connections, defective pipes, pipe joints, and manhole connections.
 2. Inflow is unintentional water entering the sanitary sewer collection system from roof drains, underdrains, surface stormwater runoff, and natural drainage. Any direct connections to the sanitary sewer system shall be removed and directed to the appropriate locations.
- B. 200 gallons per day per inch-diameter per mile of pipe shall be added to the peak design wastewater flow as the allowance for I&I.
- C. 500 gallons per day per inch-diameter per mile of pipe located in groundwater shall be added to the peak design wastewater flow as the allowance for I&I.
- D. I&I flows are not subject to a peaking factor.

3.5 HYDRAULIC DESIGN

- A. The required pipe size shall be computed by Manning's Equation below:

$$Q = \frac{1.49}{n} AR^{2/3} \sqrt{S}$$

Where:

Q = Flow (cfs)

n = Manning's Coefficient of 0.013

A = Area of Flow (ft²)

R = Hydraulic Radius (A/P)

Where: P = Wetted Perimeter
S = Slope of pipe (ft/ft)

- B. All sanitary sewer collection mains shall be designed to a maximum depth of flow, depending on age.
 - 1. Half full ($d/D=0.5$) for all mains constructed prior to 2022 due to historical tap locations on the mark.
 - 2. 4/5 full ($d/D=0.8$) for all new developments.

Where:

d = Depth of Flow

D = Diameter of Pipe

- C. Minimum design velocity at peak flow shall not be less than two (2) ft/s or greater than seven (7) ft/s. Where two (2) ft/s is not feasible, the minimum slope shall be one percent (1%) slope for an inch (8”) pipe.
 - 1. Sewer shall be designed for velocities less than seven (7) ft/s whenever possible and for subcritical flows whenever possible.
 - 2. When conditions require velocity to be greater than seven (7) feet per second, special provisions shall be made to avoid scour and protect against displacement caused by erosion or impact.
- D. When lines are ten inches (10”) and larger, Developer shall analyze flows for hydraulic jumps and special provisions shall be made to avoid H₂S and protect against its effects.

3.6 SANITARY SEWER MAIN SIZE AND SLOPE

- A. The following table shows the minimum allowable slopes per sanitary sewer main diameter. These minimum slopes may be used provided that the hydraulic design requirements in Section 3.5 of these Standards are met.

Table 2: Minimum Sanitary Sewer Main Slopes (ASCE)

Pipe Diameter (in)	Minimum Slope (%)
8	0.40%
10	0.28%
12	0.22%
15	0.15%
18	0.12%
21	0.10%

- B. The maximum slope for any sanitary sewer collection main shall be five percent (5%).

- C. The District requires sanitary sewers to maintain a consistent slope throughout the sewer alignment in order to maintain capacity.
- D. All proposed sanitary sewers shall maintain the same inner diameter (ID) pipe size to match the existing District collection system; no downsizing shall be allowed.
- E. The District may require the Developer to install a sanitary sewer collection main larger than is needed to adequately service the development.

3.7 DEPTH OF BURY

- A. Sanitary sewer collection mains shall have eight (8) feet minimum depth of cover from the top of the pipe to the finished ground surface.
- B. Where grading, existing field conditions, or service constraints demonstrate that a sanitary sewer main must have less than eight (8) feet of cover or when sewer main installation is deeper than twenty (20) feet at the invert, refer to Section 3.10.
- C. Installation of sanitary sewer mains with depths greater than twenty (20) feet at the invert shall require written approval from the District after all reasonable effort is made to keep depths to less than twenty feet.
- D. Where the elevation difference between the top of the foundation and the top of the sanitary sewer collection main is less than eight (8) feet, the Construction Drawings and the plat shall indicate the lot is served by a "shallow sewer," and appropriate elevation information shall be given.

3.8 LOCATION OF SANITARY SEWER COLLECTION MAINS

- A. All sanitary sewer collection mains shall be located in dedicated street or alley rights-of-way. Any other sanitary sewer collection mains shall be in a dedicated easement of appropriate width (refer to Section 2.4). District approval is required for all proposed locations.
- B. Sanitary sewer collection mains shall not be located under any raised medians.
- C. The centerline of sanitary sewer collection mains shall not be placed closer than five (5) feet to the lip of the street gutter without prior acceptance by the District. The sewer collection mains centerline should avoid traffic wheel paths where feasible.
- D. Sanitary sewer collection mains shall extend to the upstream extremities of the property or subdivision being served. Main extensions shall be in appropriate locations to provide adequate sanitary sewer system connections for adjacent, future developments.
 - 1. A sanitary sewer collection main serving one (1) lot shall extend all the way across the frontage for that lot.

2. The District may grant exceptions to sanitary sewer collection main extensions if development of an adjacent property is located in a different sewer basin, or if the property can currently connect to the sanitary sewer system. This will be determined by the District on a case-by-case basis.
 3. Sanitary sewer mains shall be extended offsite when required to tie into the existing collection system.
- E. Sanitary sewer collection mains shall be straight between manholes, both in alignment and slope.
- F. Stormwater and underdrain piping shall be distinguishable by color from sanitary sewer collection mains.

3.9 SANITARY SEWER COLLECTION SYSTEM PHASED INSTALLATION AND STUBOUTS

- A. Sanitary sewer collection system phasing, if proposed by the Developer, shall be clearly identified on the master utility plan. Sewer plan and profile sheets shall clearly show and label the phasing transitions in the sanitary sewer main design.
- B. The phased sanitary sewer collection system shall be designed for full build-out of the development being served including any additional offsite flows that must be passed through the development. Stub-out shall be designed for future development flows.
- C. Phased sanitary sewer main or stub-out construction shall be extended a minimum of ten (10) feet beyond phased street paving to avoid asphalt removal during excavation for future connections.
- D. A stub-out for future connection shall be provided for an adjoining phase or adjacent future developments.
- E. The stub-out design and installation shall maintain both vertical and horizontal alignment in accordance with these Criteria. The stub-out shall be shown on the sanitary sewer plan and profile sheets with the length and end of pipe invert labeled.
- F. The end of the stub-out shall be sealed with a removable watertight plug restrained by half (1/2) a cubic yard of concrete behind the plug until the time of future connection.
- G. The maximum length of a stub-out shall be forty (40) feet unless otherwise approved by the District. If the maximum stub-out length must be exceeded, the sewer main installation shall end at a terminal manhole or be extended to the next upstream manhole.
- H. Sanitary sewer main stub-outs not utilized shall be abandoned.

3.10 PIPE MATERIAL AND INSULATION

- A. Sanitary sewer collection mains shall be polyvinyl chloride (PVC) SDR 35 pipe suitable for sanitary sewer flows.

- B. Alternative pipe materials shall only be used in the following situations:
 - 1. Where sanitary sewer collection mains are installed less than four (4) feet from the finished ground elevation to the top of the pipe, approval by the District is required.
 - a. The pipe material shall be SDR 26 with flow fill from the bottom of the trench to one (1) foot above the top of pipe, and the full trench width, and manhole to manhole.
 - 2. Where sanitary sewer collection mains are installed deeper than twenty (20) feet at the invert, SDR 26 shall be used.
 - a. For alternative pipe material installation situations, external load (earth and live load) analysis is required to verify that the minimum alternative pipe material is suitable for the specific project conditions. If the alternative pipe material is unsuitable, the Design Engineer shall specify an acceptable pipe material. External pipe load calculations shall be submitted to the District for review and acceptance.
 - b. The length of the alternative pipe material to install shall be called out on the Construction Drawings.

- C. Changes between pipe materials are not permitted along a continuous sewer main. The alternative pipe material shall be installed from manhole to manhole.

- D. All sewer main lines and service lines less than eight feet (8') deep from the top of the pipe to the final grade must be foam /blue board insulated. The two-inch (2") foam board is required for every one foot (1') of cover less than eight feet (8'), both above the pipe bedding and along the trench side in the bedding zone, see standard detail for installation requirements. The foam board must cover the entire pipe trench width.

- E. To allow new connections to mains that are damaged, the main shall be replaced or rehabilitated per specifications from the upstream to the downstream manhole.

3.11 MANHOLE LOCATION AND SIZE

- A. General
 - 1. Manholes shall be installed at every change in direction, slope, or connection with other sanitary sewer collection mains.
 - 2. There shall be no more than three (3) lines designed to discharge into any one manhole. This includes both main and service lines.
 - 3. The Design Engineer shall determine if conditions require an interior protection on the manhole from microbial induced corrosion. Acceptable protections for new construction are polymer concrete, concrete with Xypex Bio-San C500 admixture, or approved HDPE manhole liner systems. Acceptable protections for existing manholes are polymer concrete liner systems or coatings. District reserves the right to require additional locations where interior coatings may

be required. Locations that require interior manhole protections may include, but are not limited to:

- a. Locations where a hydraulic jump may occur and the next downstream manhole.
 - b. Every drop manhole and the next adjacent downstream manhole.
 - c. Any manhole where invert slope exceeds five percent (5%) or velocities exceed 5 ft/s or where flows change from supercritical to subcritical.
4. Buoyancy calculations shall be provided for manholes and pipes where groundwater may be encountered, has been identified in the geotechnical report, is located in the floodplain or other water sources are present. The manhole shall be sealed from the outside with an approved seal wrap, where groundwater or other water sources are present.
 5. Connection and modifications of existing manholes that are constructed of bricks or show signs of damage shall be replaced or rehabilitated and coated per specifications.

B. Manhole Location

1. All manholes shall be located in dedicated street right-of-way or within a dedicated easement of appropriate width (refer to Section 2.4). District approval is required for all other proposed manhole locations.
2. The center of manholes shall not be placed closer than eight (8) feet to the lip of the street gutter without prior acceptance by the District.
3. The edge of the manhole cover shall be located a minimum of five (5) feet from the edge of cross pans, wherever feasible.
4. Manholes located outside of the street section shall be located in areas not subject to flooding, stormwater conveyance, ponding or detention.
 - a. If locating manholes in stormwater conveyance areas cannot be avoided, a solid, watertight, bolt down manhole cover with an integral rubber gasket shall be used.
 - b. Manholes located within the one hundred (100) year flood plain shall have a solid, watertight, rubber gasket, bolt-down manhole cover. The manhole cover and grade ring shall be bolted to the manhole cone, and all manhole joints and grade rings shall be sealed from the outside with an approved seal wrap.
 - c. All Manholes shall have all manhole joints and grade rings sealed from the outside with an approved seal wrap, and the entire outside of the manhole sprayed or brushed with damp proofing material when groundwater is present.
5. Manholes outside of road rights-of-way shall be provided with direct access by means of an all-weather road. All-weather road requirements are as follows:
 - a. All-weather roads shall be designed to support District maintenance vehicles up to thirty-five (35) tons with a minimum turning radius of sixty (60) feet.
 - b. At a minimum, all-weather roads shall be ten (10) feet wide with six (6) inches of compacted aggregate base course. Subgrade preparation, compaction, and aggregate base course shall be in accordance with the requirements of the geotechnical report.
 - c. If the all-weather road is longer than fifty (50) feet and does not have a public road access from both ends, an appropriately sized turnaround shall be provided.

- d. The Design Engineer shall verify that these minimum requirements for the all-weather road are suitable for the specific project conditions.
- e. The all-weather road shall be located in a dedicated sanitary sewer or access easement.

C. Manhole Size and Spacing

- 1. The following table displays the diameter of standard manholes and the maximum manhole spacing for each sanitary sewer pipe diameter:

Table 3: Standard Manhole Diameter and Spacing

Sewer Pipe Diameter (in)	Manhole Diameter (ft)	Manhole Spacing (ft)
8	4	400
10	4	400
12	4	400
15	5	400
18	5	400
21	5	400

- 2. The following table displays the diameter of inside drop manholes. Use standard manhole spacing from Table 3 for inside drop manhole spacing. Inside drop manhole shall only be allowed for utility conflicts and pipe sizes up to eight inches (8"). District approval is required for all other proposed inside drops.

Table 4: Inside Drop Manhole Diameter

Inside Drop Pipe Diameter (in)	Manhole Diameter (ft)
4 or 6	4
8	5

3.12 MANHOLE INVERTS

- A. The minimum elevation drop across a manhole shall be one-tenth of a foot (0.1 ft) except where cast-in-place manholes are to be installed over existing sanitary sewer mains. In such cases, the existing sanitary sewer pipe grade determines the elevation drop across the manhole, by constructing the cast-in-place manhole over the existing, straight sewer main and removing the upper half of the pipe.
- B. Where a smaller sanitary sewer main joins a larger one, the smaller sanitary sewer main crown elevation shall match the crown elevation of the larger sanitary sewer main. This includes sanitary sewer service lines.

- C. Where the invert elevation difference between the invert in and invert out is twenty-four inches (24") or more and eight inches (8") or smaller pipe size, an inside drop apparatus shall be constructed.
- D. Sanitary sewer mains and services entering a manhole with less than twenty-four inches (24") but greater than six inches (6") of elevation difference between the invert in and the invert out shall be avoided. If unavoidable, the invert shall have a sloping bench to prevent solids deposition.

3.13 GROUNDWATER BARRIERS

- A. Groundwater barriers shall be installed across the sanitary sewer collection main, ten (10) feet upstream of every manhole, in areas where sanitary sewer collection mains are below groundwater and as recommended by the Geotech Report.

3.14 SANITARY SEWER SERVICES

- A. General
 1. Sanitary sewer service lines shall not be installed in trenches with dry conduits/utilities. A service line shall be separated from other conduits a minimum of five (5) feet horizontally and eighteen inches (18") vertically.
 2. Sanitary sewer service lines shall not be installed in trenches with wet conduits/utilities. A service line shall be separated from other conduits a minimum of ten (10) feet horizontally and eighteen inches (18") vertically.
 3. Sanitary sewer services for a given lot must be tapped on the sanitary sewer collection main within the confines of the extended property lines. The sanitary sewer service line shall be located a minimum five (5) feet inside the property being served and should not be installed under driveways.
- B. Sewer Services and Cleanouts
 1. Sanitary sewer services shall be polyvinyl chloride (PVC) SDR 35 pipe.
 2. Sanitary sewer services are four inches (4") or six inches (6") in diameter and shall have a minimum slope of one percent (1%) (1/8" per foot).
 3. The maximum allowable slope for a sanitary sewer service is eight percent (8%).
 4. If a sanitary sewer service line is required to be greater than six inches (6") in diameter, its design and connection to the existing sanitary sewer system shall be considered as a collection main. Even though the sanitary sewer service is larger than six inches (6") in diameter, it is still considered private and maintained by the property owner.
 5. A separate sanitary sewer service line must serve each structure.
 6. No sanitary sewer service lines shall cross property lines.
 7. Compound sanitary sewer services shall be avoided where feasible.
 8. Sanitary sewer service connections at manholes shall be avoided where feasible.
 9. Sanitary sewer services shall be located a minimum of ten (10) feet downstream of the potable water service, wherever feasible.

10. Sewer cleanouts shall be placed on any service line greater than one-hundred feet (100'), and must meet the requirements of building codes.
11. The sanitary sewer service line shall be electronically locatable and have tracer wire installed per Standard Detail Drawings.
12. Tapping new connections to the existing sanitary sewer system shall be observed by a District Representative.
13. Sanitary sewer service connections to the sanitary sewer collection main shall be made with a tee or tapping saddle and shall be separated by at least five (5) feet along the sewer main length, including when connections are on opposite sides of the sanitary sewer collection main.
14. Sanitary sewer service clean-outs are not permitted in the public right-of-way or sanitary sewer easement.
15. Sanitary sewer service connections to collection system interceptors or trunk lines are not permitted unless approved by District.
16. Connections or use of existing Services lines with I&I or conditions that inhibit its use may be required to be replaced or be lined at the discretion of the District.

3.15 SANITARY SEWER LIFT STATIONS AND FORCE MAINS

- A. All lift stations with capacities of two thousand (2,000) gallons per day (gpd) or greater are subject to CDPHE Regulation 22.
- B. Cost Responsibilities
 1. Design and Construction
 - a. The Developer shall be solely responsible for all costs associated with the design and construction of the lift station and force mains. This includes the cost of any easements, land acquisition, and documents associated with permitting approval through CDPHE.
 2. Operations and Maintenance
 - a. Private Facilities: Private lift stations are defined as any lift station serving one or more users.
 - b. Lift stations shall be privately owned and maintained, unless accepted by the District on a case-by-case basis.
- C. Planning and Permitting
 1. General
 - a. Gravity-based solutions are preferred to lift stations as they provide the most reliable and lowest cost service for customers. The use of a lift station and force main shall be evaluated on a case-by-case basis. If there is an appropriate gravity solution, then the developer shall design and construct the proposed improvements meeting the Kremmling Sanitation District Criteria. Any lift station or force main shall first be approved by the District following proper justification by the Developer. Where a lift station is determined to be required, it shall be designed to allow for an eventual connection to a gravity system.

- b. The lift station and force main design shall adhere to state and regional approval processes, and the Developer shall keep informed and notify the District of major milestones during the design and approval processes. The Developer shall adhere to the submittal requirements previously stated in Section 2 of these Criteria.
2. Procedures
- a. The Developer shall employ the services of an engineer licensed in Colorado who has successfully designed and permitted at least two lift stations of similar size as proposed, within the State of Colorado. The Developer and the engineer shall adhere to the following procedures through the planning and design phases:
 - i. Coordinate a conceptual project meeting with the District to provide justification for the project and initial design considerations, including site location, force main alignments, land acquisition requirements, preliminary design criteria, project schedule, and permitting requirements.
 - ii. Upon initial conceptual acceptance for consideration of the need for a lift station, provide written project justification for the project and design considerations, including site location, force main alignments, land acquisition requirements, preliminary design criteria, project schedule, and permitting requirements.
 - iii. Attend follow-up meeting following completion of the review of conceptual documents.
 - iv. It is the expectation that the developer keep the District informed of the project's progress from design through construction approval. This includes notifying the District of the major project milestones associated with the CDPHE review and approval process and allowing for District review of major reports and documents. Major milestones include, but are not limited to:
 - Signed and approved Site Application submitted to CDPHE
 - Basis of Design Report (BDR) submittal to CDPHE
 - Design approval from CDPHE
 - Funding requests
 - Public meetings/outreach
 - v. Upon the District's review and acceptance of the conceptual design, the applicant may proceed with the Lift Station Site Application process in accordance with CDPHE Regulation 22.
- D. Following local agencies approval of the Site Application, the applicant shall submit the Site Application and required counterparts in accordance with Regulation 22 to CDPHE for review and approval.
1. The Lift Station BDR shall be reviewed by the District prior to submitting the BDR to CDPHE for review and approval. The BDR shall include at least a 60 percent design package and shall only be submitted to CDPHE upon District approval of 60 percent design package.

2. Prepare and deliver final design plans and technical specifications for the District's review and approval.
 3. Applicant shall coordinate with the District through the construction bidding process as necessary.
 4. Applicant shall coordinate construction inspections with District Inspectors.
 5. Applicant shall submit all construction submittals for review, including shop drawings and data and operation and maintenance manuals.
 6. Applicant shall coordinate with the District for start-up testing and required training.
 7. Applicant shall submit final record drawings to the District in AutoCAD and pdf format.
- E. Colorado Department of Public Health and Environment
1. The design and construction of all lift stations and force mains shall adhere to CDPHE's most recent version of Regulation 22 – Site Location and Design Approval for Domestic Wastewater Treatment Works (The District reserves the right to review all procedures and reports required under Regulation 22 and request revision if necessary. Where CDPHE's Regulation 22 and the Standards differ, the more restrictive of the conditions shall apply).
- F. Kremmling Sanitation District
1. The Developer shall coordinate with the following town and county departments to ensure all procedures and policies are adhered to.
 - a. Water Department
 - b. Engineering Review
 - c. Planning Department
 - d. Building Inspections
 - e. Other Departments as Required
- G. Lift Station Design Criteria
1. Applicable Codes, Environmental Compliance, and Health and Safety
 - a. Applicable Codes: For work done in the District, work shall be performed in accordance with these Standards and the codes of the respective jurisdiction having authority .
 - b. Environmental Compliance: Environmental assessments and/or environmental reviews may be required as a preliminary investigation to determine if a particular parcel of real property is subject to recognized environmental constraints, such as, and not limited to, the following: floodplain areas, wetlands, endangered species, and hazardous conditions. Should environmental constraints exist as identified above, it is the Developer's responsibility to incorporate mitigation measures to comply with environmental requirements in accordance with applicable and current rules and regulations.
 - c. Health and Safety: Public lift stations are required to conform to all OSHA health and safety requirements. Operation staff safety shall also be considered during the design and construction of the lift station including, but not limited to:
 - i. Readily accessible equipment placement for maintenance activities

- ii. Classified areas in accordance with the National Fire Protection Association (NFPA) 820 Regulations
 - iii. Lifting assistance for heavy equipment
 - iv. Nonslip floor finishes
 - v. Handrails
 - vi. First-aid and safety equipment
 - vii. Fall protection
2. Limitation of confined spaces – it is desired by the District to limit confined space entries where possible
3. Determination of Wastewater Flows
 - a. Existing wastewater flows shall be calculated using the calculation methods stated in Section 3.5. Should the project area not fit the previously stated design flow estimation methods, applicable and industry-standard calculation methods shall be utilized. Methods include real-time flow monitoring or calculations based on land use. Methods and calculations shall be included in relevant planning documents and subject to the District’s review.
 - b. Proposed and future wastewater flow projections shall be estimated for the build-out conditions of the service area. Estimation methods shall be based on projected land-use. The planning period and projected land-use within the service area shall be coordinated with the District during the planning phases.
 - c. Organic and other applicable wastewater constituent loadings shall be considered and evaluated based on existing and projected land use. It is the Developer’s responsibility to calculate based on the most current available information, flows and constituent loadings for assessing available sewer and wastewater treatment capacities.
4. Impacts on Downstream Lift Stations or Sewer Capacities
 - a. Ultimate peak hour design flows shall be used to determine the impact to the downstream collection system infrastructure, including treatment facilities, lift stations, and sewers. Existing infrastructure needs to be able to accommodate peak flows and loadings from new lift stations and force mains. The capacity of existing infrastructure to accommodate flows from new lift stations shall be justified to the District as part of the planning and design documents.
5. Lift Station Capacity
 - a. Lift station capacity shall be designed to accommodate existing and future projected peak flows for the entire service area.
 - b. Hydraulic calculations and system/pump curves require consideration and shall be submitted for review during the planning phases to the District and as part of the CDPHE’s approval process.
 - c. Receiving sewers shall be evaluated to ensure adequate capacity to accommodate the ultimate lift station flow.
6. Emergency Storage
 - a. The lift station shall be designed for at least sixty (60) minutes of emergency storage at peak hour flow conditions or as required by CDPHE. Emergency storage can utilize volume

within the wet well above the high level alarm and upstream collection system piping, provided that it is demonstrated that back-up will not occur into any existing or potential future service connections or taps. No future taps shall be constructed within the section of influent sewer or sewers to the lift station designated to provide emergency storage. If a piping connection is required to accommodate emergency storage provisions, the invert of the pipe connecting the wet well to emergency storage shall be above the high-level alarm. Additional emergency storage may be required at the discretion of the District based on site location, emergency response time, and potential environmental concerns.

- b. Emergency storage can be accomplished using an additional storage vault structure. The emergency storage structures shall provide adequate access and floor slope for cleaning and shall be designed with pre-cast concrete, cast-in-place concrete, fiberglass reinforced plastic, or other approved materials. If constructed of concrete, adequate protection (i.e. polymer concrete or concrete admixtures) shall be provided to mitigate corrosion caused by hydrogen sulfide. If used, the emergency storage vault shall be designed to provide flow to and from the wet well to the vault and with adequate access for pumping via vacuum truck or other appropriate method.
- c. If emergency storage can be accomplished through gravity flow from the lift station to another existing collection system, the District may consider that as an option to meet emergency storage requirements. It shall be demonstrated that the gravity overflow, existing collection system, and downstream facilities be adequately sized to accept increased flow. Additionally, should the collection system be operated by another entity, a legal agreement stating the entity can and shall receive emergency flows shall be coordinated and presented to the District during the design review process.

H. Force Main Design Criteria

1. Materials and Sizing

- a. Force main material shall be AWWA C900-16 with minimum wall thickness of at least DR-25. DR-18 or DR-14 shall be required if pressure or surface loading at any location in the system exceeds the DR-25 pressure rating.
- b. Force mains shall be a minimum four inch (4") diameter. Force mains shall be sized appropriately for a minimum fluid velocity of two feet (2') per second and a maximum velocity of seven and a half feet (7.5') per second. Sizing shall also conform to CDPHE design requirements, whichever is most limiting. Parallel force mains are strongly preferred by the District for maintenance procedures, emergency conditions, and capacity optimization between existing and build-out flows. If parallel force mains are not considered feasible for a specific installation, it shall be demonstrated that the force main diameter is optimal for existing and build-out flow velocities.
- c. If force main diameter is such that the wastewater velocity is less than two (2) feet per second at initial operating conditions, the design shall include VFDs on the pumps to allow the motors for the pump or pumps to increase frequency to increase the wastewater velocity in the force main to be a minimum of three (3) feet per second for a minimum flushing time of five (5) minutes.

- d. Force main clean-out access shall be provided every five hundred feet (500') in situations where the force main is nine hundred and fifty feet (950') or longer. Clean-outs shall provide adequate access to allow for pipeline condition observations via video camera and maintenance.
- 2. Force Main Alignments and Separation
 - a. The minimum buried depth of the force main shall be eight feet (8') from top of pipe, lines less than eight feet (8') deep from the top of pipe to the final grade must be foam /blue board insulated. The 2" foam board required for every 1' of cover less than 8', see standard detail for installation requirements.
 - b. Wastewater force mains shall adhere to CDPHE and District standards for separation between potable water lines and other utilities. Wastewater force mains shall travel below existing potable water lines, meeting the minimum requirements as outlined in Section 3.15. Should minimum separation requirements not be possible, encasement may be required.
 - c. Should the wastewater force main alignment be such that it cannot accommodate these separation requirements vertically or horizontally, provisions shall be provided to safeguard the existing utilities in accordance with the District design criteria and construction standards.
- 3. Special Permitting Requirements
 - a. In situations where the force main alignment crosses areas that include wetlands, floodplains, irrigation ditches, railroads, and waterways, the Developer shall be responsible for all permitting during the design phase to ensure that local and state requirements are adhered to. The Developer shall document all required permits with the District prior to proceeding with construction. In all cases, the Developer shall evaluate alternative force main alignments to minimize impact to sensitive areas described herein.
 - b. Easements required for the force main alignment shall adhere to Section 2.4 of these criteria. All easements required for the force main shall be approved by the District and granted to the District prior to District approval of construction documents.

4 CONSTRUCTION SPECIFICATIONS

4.1 SUBMITTALS

4.1.1 General

- A. This Section includes provisions for Contractor submittals. Additional provisions may be included in specific Specifications Sections.
- B. This Section contains general information pertaining to the processing of submittals. Additional detailed submittal requirements are contained within the individual technical Specifications Sections.
- C. Submittals shall be submitted District Engineer in an electronic file using the software and system designed by the District.
- D. This Section specifies the general methods and requirements of submissions applicable to the following work-related submittals: Shop Drawings, Product Data, Manuals, Samples, Certificates of Compliance, Statements of Qualifications, Test Results, Survey Data, Calculations and Construction or Submittal Schedules. Detailed submittal requirements will be specified in the technical Specifications sections.
- E. All submittals shall be clearly identified by reference to Specification Section, Paragraph and Drawing No. or Detail as applicable. Submittals should be clear, legible and of sufficient size for presentation of data. The "Submittal Transmittal Form" and the "Certification Statement" to be used with each submittal is included at the end of this Section.
- F. Prepare, maintain, and submit submittal logs as specified herein.

4.1.2 Submission of Shop Drawings, Product Data, and Samples

- A. Shop Drawings
 - 1. Shop drawings include, but are not necessarily limited to, custom-prepared data such as fabrication and erection/installation (working) drawings, design calculations, lists, graphs, operating instructions, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certifications, as applicable to the work.
 - 2. All details on shop drawings submitted for approval shall show clearly the relation of the various parts of the work and control lines, and where correct fabrication of the work depends upon field measurements such measurements shall be made and noted on the drawings before being submitted for approval.

B. Product Data

1. Product data as specified in individual Sections include, but are not necessarily limited to, standard prepared data for manufactured products (sometimes referred to as catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliance and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare-parts listing and printed product warranties, as applicable to the work.

C. Samples

1. Samples specified in individual Sections include, but are not necessarily limited to, physical examples of the work, such as sections of manufactured or fabricated work, small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets, specimens for coordination of visual effect, graphic symbols and units of work to be used by the District for independent inspection and testing, as applicable to the work.

4.1.3 Contractor's Responsibilities

- A. The Contractor shall prepare, approve, sign and submit to the District or Engineer of Record any and all Shop Drawings, Manufacturers' Project Data, Certificates, Wiring Diagrams, Operation and Maintenance Manuals and Samples required by the Contract Documents. NOTE: All references in the Technical Sections under "Shop Drawings" or "Submittal" to the words "approval of" shall mean "reviewed by".
- B. The Contractor, by preparing, reviewing, approving and submitting the Shop Drawings, Manufacturers' Product Data, Certifications, Wiring Diagrams, Operation and Maintenance Manuals and Samples, represents that the Contractor has determined and verified all materials, field measurements and construction criteria related thereto, and has checked and coordinated the information contained within such submittals with the requirements of the Work, the Project and the Contract Documents.
- C. The Contractor shall inform the District or Engineer of Record, in writing, of any and all deviations and/or questions regarding the Contract Documents, and shall properly identify these areas of concern in the letter of transmittal of the Shop Drawings, Manufacturers' Product Data, Certification, Wiring Diagram and Samples for proper written disposition respectively by the Engineer of Record. The Contractor shall provide reproducible Shop Drawings.
- D. All Shop Drawings, Manufacturers' Product Data, Wiring Diagrams, Certifications, Operation and Maintenance Manuals and Samples submitted, shall be accompanied by a preprinted standard

transmittal form with submittal number, and shall be addressed to the District or Engineer of Record to be received and filed.

- E. The Contractor is not relieved of the responsibility for any deviation from the requirements of the Contract Documents by virtue of the Contractor's approval and submittal of the Shop Drawings, Manufacturers' Product Data, Wiring Diagrams, Operation and Maintenance Manuals, and Samples to the District or Engineer of Record. All deviations and/or interpretations of the Contract Documents must be approved in writing by the District or Engineer of Record.
- F. The review of the Shop Drawings, Manufacturers' Product Data, Certifications, Wiring Diagrams, Operation and Maintenance Manuals; and Samples by the District or Engineer of Record does not relieve the Contractor of its responsibility from any requirements of the Contract Document, or any errors or omissions in such submittals, or for any failure to perform the requirements and intent of Contract Documents. The Contractor shall be responsible for a fully functional system as intended by the Contract Documents.
- G. The Contractor shall review shop drawings, product data and samples, including those by subcontractors, prior to submission to determine and verify the following: 1. Catalog numbers and similar data. 2. Conformance with the Specifications.
- H. Each shop drawing, sample and product data submitted by the Contractor shall have affixed to it the following Certification Statement including the Contractor's Company name and signed by the Contractor: "Certification Statement: By this submittal, I hereby represent that I have determined and verified all materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements." The cover sheet shall fully describe the packaged data and include a listing of all items within the package. Provide to the District or Engineer of Record a copy of each submittal transmittal sheet for shop drawings, product data, and samples at the time of submittal of said drawings, product data and samples.
- I. The Contractor shall utilize a submittal identification numbering system. Clearly identifying the Submittal number, Product, and Date.
- J. Notify the District or Engineer of Record in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.
- K. The review and approval of shop drawings, samples or product data by the District or Engineer of Record shall not relieve the Contractor from their responsibility regarding the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the District and Engineer of Record will have no responsibility thereof.
- L. No portion of the Work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item.

Fabrication performed, materials purchased or on- site construction accomplished which does not conform to approved shop drawings and data shall be at the Contractor's risk. The District will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

- M. Project Work, materials, fabrication, and installation shall conform to approved shop drawings, applicable samples, and product data.

4.1.4 Submission Requirements

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Work or in the work of any other contractor.
- B. Each submittal, appropriately coded, will be returned within thirty (30) Calendar Days following receipt of the submittal by the District or Engineer of Record.
 - 1. Submittal identification number
 - 2. The date of submission and the dates of any previous submissions.
 - 3. The Project title and number.
 - 4. Contractor identification.
 - 5. The names and telephone numbers of:
 - a. Contractor
 - b. Supplier
 - c. Manufacturer
 - 6. Field dimensions clearly identified as such.
 - 7. Identification of deviations from Contract Documents.
 - 8. Identification of revisions on resubmittals.

4.1.5 Review of Shop Drawings, Product Data, Working Drawings, and Samples

- A. The review of shop drawings, data, and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:
 - 1. as permitting any departure from the Contract requirements;
 - 2. as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials;
 - 3. as approving departures from details furnished by the District, except as otherwise provided herein.
- B. The Contractor remains responsible for details and accuracy, for coordinating the Work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.
- C. If the shop drawings, data or samples as submitted describe variations and show a departure from the Contract requirements which District or Engineer of Record finds to be in the interest of the

District and to be so minor as not to involve a change in Contract Price or time for performance, the District or Engineer of Record may return the reviewed drawings without noting an exception.

- D. The District or Engineer of Record will reject incomplete submittals as not complying with the Contract requirements. Contractor shall provide space for two and a half inch (2.5") by three and a half inch (3.5") review stamp for each submittal.
- E. After receipt of a complete submittal and within the time limits described below, the District or Engineer of Record will transmit the submittal back to the Contractor marked with one of the following review status: "Reviewed, No Exceptions Taken" "Make Corrections Noted, Do Not Resubmit" "Revised and Resubmit" "Rejected".
- F. For items marked "Make Corrections Noted, Do Not Resubmit," the revisions will be marked on the submittal or will be described as comments in the response letter. The submittal will be considered approved without formal revision. The Contractor shall, within 7 calendar days, submit two (2) corrected record copies of the submittal to the District or Engineer of Record for record purposes.
- G. If the submittal is returned to the Contractor marked "Revised and Resubmit," the submittal will be transmitted to the Contractor with a statement of the deficiencies. The Contractor shall promptly revise the submittal and resubmit to the District or Engineer of Record.
- H. If the submittal is returned to the Contractor marked "Rejected" with comments the Contractor shall revise said submittal and shall resubmit the revised submittal to the District or Engineer of Record.
- I. Revisions indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents, Specifications, or Drawings. Submittal revisions shall not be taken as the basis of claims for extra work. The Contractor shall have no claim for damages or extension of time due to any delay resulting from making required revisions to the submittals. The review of submittals by District or Engineer of Record shall in no way relieve the Contractor of responsibility for errors or omissions contained therein nor will such review operate to waive or modify any provisions or requirements contained in the Contract Documents, Specifications, or Drawings.
- J. After approval of submittals, the Contractor shall not deviate from the approved submittal without the prior written consent from the District or Engineer of Record. Commencement of production Work performed in advance of the receipt of approval of submittals shall be entirely at the Contractor's risk.
- K. Resubmittals will be handled in the same manner as first submittals. On resubmittals, the Contractor shall direct specific attention, in writing, on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the District or Engineer of Record, on previous submissions. Any such revisions that are not clearly identified shall be made at the risk of the Contractor. The Contractor

shall make corrections to any work done because of this type revision that is not in accordance with the Contract Documents as may be required by the District or Engineer of Record.

- L. Partial submittals may not be reviewed. The District or Engineer of Record will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the Contractor, and will be considered "Rejected" until resubmitted. The District or Engineer of Record may at his/her option, provide a list or mark the submittal directing the Contractor to the areas that are incomplete.

- M. Review Fees
 - 1. Shop drawings and other submittals will be reviewed at the Developer's/Contractor's Expense, based on the District or Engineer of Record's then prevailing rates. The Contractor shall reimburse the District for all such fees invoiced to the District. Submittals are required until approved.
 - 2. Any need for more than one resubmission, or any other delay in obtaining District or Engineer of Record review of submittals, will not entitle the Contractor to extension of the time for completion.

- N. If the Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, the Contractor shall give written notice thereof to the District or Engineer of Record at least seven (7) workdays before release for manufacturing.

- O. When the shop drawings have been completed to the satisfaction of the District or Engineer of Record, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the District or Engineer of Record.

4.1.6 Distribution

- A. The Engineer of Record shall distribute reproductions of approved shop drawings and copies of approved product data and samples, where required, to the job site file and subcontractors as required or directed by the District.

4.1.7 Schedules

- A. The Contractor shall provide all schedules required by the requirements of these Standards.

4.1.8 General Procedures for Submittals

- A. Coordination of Submittal Times: The Design Engineer shall prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual sections of the Specifications so that the installation will not be delayed by processing times including disapproval and resubmittal (if required), coordination with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. No

extension of the time for completion will be authorized because of the Contractor's failure to transmit submittals sufficiently in advance of the work.

4.1.9 Quality Control Submittals

A. Certificates:

1. Manufacturer's Certificate of Compliance:

- a. The Manufacturer shall when specified in individual Specification sections or where products are specified to a recognized standard or code, submit to the District, prior to shipment of product or material to the Project site, certificates of compliance.
- b. The District or Engineer of Record may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
- c. The certificate shall be signed by the product manufacturer certifying that materials, manufacture, and product specified conform to or exceed the specified requirements and intent for which the product will be used. Submit supporting reference data, affidavits, and certifications as appropriate.
- d. The certificate may reflect recent or previous test results on material or product, but must be acceptable to the District.

2. Certificates of Successful Testing or Inspection: The Contractor shall submit to the District documentation of testing or inspection when required by Laws and Regulations specified in the individual Specification.

B. Operation and Maintenance Manual: The Contractor shall submit to the District the Operation and Maintenance Manual in accordance with these Standards .

C. Statements of Qualification: The Contractor shall submit to the District evidence of qualification, certification, or registration as required in the Contract Documents, to verify the qualifications of Engineers, materials testing laboratories, specialty Subcontractors, trades, specialists, consultants, installers, and other professionals.

D. Written Test Reports of Each Test and Inspection: As a minimum, the Contractor shall provide to the District the following:

1. Date of test and date issued, Project title and number, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
2. Date and time of sampling or inspection and record of temperature and weather conditions.
3. Identification of product and Specification section, location of Sample, test or inspection in the Project, type of inspection or test with referenced standard or code, certified results of test.
4. Compliance with Contract Documents and identifying corrective action necessary to bring materials and equipment into compliance.
5. Provide an interpretation of test results when requested by the District or Engineer of Record.

4.1.10 Submittal Log

- A. The Contractor shall prepare and maintain an accurate submittal log for the duration of the project. The Contractor shall submit the initial submittal log within 30 Calendar Days after Notice to Proceed. The Contractor shall submit an updated submittal log with each submittal and upon request of the District or Engineer of Record. The submittal log shall contain a listing of all submittals required by the Contract Documents and shall include the following.
1. Submittal identification number
 2. Specification Section Reference
 3. Description of submittal item
 4. Projected submission date
 5. Actual submission date
 6. Date returned by the Engineer
 7. Notation of the District or Engineer of Record response
 8. Notation if re-submittal or record copy is required

4.2 EXCAVATION AND FILL

4.2.1 General

- A. This section covers excavation and trenching, including but not limited to dewatering, preparation of subgrades, pipe bedding, backfilling, compacting, groundwater barriers, materials testing, and finish grading for underground pipelines and appurtenances.

4.2.2 Required Submittals

The Contractor shall submit to the District the following:

- A. Dewatering
1. Water Control Plan: Submit for review by the District prior to start of any field work. At a minimum, the Water Control Plan shall include the following:
 - a. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply; discharge locations to be utilized; and dewatering pollution control BMPs.
 - b. Drawings showing locations, dimensions, and relationships of elements of each system.
 - c. Design calculations demonstrating the adequacy of proposed dewatering systems and components.
 - d. Surface water control and drainage installations and related pollution control BMPs.
 - e. Locations and types of monitoring systems.
 - f. Proposed methods and locations for disposing of the removed water.
 - g. Any treatment system in place to meet discharge quality criteria if applicable.
 - h. If the system is modified during installation or operation, revise or amend and resubmit the Water Control Plan.

2. Statement of Qualifications for Dewatering Specialist: Provide a summary of project experience and references for a designer of dewatering systems.
3. Well Permits: Submit to the District before the start of field work.
4. Discharge Permits: Submit to the District before the start of field work and keep onsite for the duration of the work.

B. Fill and Backfill

1. Results of particle size testing of proposed offsite source material in accordance with ASTM D422.
2. Results of Atterberg limit testing of proposed offsite source material in accordance with ASTM D4318 (fine-grained material only).
3. Results of Standard proctor testing (ASTM D698) or Modified proctor testing (ASTM D1557) of proposed offsite source material as appropriate, based on compaction requirements stated herein.
4. Certified test results from an independent testing agency.

C. Trench Backfill

1. Shop Drawings: Manufacturer's descriptive literature for marking tapes.
2. Samples: Submit samples of materials proposed to be used in the Work to demonstrate material conformance with these Specifications.
 - a. Samples to be provided include:
 - i. Trench stabilization material.
 - ii. Bedding and pipe zone material.
 - iii. Granular drain.
 - iv. Granular backfill.
 - v. Earth backfill.

4.2.3 Construction Staking

- A. Construction staking shall be performed under the direct supervision of a Professional Land Surveyor licensed in the State of Colorado.
- B. Adequate staking shall be provided to establish acceptable horizontal and vertical control.
- C. Offsets shall be staked so that the District may check vertical and horizontal alignment.
- D. All survey notes and construction staking notes shall be entered into bound, hard cover field books, kept at the construction site for the duration of the project, and shall be made available to the District upon request.
- E. All survey data, which is developed by the Contractor or the Engineer of Record in performing surveys required by the work, shall be available to the District for examination and reproduction throughout the construction and warranty periods.

- F. The District Inspector shall be informed of all field changes to the District accepted Construction Drawings. Approval for the changes shall be required from the District prior to the changes being made in the field.

4.2.4 Field Conditions

The Contractor shall ensure the following:

- A. Drainage and groundwater.
 - 1. Keep excavations and trenches free of water during construction. Divert surface runoff and utilize sumps, gravel blankets, well points, drain lines or other means of dewatering, as necessary.
 - a. Dewater the excavation or trench until the structure, pipe, or other, to be installed therein, is completed to the extent that no damage from hydrostatic pressure, floatation, or other cause will result.
 - b. Water shall be removed from the trench to the extent necessary in order to provide a firm subgrade and dry conditions for pipeline installation.
 - 2. The pipeline being constructed shall not be used for dewatering.
 - 3. The piping used to dewater the trench shall not be left in the trench when backfilled.
 - 4. For trenched installations, groundwater barriers shall be installed if groundwater is encountered or expected. Groundwater barriers shall be installed as shown on the drawings and, as necessary, based on field conditions.
 - 5. Prior to beginning dewatering operations, the Contractor shall obtain all necessary permits and appropriate authorization to start dewatering. If groundwater will be discharged or drained into an irrigation ditch, pond, stream or waterway, a CDPHE Dewatering Permit will be required.
 - a. The Contractor is required to complete and process the Discharge Monitoring Report (DMR) which is typically a part of the Dewatering Permit.
 - b. Upon completion of the work, the Contractor shall be responsible for completing a CDPHE Discharge Termination Notice.
- B. Blasting is not permitted within the jurisdiction of the Town or District unless otherwise authorized by the Town. If authorized, permitting and requirements associated with blasting are the responsibility of the Contractor.
- C. Sequencing
 - 1. Backfill shall be completed at the end of each day to the extent that no damage from hydrostatic pressure, flotation, or other causes will result.
 - 2. Where excavation is a hazard to automotive or pedestrian traffic, the amount of open trench and the time duration of that opening shall be minimized. The District shall direct the amount of open trench that is acceptable for the condition encountered.
 - 3. During construction, maintain access to private residences and businesses.

D. Underground Obstructions

1. It is the Contractor's responsibility to call for utility locates. Call UNCC at 1-800-922-1987 or dial 811 for locates.
2. Depending on the required subsurface utility engineering (SUE) quality level, the Contractor shall be prepared to expose and verify the size, location, and elevation of underground utilities and other obstructions sufficiently in advance of construction to permit changes to be made to the Construction Drawings in the event there is a conflict with the proposed and existing utilities. In the event there is a conflict, the Contractor shall notify the District and the affected utility company immediately.
3. Protect and support utilities, appurtenances, structures, etc., by shoring, bracing, or other means necessary.

E. Weather

1. Do not install pipe or place pipe bedding on frozen soil in the trench bottom.
2. Do not place frozen materials, snow or ice in backfill, fill, or embankments.
3. Do not deposit, tamp, roll or otherwise mechanically compact backfill in water.

4.2.5 Quality Assurance

The Contractor shall:

A. Preparation of Subgrade

1. Notify District when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

B. Excavation

1. Provide adequate survey control to avoid unauthorized over excavation.

C. Fill and Backfill

1. Notify District when:
 - a. Structure or pipeline is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
 - b. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
 - c. Fill material appears to be deviating from the Specifications.

4.2.6 Soil and Bedrock Conditions

- A. A geotechnical investigation may have been performed for the project in order to obtain relative data concerning the character of material in and upon which the project is to be built. If an investigation has been performed, the information will be available to the Contractor for information purposes only and is not to be considered a part of the Contract Documents. The Contractor shall

satisfy himself as to the kind and type of soil and/or rock to be encountered and any water conditions that might affect the construction of the project.

4.3 PRODUCTS, MATERIALS AND EQUIPMENT

4.3.1 General

- A. All material shall be free from frozen matter, stumps, roots, brush, other organic matter, cinders, corrosive material, debris, broken asphalt and concrete, and any other objectionable material that is not suitable in the opinion of the District. This section details products and materials that are acceptable to the District and the specifications related to those products, materials, and equipment.
- B. If job excavated material is not sufficient or suitable, suitable material shall be imported.

4.3.2 Subgrade Material Below Structures and Bedding

- A. At a minimum, the top six inches (6") of in-situ soil below structures shall be removed and replaced with an approved structural fill material. If deemed necessary by the District, more than six inches (6") of material from the trench bottom may require removal and replacement with a stabilization material, Per the District Standard Details
- B. Structures consist of, but are not limited to, vaults, sewer manholes, and equipment pads.

4.3.3 Stabilization Material

- A. In the case of poor soil conditions, subgrade stabilization may be required to adequately support structural foundations and utility pipelines. If deemed necessary by the District, more than six inches (6") of material from the trench bottom may require removal and replacement with a stabilization material.

4.3.4 Insulation Board

- A. Insulation board shall be installed on the trench walls and on top of the bedding zone when the depth of cover over the sewer main and service lines is less than eight (8) feet.
- B. Insulation board shall be high-density and rated for high compressibility of a minimum of 100 psi.
- C. Insulation board shall be a minimum two inches (2") thick for everyone one foot (1') of cover below eight feet (8"). Acceptable insulation board manufacturers are:
 - 1. Dow Chemical Company - Styrofoam™
 - 2. Owens-Corning
 - 3. Or approved equivalent.

4.3.5 Trench Backfill Material

- A. Trench backfill material shall be placed from a point twelve inches (12") above the top of pipe exterior to six inches (6") below the ground surface, or bottom of the topsoil layer, or bottom of the pavement subgrade, whichever is applicable.

4.4 EXECUTION

4.4.1 Subgrade Preparation

Contractors shall ensure the following:

- A. General
 - 1. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.
 - 2. Bring the subgrade to the proper grade and cross-section, and a uniformly compact surface.
 - 3. Do not use sections of prepared ground surface as haul roads. Protect the prepared subgrade from traffic.
 - 4. Maintain prepared ground surface in finished condition until the next course is placed.
- B. Compaction
 - 1. Under Earth fill and Exposed Cut Surfaces: Compact upper eight inches (8") to a minimum of ninety-five percent (95%) relative compaction as determined in accordance with ASTM D1557 or 93 percent relative compaction as determined in accordance with ASTM D698.
 - 2. Under Structures Including Slabs, Tanks and Other Miscellaneous Structures: Areas shall be over-excavated to such an extent to provide a minimum of 6 inches of granular fill on prepared subgrade. Scarify and compact the upper 8 inches of subgrade to a minimum of ninety-five percent (95%) of Standard Proctor compaction as determined in accordance with ASTM D698.
- C. Moisture Conditioning
 - 1. Dry Subgrade: Add water, then mix to make the moisture content uniform throughout.
 - 2. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten the drying process.
- D. Testing
 - 1. Proof-roll subgrade with a fully loaded tandem-axle dump truck or similar vehicle to detect soft or loose subgrade or unsuitable material. Proof-roll shall be conducted prior to scarifying/recompacting to identify soft or loose subgrade or unsuitable material. District shall be notified no less than two (2) days in advance of proof-rolling activities and will be present to examine and approve subgrade before backfilling begins. District shall approve proof-roll prior to backfill.
 - 2. Contractor shall provide an independent testing laboratory to conduct in-place density tests.

E. Correction

1. Soft or Loose Subgrade:
 - a. Adjust the moisture content and recompact, or
 - b. Over-excavate as specified in Section 3.3 of this specification, and replace with suitable material from the excavation. If unsuitable soil is encountered at a depth of 3 feet below the planned subgrade, excavation shall be halted and the District notified immediately.
 - c. In the event the unacceptable material is encountered at the 3-foot over-excavation, a geogrid shall be provided and placed, and overlain with a geotextile. The over-excavation shall be filled to plan grade with stabilization material. Stabilization material shall be placed in lifts not more than 10 inches thick and shall be compacted to the satisfaction of the District.
2. Unsuitable Material: Over-excavate as specified in Section 3.3 of these Standards and replace with suitable material from the excavation.

4.4.2 Excavation

The Contractor shall ensure the following:

A. General

1. Excavate to the lines, grades, and dimensions shown in the drawings and as necessary to accomplish work. Excavate to within tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against the earth.
2. Do not over-excavate without written authorization of the District.
3. Remove or protect obstructions as shown in the drawings.

B. Unclassified Excavation

1. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

C. Trench Width

1. Minimum Width of Trenches: As specified in the standard details.
2. Maximum Trench Width: Unlimited, unless otherwise shown or specified, or unless excess width will cause damage to existing facilities, adjacent property, or completed Work.

D. Pipe Bedding Grooves for Nonperforated Drain Lines

1. Semicircular, trapezoidal, or 90-degree-V.
2. Excavated or plowed into the trench bottom. Forming a groove by compaction will not be acceptable.

E. Embankment and Cut Slopes

1. Shape, trim, and finish cut slopes to conform with lines, grades, and cross sections shown in the drawings, with proper allowance for topsoil or slope protection, where shown.
2. Remove stones and rock that exceed 3-inch diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.
3. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and rights-of-way, or adversely impacts existing facilities, adjacent property, or completed work.
4. Temporary earthen slopes or benching shall meet current OSHA requirements or be designed by a Professional Engineer in the State of Colorado.

F. Stockpiling Excavated Material

1. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.
2. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.
3. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct roads or streets.
4. Do not stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.
5. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

G. Disposal of Spoil

1. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite.
2. Dispose of debris resulting from removal of underground materials, organic matter, trash, refuse, junk, and other materials in accordance with local and federal governmental regulations.

4.4.3 Fill and Backfill

The Contractor shall ensure the following:

A. General

1. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.
2. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to the specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

3. During filling and backfilling, keep the level of fill and backfill around each structure and pipeline even.
 4. Do not place fill or backfill if fill or backfill material is frozen, or if the surface upon which fill or backfill is to be placed is frozen.
 5. If pipe, conduit, duct bank, or cable is to be laid within fill or backfill:
 - a. Fill or backfill to an elevation 2 feet above the top of item to be laid.
 - b. Excavate a trench for the installation of the item.
 - c. Install bedding, if applicable.
 - d. Install item.
 - e. Backfill the envelope zone and remaining trench, before resuming filling or backfilling as specified in this section.
 6. Tolerances:
 - a. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
 - b. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.
 7. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.
- B. Backfill Under and Around Structures
1. Under Structures:
 - a. Over-excavate and prepare subgrade as specified, or fill on prepared subgrade with earth fill to within 6 inches of the bottom of the structure.
 - b. Earthfill shall be placed in 8-inch maximum lifts and compacted at a moisture content of optimum plus or minus 2 percent. Each lift of moisture-conditioned earthfill shall be compacted to a minimum of ninety-five percent (95%) of standard proctor compaction as determined in accordance with ASTM D1698
 - c. Place a minimum of six inches (6") of stabilization material below structures and slabs. Stabilization material shall be compacted and tested in accordance with ASTM D4254 to a minimum relative density of sixty-five percent (65%).
 - d. Backfill around structures with cohesive material to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of the eight-inch (8") maximum thickness and compact each lift to a minimum of ninety-five percent (95%) relative compaction as determined in accordance with ASTM D1557 or 93 percent relative compaction as determined in accordance with ASTM D698.
 - e. Other Areas: Backfill with earth fill to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 8-inch maximum thickness and compact each lift to a minimum of ninety percent (90%) relative compaction as determined in accordance with ASTM D1557 or 93 percent relative compaction as determined in accordance with ASTM D698.

C. Fill

1. Outside Influence Areas beneath Structures, Tanks, Pavements, Curbs, Slabs, Piping, and Other Facilities, unless otherwise shown, place earth fill as follows:
 - a. Allow for a six-inch (6") thickness of topsoil where required.
 - b. Maximum 8-inch thick lifts.
 - c. Place and compact fill across full width of embankment.
 - d. Compact to a minimum of ninety percent (90%) relative compaction as determined in accordance with ASTM D1557 or ninety-three percent (93%) relative compaction as determined in accordance with ASTM D698.
 - e. Dress completed embankment with allowance for topsoil, crest surfacing, and slope protection, where applicable.

D. Site Testing

1. Gradation:
 - a. One sample from each 1,500 tons of finished product or more often as determined by the District, if variation in gradation is occurring, or if material appears to depart from Specifications.
 - b. If test results indicate the material does not meet these Standards, terminate material placement until corrective measures are taken.
 - c. Remove material placed in Work that does not meet Specification requirements.
2. Atterberg Limits:
 - a. One sample from each one thousand five hundred (1,500) tons of finished product or more often as determined by the District, if variation in gradation is occurring, or if material appears to depart from Specifications.
 - b. If test results indicate the material does not meet these Standards, terminate material placement until corrective measures are taken.
 - c. Remove material placed in Work that does not meet Specification requirements.
3. Contractor shall provide an independent testing laboratory to conduct in-place Density Tests: In accordance with ASTM D1556 or D6938. During placement of materials, every 200' of mainline trench section, one test at every service line at the edge of the right-of-way, and one test at every manhole. Test depths shall start two feet (2') above pipe bedding and continue at two feet (2') vertical intervals with one test at the final grade. All test results shall be provided to the District on a weekly basis.

E. Replacing Over-Excavated Material

1. Replace excavation carried below grade lines shown or established by the District as follows:
 - a. Beneath Structures: Granular fill.
 - b. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
 - c. Trenches:
 - i. Unauthorized Over excavation: Either trench stabilization material or granular pipe base material.
 - d. Permanent Cut Slopes (Where Overlying Area is Not to Receive Fill or Backfill):

- i. Flat to Moderate Steep Slopes (3:1, Horizontal Run: Vertical Rise or Flatter): Earth fill.
- ii. Steep Slopes (Steeper than 3:1):
 - Correct over excavation by transitioning between overcut areas and the designed slope adjoining areas, provided such cutting does not extend offsite or outside easements and rights-of-way, or adversely impacts existing facilities, adjacent property, or completed work.
 - Backfilling over excavated areas is prohibited, unless in the District's opinion, backfill will remain stable, and over-excavated material is replaced as compacted earth fill.

4.4.4 Trenching

The Contractor shall ensure the following:

- A. Do not drop backfill directly upon any structure or pipe. Do not place backfill around or upon any structure until the concrete or CLSM has attained sufficient strength to withstand the loads imposed.
- B. Place backfill after water is removed from the excavation, and the excavation bottom or surface upon which backfill is to be placed is firm and has been dried to a moisture content suitable for scarifying and recompaction. Remove water in a manner that minimizes soil erosion from trench sides and bottom. Provide continuous water control until trench backfill is complete.
- C. Excavate trenches by open-cut methods, except where a boring is indicated on the Construction Drawings, required by jurisdictional agencies, or desired by the Contractor and approved by the District.
- D. Do not use mechanical equipment in locations where its operation would cause damage to trees, buildings, culverts, utilities, structures or other property above or below ground. In all such locations, hand-excavating methods shall be used.
- E. Use mechanical equipment designed and operated so the rough excavated trench bottom elevation can be controlled with uniform trench width and vertical sidewalls from an elevation one (1) foot above the top of installed pipe to the bottom of the trench. The trench alignment shall be sufficiently accurate to permit pipe to be aligned properly between the pipe and sidewalls of the trench. Do not undercut the trench sidewall to obtain clearance.
- F. Contractor shall follow the most current regulations concerning excavations set forth by OSHA: 29 CFR Part 1926.
- G. Excavation in Rock
 - 1. When rock is present, over-excavate a minimum of six inches (6") below the bottom of the required trench bottom.
 - 2. Backfill to the required trench bottom with compacted bedding material.

- H. Preparation of Trench Bottom
 1. Grade trench bottom uniformly to provide clearance for each section of pipe and bedding material.
 2. Remove loose materials, water, and foreign objects.
 3. Provide a firm subgrade suitable for the placement of bedding material.
 4. Wherever unstable material is encountered in the bottom of the trench, overexcavate such material to a depth suitable for constructing a stable subgrade or as determined by the District. Backfill over-excavation with stabilization material and compact. A geotextile fabric layer shall be placed between the stabilization material and the bedding material.

- I. Stockpiling Excavated Materials
 1. Pile suitable material for backfilling in an orderly manner a sufficient distance from trench banks to avoid overloading and to prevent slide or cave-ins.
 2. Do not stockpile excavated material against existing structures or appurtenances.
 3. The Contractor shall follow the most current OSHA regulations concerning excavations.

- J. Trench Widths
 1. Trench width shall be maintained to within three inches (3") of that specified on the plans unless otherwise specified by the District.

4.4.5 Pipe Bedding

The Contractor shall ensure the following:

- A. Placement and Compaction
 1. Distribute, grade, and compact bedding material to provide uniform and continuous support beneath the pipe at all points between bells and pipe joints.
 2. Bell holes shall be dug deep enough to provide a minimum two inches (2") of clearance between the bell and bedding material. The pipe shall not be supported by the pipe bell.
 3. Deposit bedding material and compact uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
 4. Compact granular bedding material by vibrating, slicing with a shovel, or a bent tee-bar. Care shall be taken not to damage the pipe during compaction. Handheld equipment shall be used to compact material immediately adjacent to the pipe.
 5. All utility trenches within the street right-of-way (including service lines) must be mechanically compacted to not less than ninety-five percent (95%) of maximum density within \pm two percent (2%) of optimum moisture content as determined by AASHTO T99. Alternatively, utility trenches can also be backfilled with CLSM to the bottom of the new pavement.
 6. Trench backfill in utility easements within twenty (20) feet of right-of-way shall be mechanically compacted to 95% maximum density or backfilled with CLSM to within one foot of the finish grade.
 7. Trench backfill in utility easements beyond twenty (20) feet from right-of-way shall be compacted to ninety percent (90%) maximum density.

8. Place pipe bedding in accordance with the District Standard Drawings.

4.4.6 Tracer Wire and Test Stations

- A. The Contractor shall refer to the proper construction specification and the standard drawings for the utility-specific tracer wire and test station requirements.
 1. For sanitary sewer service tracer wire and test stations, refer to the standard drawings.

4.4.7 Ground Water Barriers

- A. Groundwater barriers shall be constructed in such a manner as to impede the passage of water through the bedding material and shall be installed when high groundwater conditions exist or as directed by the District.
- B. Ground water barriers shall be keyed at least one (1) foot into the trench wall and bottom, and spaced ten (10) feet upstream of each manhole for gravity sanitary sewers or every 400 feet on water lines and sanitary sewer force mains.
- C. At a minimum, groundwater barriers shall extend one (1) foot above the bedding material.

4.4.8 Insulation Board

- A. Insulation board, if preapproved by the District, shall be installed above and sides of the bedding zone wherever the depth of cover over the water main is less than eight (8) feet.
 1. Insulation board installation shall consist of a two-inch (2") minimum thickness per board per every one foot (1') of cover below eight feet (8'), with offset joints.
 2. Insulation board shall be placed across the full trench width and height of the bedding zone.
- B. Refer to District Standard Drawings for additional installation requirements.

4.4.9 Backfilling and Compaction

- A. Backfill trench promptly after completion of pipe bedding, but only after the District has inspected the work.
- B. Backfilling and compaction operations and requirements shall be in accordance with these specifications.
- C. Use backfilling and compaction methods and equipment appropriate for the backfill material. Do not use equipment or methods that will transmit damaging shocks to the pipe.
- D. Do not perform compaction by jetting or water settling.
- E. Rock and bedrock encountered in the excavation shall not be used in backfill.

- F. For areas not receiving surface improvements after construction, return the final grading to the depth of stripping over all areas disturbed by construction operations and replace topsoil.
- G. All surface cuts shall be, as a minimum, restored to a condition equal to, or better than, that prior to construction. All gravel or paved streets shall be restored in accordance with the regulations and requirements of the agency having control or jurisdiction over the street, roadway or right-of-way.
- H. Controlled Low Strength Material:
 - 1. Maintain stability of pipe and conduit throughout CLSM placement and curing. Anchor pipe as needed to prevent movement of the pipe caused by flotation or lateral displacement. If any movement occurs, remove the CLSM material and place the pipe back on line and grade. Remove sloughed material or other debris from the top of previously placed CLSM.
 - 2. Place in lifts as necessary to prevent uplift (flotation) of new and existing facilities.
 - 3. Fill the entire trench section to pavement finish grade for a temporary driving surface in traveled areas, and screed off excess and finish with a float.
 - 4. In other areas, fill the trench section to the top of trench backfill zone.
 - 5. Allow CLSM to set before placing backfill. Prior to placing backfill over CLSM, achieve an indentation diameter less than or equal to three (3) inches as determined by ASTM D6024.

4.4.10 Materials and Quality Control Testing

- A. The Contractor is responsible for quality control testing and the testing shall be performed by an independent testing agency employed by the Contractor.
- B. The following requirements shall apply:
 - 1. Trench Compaction
 - a. Compaction – 95% (ASTM D698)
 - b. Moisture – $\pm 2\%$
 - 2. Bedding Material
 - a. Compaction – 65% of relative density (ASTM D4254)
 - 3. CLSM:
 - a. Provide adequate facilities for safe storage and proper curing of CLSM test cylinders onsite for the first twenty four (24) hours, and for additional time as may be required before transporting to test lab.
 - b. Provide CLSM testing of air content for making cylinders from the point of discharge into forms. When CLSM is pumped, samples used shall be taken from the discharge end of the pump hose.
 - c. Specimens shall be made, cured, and tested in accordance with ASTM D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

- d. One set of test cylinders shall be tested for each one hundred (100) cubic yard of CLSM placed, but no less than one set per day. Frequency of testing may be changed at direction of District.
- e. Reject CLSM represented by cylinders failing to meet the strength and air content specified.
- f. Failing test of placed material will require a one (1) year extension of warranty period.

C. Services

- 1. Sanitary sewer services shall have a minimum of one (1) moisture/density test per service at two feet (2') vertical increments or at the District's discretion.
- 2. Moisture/density tests in the vicinity of vaults, valve boxes and manholes shall be performed at a minimum of one (1) foot away from the edge of vault/manhole sections or valve boxes.
 - a. Tests shall be performed in random directions from the vault, manhole, or valve box, on separate lifts.
 - b. A minimum of one (1) test shall be performed, on opposite sides of the vault, manhole or valve box, for every two (2) feet of backfill material.
- 3. The Contractor shall keep copies of all quality control test results in a notebook at the job site for the duration of the project. Test results shall be made available to the District at all times.

4.4.11 Compaction Test Failure

- A. If the required compaction and moisture test is not obtained, it shall be the responsibility of the Contractor to recompact or rework the material to the required state of compaction and moisture.
- B. In cases where there is a failure to achieve the required compaction or moisture, the District may require that the backfill be removed and recompact or replaced entirely with suitable materials.
- C. Water line and sanitary sewer line/manhole testing may be required after recompaction if the testing had been performed prior to recompaction.
 - 1. Sanitary sewer line testing shall be performed between manholes on both sides of the recompact area.
 - 2. Sanitary sewer manhole testing shall be performed if recompact occurs in the vicinity of the manhole.

4.5 PROJECT RECORD DOCUMENTS

4.5.1 General

- A. This section addresses the requirements for Project Record Documents.
- B. Reference Section 2 of these Standards for supplementary information to this specification.
- C. The Contractor shall be responsible for ensuring the performance of the provisions of this subsection.

4.5.2 Execution

- A. Record Documents
 - 1. Quality Assurance:
 - a. Furnish a qualified and experienced person, whose duty and responsibility shall be to maintain the record documents.
 - b. Accuracy of Records:
 - i. Coordinate changes within Project Record Documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show the change. Project Record Documents may be kept digitally but must be backed up daily.
 - ii. The purpose of Project Record Documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
 - iii. Field verify all as-built dimensions and materials.
 - c. Make entries within forty-eight (48) hours after receipt of information that a change in the Work has occurred.
 - d. Prior to each request for progress payment, pay application, or when a field change is requested or made, the Engineer of Record, Project manager, or District may request review and approval of the current Redline Drawings. Failure to properly maintain, update, and submit Redline Drawings may result in a deferral of the whole or any part of Contractor's Application for Payment, either partial or final, and substantial completion may be delayed.
 - 2. The District reserves the right to review Redline Drawings throughout the project.
- B. Maintenance of Documents and Samples
 - 1. Do not use Project Record Documents for construction purposes.
 - 2. Store documents in the Contractor's field office apart from documents used for construction. Protect Project Record Documents from deterioration and store the same in a secure location. Updated Project Record Documents shall be scanned and saved as a PDF no less than monthly.
 - 3. File documents and samples in accordance with the specification's section numbers.
 - 4. Maintain documents and samples in a clean, dry, legible condition and in good order.
 - 5. Documents shall be made available for inspection by the District upon request. All accurate and recent Construction Documents shall be provided upon District request.
- C. Recording During Construction
 - 1. Label each drawing "REDLINE DRAWING" in neat, large-printed letters.
 - 2. Mark whichever drawing is most capable of showing "field" condition fully and accurately; however, where shop drawings are used for mark-up, record a cross-reference at corresponding locations on the Redline Drawings.

3. Mark drawings legibly with a pen or pencil. Ink shall not be water-based or subject to easy smearing.
4. Date entries.
5. Call attention to the entry by “cloud” drawn around the area or areas affected.
6. Record information concurrently with construction progress.
7. Record new information that was not shown on the Construction Drawings or shop drawings. Give particular attention to concealed work which would be difficult to measure and record later.
8. Record all field dimensions, elevations, details, deviations in sizes, locations, materials, or other features of the Work. It shall be possible, using these Redline Drawings, to correctly and easily locate, identify, and establish dimensions of work features which will be concealed in finished work or underground.
9. Establish locations and materials of concealed and underground work, utilities, and appurtenances, with accurate horizontal and vertical dimensions. Horizontal locations shall be referenced to a minimum of two (2) permanent surface improvements. Vertical element locations shall be in relation to the project vertical datum. Do not backfill, cover, place, or proceed with any work until the necessary Redline Drawings information is obtained.

D. Redline Drawings and Submission

1. Contractor shall submit Redline Drawing information to the Engineer of Record and District on a monthly basis or prior to each request for progress payment, pay application, or when a field change is requested or made for review and approval.
 - a. The Engineer of Record and District shall review the submitted Redline Drawing information, and any corrections, additions, or omissions identified shall be incorporated into the Redline Drawings by the Contractor prior to approval.
2. Accompany the submittal to the Engineer of Record and District with a transmittal letter containing:
 - a. Date
 - b. Project title and number
 - c. Contractor’s name, address, and telephone number
 - d. Index containing title and number of each Record Document
 - e. Signature of Contractor or his authorized representative
3. Redline Drawings shall be submitted and approved by the Engineer of Record and District prior to the issuance of Substantial Completion.

E. Final As-Constructed Record Drawings and Submission

1. Engineer of Record shall incorporate changes from approved Redline Drawings to produce final As-Constructed Record Drawings. As-Constructed Record Drawings shall be submitted to the District for review and approval within 1 month of the Engineer of Record receiving the approved Redline Drawings.
 - a. The District shall review the submitted As-Constructed Drawing information and any corrections, additions, or omissions identified from the comparison to the approved

Redline Drawings shall be incorporated into the As-Constructed Record Drawings by the Engineer of Record prior to approval.

- b. Engineer of Record shall submit approved As-Constructed Record Drawings to the District as noted below within 1 month of District approval of As-Constructed Record Drawings:
 - i. Electronic PDF format
 - ii. AutoCAD per the most current version of “Electronic Data Submittal Standards (EDSS)” GIS shape files per the most current version of “Electronic Data Submittal Standards (EDSS)”

5 SANITARY SEWER SPECIFICATIONS

5.1 SANITARY UTILITY SEWER PIPING

5.1.1 General

- A. This section addresses the installation of sanitary sewer collection mains and includes the acceptable products, materials, and construction practices that may be used in the installation of sanitary sewer collection systems.
- B. The Contractor shall be responsible for ensuring the performance of the provisions of this section.

5.1.2 Submittal Requirements

- A. Shop Fabricated Piping:
 - 1. Pipe Manufacturer.
 - 2. Pipe Size.
 - 3. Pipe Dimensions.
 - 4. Pipe Class / Pressure Rating.
 - 5. Color (For PVC).
 - 6. Manufacturer's Recommended Joint Deflection.

5.1.3 Storage and Handling

- A. Pipe shall be handled and stored according to the manufacturer's recommendations.
- B. Handling
 - 1. Use wide fabric choker slings when lifting pipe.
 - 2. Do not drop pipe or fittings, including dropping on cushions.
 - 3. Do not use hooks or bare cable.
 - 4. Polyvinyl chloride pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care should be used in handling and installing PVC pipe during cold weather. Do not install pipe when the temperature is below 40 degrees F.
 - 5. Care must be taken to prevent damage to the pipe and fittings and coating and lining (when applicable) by impact, bending, compression, or abrasion. If damage does occur due to the manufacturer's handling recommendations not being followed, Contractor is to replace the damaged piece(s).
- C. Storage
 - 1. Store and use pipe lubricants in a manner that will avoid contamination.
 - 2. Pipe, gaskets, and all other installation materials shall be stored in accordance with the manufacturer's specifications.
 - 3. Pipe shall be stored on a surface that provides even support for the pipe barrel. Pipe shall not be stored in such a way as to be supported by the bell.

4. Cold Weather Storage: Locate products to prevent coating from freezing to the ground.
- D. Pipe delivered for construction shall be strung to minimize the entrance of foreign material.
- E. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of a day's work or for extended periods at the District's direction .
- F. Do not allow debris, tools, clothing, or other materials to enter the pipe. Precautions shall be taken to protect the interior of pipes against contamination.
- G. Use effective measures to prevent uplifting or floating of the pipeline prior to completion of backfilling operations.
- H. Protect pipe and appurtenances against dropping and damage. Damaged pipe and appurtenances that are rejected shall be marked and removed from the site.
- I. Do not install pipe when the trench contains water. Water that is encountered in the trench shall be removed to the extent necessary to provide a firm subgrade and to prevent the entrance of water into the pipeline.
 1. Surface runoff shall be diverted as necessary to keep excavations and trenches free from water during construction.
 2. The excavation or trench shall be kept free from water until the structure and/or pipe to be installed is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.
 3. The installed pipe shall not be used to dewater the trench.

5.1.4 Products and Execution

- A. General
 1. All piping shall be supplied by one manufacturer.
 2. All materials used in the construction of gravity sanitary sewer collection systems shall be new.
 3. Construction Staking.
 - a. Reference construction specification 4.4.3, Fill and Backfill.
 - b. Horizontal alignment shall remain uniform between consecutive manholes and shall not deviate from the District's accepted Construction Drawings.
 - c. Vertical alignment shall remain uniform between consecutive manholes and shall not deviate from the District accepted Construction Drawings by more than ¼-inch, as measured from the pipe invert.
 - d. Joint Deflection: A maximum of seventy-five percent (75%) of the manufacturer's recommendation.
- B. Inspection
 1. Pipe barrel and manholes shall be free of dirt or other foreign objects prior to installation.

2. Pipe and manholes shall be inspected for cracks, dents, abrasions, or other flaws prior to installation.
 3. Damaged or flawed pipe or manholes shall be rejected, marked, and removed from the site.
 4. Operational Inspection: At the completion of the project, in the presence of the District, and as required by the District, the Contractor shall open all manholes and camera all lines to ensure that no debris is left in the lines/manholes and the lines are not plugged.
- C. Preparation
1. Trenching, Backfilling, and Compaction. Reference construction specification Section 4.
 2. Existing Utilities
 - a. The horizontal and vertical location of existing utilities shall be field verified prior to the start of construction.
 3. Contractor to protect all existing utilities and all damaged items shall be repaired or replaced to the satisfaction of the District and utility owners at the Contractor's expense.
 4. Any deviation from what is shown on the approved Construction Drawings shall be reported to the District immediately for approval and documented on the As Constructed Record Drawings.
- D. Connections to Existing System
1. Main connections to the District's existing sanitary sewer collection system shall be made at an existing manhole or by setting a new manhole on the existing line. A watertight plug shall be installed in the new line and secured to the manhole to prevent any material or the plug from entering the existing system until the District accepts the new system.
 2. At locations where a connection to an existing sanitary sewer collection main is to be made, the Contractor shall locate the existing main both vertically and horizontally and verify its exact size and material prior to the start of construction. Report any difference from the design to the District and the Design Engineer to verify the suitability of the design.
 3. The District personnel will examine the existing pipe or manhole. Any necessary adjustments in line, grade, or connection requirements to accomplish the connection shall be reviewed and accepted by the District prior to making the connection.
- E. Pipe Installation
1. The only acceptable methods for laying sanitary sewer lines shall be with a laser.
 2. Pipe Laying
 - a. Pipe shall be installed according to the manufacturer's recommendations.
 - b. Pipe installation shall begin at the lowest elevation and proceed upstream to the highest unless prior written approval is obtained from the District.
 - i. Pipe shall be installed so that the bells are pointing uphill.
 - ii. Lay pipe true to line and grade.
 - c. Take effective measures to prevent the opening of joints during bedding and backfilling operations.
 - d. Complete the joint in accordance with the applicable pipe material specification and adjust the pipe to the correct line and grade as each length of pipe is placed in the trench. Make

adjustments in line and grade by scraping away or filling pipe bedding under the entire length of the pipe, except at bells, and not by edging, blocking, or mounding up the pipe or bells.

- e. Secure the pipe in place with the specified bedding tamped under and around the pipe except at the joints.
 - i. Do not disturb the pipe after the jointing has been completed.
 - ii. Do not use mechanical compacting equipment in the zone above the horizontal centerline of the pipe and below a plane one (1) foot above the top of the pipe.
 - f. Do not walk on the pipe or otherwise disturb the pipe after the jointing has been completed.
 - g. PVC piping placement:
 - i. Do not lay pipe when the temperature is below forty (40) degrees F, or above 90 degrees F when exposed to direct sunlight.
3. Sewer Crossing
- a. Where sanitary sewer lines cross beneath potable water lines with less than eighteen-inches (18") clearance, sanitary sewer lines cross above potable water lines, or the ten (10) feet horizontal clearance between potable water lines and sanitary sewer lines cannot be maintained, pipe encasement shall be provided.

5.2 SANITARY SEWER SERVICES LINES

5.2.1 General

- A. This section addresses the furnishing and installation of sanitary sewer service lines, clean-outs, and other appurtenances.
- B. Reference construction specification Sanitary Utility Sewer Piping.

5.2.2 Products and Execution

- A. General
 - 1. Sanitary sewer service connections shall be installed at locations designated on the District's accepted Construction Drawings.
- B. Pipe
 - 1. Piping shall be a minimum of four inches (4") in diameter.
- C. Sanitary Service Saddle
 - 1. Contractor to supply a service saddle for connection to existing sewer mains.
 - 2. Contractor to supply service wyes for connection to new sewer mains.
 - 3. Saddles shall be romac part # 218-480 4U sewer saddle.
- D. Flexible Couplings
 - 1. Flexible coupling may be used when bell and spigot pipe joints cannot be made.

2. Acceptable flexible coupling manufacturers are:
 - a. Fernco – Strong Back
 - b. Or approved equivalent.

- E. Trenching, Backfilling, and Compaction
 1. Reference construction specification Section on Excavation and Fill.

- F. Taps
 1. Unless the District gives prior approval, District personnel must be present to observe all service taps on existing mains. Tapping of existing sewer line and manholes to be scheduled with the District at least seventy-two (72) hours prior to construction.
 - a. For connection to existing manholes, contractors shall install the connection and be accepted by District personnel.
 2. Any connection to existing manholes shall require the installation of a flow channel per District Standard Drawings.
 3. The Contractor shall not make any taps without permission from the District.
 4. Wyes and bends shall not be permitted for service connections unless previously approved in writing by the District.
 5. Taps shall not be made within five (5) feet of a manhole.
 6. The spring line of the service connection shall be a minimum of one inch (1”) above the spring line of the sanitary sewer collection main and no closer than three (3) feet to the bell or spigot of the pipe.

- G. Service Lines
 1. All sanitary sewer services shall be extended at a constant grade from the tap on the collection main to the building.
 2. Sanitary sewer service lines shall be uniform in size from the tap to the building.
 3. Sanitary sewer service trenches shall be subject to compaction specifications.
 4. The end of all sanitary sewer services will be plugged with an airtight cap or plug.
 5. The end of all sanitary sewer services shall be marked with a two inch by four inch (2” x 4”) exterior grade, pressure treated lumber post.
 - a. All wooden posts shall extend from the end of the service to a point two (2) feet, minimum, above the ground surface and shall be painted green.
 - b. An adequate steel stake that can be located by a ferrous metal detector should be placed at the end of the service. The steel shall be installed at an adequate depth so it will not be disturbed by grading and construction operations.
 - c. Maintenance of the marker posts shall be the responsibility of the Contractor until the sanitary sewer system has been accepted by the District. After the system has been accepted by the District, the Owner or Developer shall be responsible for maintaining the marker posts until the service line is completed to a structure.
 6. Tracer Wire
 - a. Tracer wire shall be installed per Sewer Standard Drawings.

7. Test Station
 - a. Test stations shall be installed per Sewer Standard Drawings.
 - b. Test stations to be installed by builder at service cleanout near structure.

5.3 SANITARY UTILITY SEWER MANHOLES, FRAMES, AND COVERS

5.3.1 General

- A. This section addresses sanitary sewer manholes and includes the acceptable products, materials, and construction practices to be used in the construction and installation of manholes.
- B. Manholes shall be furnished with all accessories, including base, cone section, gaskets, and ring and cover.

5.3.2 Submittal Requirements

- A. Conform to bid document requirements
- B. Submit manufacturer's data and details of following items for approval:
 1. Shop drawings of manhole sections, base units and construction details, jointing methods, materials, and dimensions
 2. Summary of criteria used in manhole design including, as minimum, material properties, loading criteria, and dimensions assumed. Include certification from manufacturer that concrete manhole design meets or exceeds the load and strength requirements of ASTM C478 and ASTM C857, reinforced in accordance with ACI 440.1R-15.
 3. Frames, grates, rings, and covers
 4. Materials to be used in fabricating pipe drop connections
 5. Materials to be used for pipe connections
 6. Materials to be used for stubs and stub plugs, if required

5.3.3 Products and Execution

- A. General
 1. AASHTO HS-20 design, or as required loading applied to manhole cover and transition and base slabs.
- B. Product Delivery, Storage, and Handling
 1. Manholes shall be delivered, handled, stored, and protected in such a manner as to prevent damage to materials. Rubber gaskets shall be stored in a clean area away from grease, oil, ozone producing electric motors, heat, and direct rays of the sun.
 2. All joint surfaces shall be free from dirt, oil, and grease at the time of installation.
- C. Precast Concrete Manholes
 1. Precast manhole bases, barrels, and cone sections shall be manufactured in accordance with ASTM C478 and shall be made with Type I/II cement. All cone sections shall be the eccentric type, with the exception of shallow (flat top) manholes

2. Concrete and Reinforcing Materials

- a. All reinforcing materials shall conform to ASTM A1064, ASTM A615, and ASTM A996.
- b. Provide concrete manhole sections, monolithic base sections, and related components
 - i. Provide base riser section with monolithic floors, unless shown otherwise
 - ii. Provide riser sections joined with bell and spigot / ship-lap design, seamed with butyl mastic and or rubber gaskets (ASTM C990), so that on assembly, the manhole base, riser, and top section make a continuous and uniform manhole structure
 - iii. Construct riser sections for concrete manholes from standard concrete manhole sections of the diameter indicated on drawings. Each manhole shall be marked with the following information:
 - Manufacturer's name or trademark
 - Manufacturer's location
 - Production Date.
 - iv. Manhole joints shall be assembled with a bell/spigot or shiplap butyl mastic and/or gasketed joint so that on assembly, the manhole base, riser, and top section make a continuous and uniform manhole. Joint sealing surfaces shall be free of dents, gouges and other surface irregularities that would affect joint integrity.
 - v. Minimum clearance between wall penetrations and joints shall be according to the manufacturer's design.
 - vi. Construct invert channels to provide smooth flow transition with minimal disruption of flow at pipe-manhole connections. Invert slope through the manhole is as indicated on the drawings.

D. Grade Adjustment Rings

1. Precast grade adjustment rings shall be manufactured in accordance with ASTM C478 and shall be made with Type I/II cement.
2. Grade adjustment rings shall be a maximum of 8 inches (8").
3. High Density Polyethylene (HDPE) grade adjustment rings shall be manufactured in accordance with ASTM D4976. Acceptable manufacturers are:
 - a. LADTECH, Inc.
 - b. Or approved equivalent.

E. Grout – Concrete Manhole

1. Grout shall be pre-mixed or job-mixed non-shrink and non-metallic.
2. The acceptable types and manufacturers for pre-mixed, non-shrink, non-metallic grout are:
 - a. QUIKRETE[®] - Hydraulic Water – Stop Cement #1126
 - b. DAYTON Superior – Re-Crete 20 Minute Set.
 - c. Or approved equivalent.

F. Ring and Cover

1. All rings shall be a maximum of eight inches (8") in height and have an internal diameter of twenty-four inches (24").

2. Standard iron ring and covers shall be HS-20 load capable gray iron conforming to ASTM A48 Class 305B, with a black bituminous finish.
 - a. The word "SEWER" shall be cast in the cover.
 - b. Horizontal bearing surfaces of all rings and covers shall be machined to eliminate any rocking action or non-uniform bearing.
 - c. Pick-hole shall be one and one-half inch (1 ½") wide by one-half inch (½") deep. Acceptable rings and covers are:
 - i. Castings, Inc. – MH-250-24 CI
 - ii. Or approved equivalent.
 - d. For manholes in traffic areas, covers shall be HS-20 load-capable and meet the same criteria listed above. For non-pedestrian traffic areas, covers shall be non-perforated checker pattern with maximum 3/16 inch (3/16") raised pattern. For pedestrian traffic areas, manhole covers shall also have a non-skid pattern, complying with the American with Disabilities Act requirements. Acceptable ADA covers are:
 - i. Castings, Inc. – MH-310-24CI
 - ii. Or approved equivalent.
 3. Manhole covers located within designated one hundred (100) year floodplains and areas subject to water inundation shall meet the criteria listed above for standard iron ring and covers as well as the following:
 - a. Cover shall be the non-perforated, solid, bolt-down, gasket-type cover.
 - b. Gasket shall be one eighth by three-fourths inches (1/8"x3/4") Rubber or approved equivalent.
 - c. Ring and covers shall be HS-20 load capable gray iron conforming to ASTM A48 Class 30, with a black coat finish.
 - d. The word "SEWER" shall be cast in the cover.
 - e. Acceptable manufacturers are:
 - i. Castings, Inc.
 - ii. Or approved equivalent.
- G. Manhole Joint Wrap and Exterior Coatings
1. Manhole joint wrap twelve inch (12") wide conceal if groundwater is present.
 2. Exterior manhole/vault shall be coated with TNEMEC Series 46-465 if groundwater is present.
- H. Connections to Existing Manholes
1. Construct in such a manner that the finished work conforms to the requirements specified for new manholes.
 2. Connections shall be made by core-drilling as small a hole as necessary to insert the new pipe and modular sealing unit. Chipping or breaking out manhole walls is not allowed. Use of a rotary hammer is not acceptable.
 3. Grind the existing manhole base to the cross-section of the new pipe and finish with grout to form a smooth, continuous invert. Chipping or breaking out the manhole base is not acceptable.

4. Seal the annular space between the pipe and existing manhole wall with a modular sealing unit and smooth finish inside the manhole wall with non-shrink grout.
5. Flow is to be maintained through temporary pumping. Prior approval of the proposed pumping plan shall be obtained from the District.

5.4 SEWER AND MANHOLE TESTING

5.4.1 General

- A. This section addresses the testing of sanitary sewer collection mains, manholes, and appurtenances.
- B. All sanitary sewer pipelines shall be air tested per these specifications.
- C. All sanitary sewer manholes shall be vacuum tested per these specifications.
- D. All sanitary sewer collection systems shall be video inspected per these specifications.

5.4.2 References

- A. ASTM International (ASTM): C1244, Standard Test Method for Concrete Sewer Manholes by Negative Air Pressure (Vacuum) Test Prior to Backfill, latest revision.
- B. F1417, Standard Test Method for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air, latest revision.

5.4.3 Submittal Requirements

- A. Video Inspections
 1. Flash Drives or USB portable hard drives
 - a. Submit Flash Drive or USB portable hard drives of completed, narrated, color digital videos identified by Project name, street name, right-of-way property name, and manhole numbers.
 - b. Flash Drives or USB portable hard drives become the property of the District
 2. Inspection Logs
 - a. Submit cleaning and television inspection logs of all newly installed sewer lines, manholes, structures, and all connections to an existing sewer line.
 - b. Cleaning and television inspection logs shall be submitted prior to the request for progress payment, pay applications, or prior to substantial completion. Failure to provide an inspection log may result in delay of substantial completion or progress payments.
 - c. Include the following minimum information
 - i. Stationing and location of lateral services, wyes, or tees
 - ii. Date and clock time references
 - iii. Pipe joints
 - iv. Infiltration/Inflow defects
 - v. Cracks
 - vi. Leaks
 - vii. Offset joints

3. Submit a specific, detailed description of the proposed bypass pumping system, including a written description of the plan addressing schedule, quantity, and location of pumping equipment.
4. Submit a spill plan to address any spills that might occur.
5. Field Quality-Control Submittals: Indicate results of Contractor-Furnished tests and inspections.

B. Vacuum Testing

1. Submit the following items prior to the start of testing
 - a. Testing procedures
 - b. List of test equipment
 - c. Testing sequence schedule
 - d. Provisions for the disposal of flushing and test water
 - e. Certification of test gauge calibration
 - f. Test and Evaluation Reports: Indicate results of manhole tests
 - g. Submit qualifications for the applicator

C. Air Testing

1. Submit the following items prior to the start of testing
 - a. Testing procedures
 - b. List of test equipment
 - c. Testing sequence schedule
 - d. Provisions for the disposal of flushing and test water
 - e. Certification of test gauge calibration
2. Test and Evaluation Reports: Indicate results of piping tests

5.4.4 Products and Execution

A. General

1. Testing shall be conducted when:
 - a. Backfill and compaction has been completed, but before paving and curb and gutter improvements are installed.
 - b. Line and manholes have been thoroughly cleaned of all foreign material.
2. The Contractor shall furnish all equipment, labor, and incidentals necessary to perform tests. The pressure gauge shall be capable of indicating pressure to the nearest 0.1 pounds per square inch (psi) increment.
3. The District shall witness tests and record times, leakage readings, and pressure over the test period. Contractor shall provide the District with a minimum forty-eight (48) hours advance notice of any tests.

B. Video Inspections

1. Flash Drive or USB portable hard drive
 - a. Description: Digital video formatted files

- b. Audio track containing simultaneously recorded narrative commentary and evaluations of the videographer, describing in detail the condition of the pipeline interior.
- C. Vacuum Testing
- 1. Equipment
 - a. Vacuum pump
 - b. Vacuum line
 - c. Vacuum tester base
 - i. Compression band seal
 - ii. Outlet port
 - d. Shutoff valve
 - e. Stopwatch
 - f. Plugs
 - g. Vacuum Gauge: Calibrated to 0.1 in. Hg
- D. Air Testing
- 1. Equipment
 - a. Air compressor
 - b. Air supply line
 - c. Shutoff valves
 - d. Pressure regulator
 - e. Pressure relief valve
 - f. Stopwatch
 - g. Plugs
 - h. Pressure Gage: Calibrated to 0.1 psi
- E. Air Testing Sanitary Sewer Mains
- 1. Conduct tests in conformance with ASTM F1417 and these specifications.
 - 2. All pressures in this section assume no groundwater back pressure; if groundwater is present, increase test air pressures to compensate for the back pressure. Each foot of groundwater produces approximately 0.433 psi back pressure. For groundwater in excess of five feet (5') above the pipe crown, an infiltration test shall be used in lieu of air testing.
 - 3. Preparation for tests:
 - a. Flush and clean the sewer line prior to testing in order to wet the pipe surfaces and produce more consistent results.
 - b. Provide a relief valve on the pressuring equipment to avoid over-pressurizing and damaging an otherwise acceptable line. Set the relief valve at 5.0 psi.
 - c. Plug and brace all openings in the main sanitary sewer line and the upper connections. Check all pipe plugs with a soap solution to detect any air leakage. If leaks are found, release the air pressure, eliminate the leaks, and start the test procedures over again.
 - d. Please see the following table for testing durations:

Table 5: Specified Test Duration for Length of Pipe Indicated (Duration indicated in min:sec)

Pipe Diameter (in)	Pipe Length (ft)						
	0-	200	250	300	350	400	500
8	7:34	7:34	7:34	7:36	8:52	10:08	12:38
10	9:26	9:26	9:53	11:52	13:51	15:49	19:45
12	11:20	11:24	14:15	17:05	19:56	22:47	28:26
15	14:10	17:48	22:15	26:42	31:09	35:36	44:26

4. Sections of the pipe that fail the air test shall have the defects repaired and the test repeated.
- F. Vacuum Testing Manholes
1. Manholes shall be tested before the ring and cover and grade adjustment rings are installed, and after backfill and compaction are complete.
 2. Conduct tests in conformance with ASTM C1244 and these specifications.
 3. Preparation for tests:
 - a. All lift holes, joints, and other imperfections shall be filled with an approved non-shrink grout, to provide a smooth finish appearance.
 - b. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.
 4. Test Procedure:
 - a. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendation.
 - b. A vacuum of ten inches (10") mercury shall be drawn in the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off.
 - c. The time shall be measured for the vacuum to drop to nine inches (9") mercury.
 - d. The manhole shall pass if the time for the vacuum reading to drop from ten inches (10") mercury to nine inches (9") mercury meets or exceeds the values indicated in the following table:

Table 6: Manhole Testing Durations

Depth ¹ (ft)	Diameter (in)		
	48	60	72
	Time (seconds)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

¹Round actual depth of manhole to next depth up (ex. 11 foot deep manhole, use depth of 12 feet).

5. If the manhole fails any test, necessary repairs shall be made by an approved method, and the manhole shall be retested until a satisfactory test is obtained.

6 CONSTRUCTION WARRANTY

6.1 CONSTRUCTION WARRANTY PERIOD

- A. The term "construction warranty period" is hereby defined to be two years from the issuance of a substantial completion certificate. The request for the substantial completion certificate may be initiated by the district or the developer but, in all cases, is the sole responsibility of the developer.

6.2 INITIAL INSPECTION OF COMPLETED IMPROVEMENTS

- A. Upon receiving the request for a substantial completion certificate and prior to accepting any building permits, the district shall inspect the completed improvements for compliance with approved standards and issue a punch list of repairs if needed.
- B. The lack of any punch list items does not relieve the developer from any responsibilities for repairs/replacements which may develop due to inadequate design, workmanship or materials during the two-year warranty period. This initial inspection will be used to determine the limitation of responsibilities, if any, of the developer.
- C. If there are no significant deficiencies, a certificate of substantial completion will be issued, subject to any and all requirements of the inspection.

6.3 INTERMEDIATE INSPECTION OF COMPLETED IMPROVEMENTS

- A. Prior to the expiration of the two-year warranty period, the district may schedule, in its sole discretion, an intermediate inspection of the completed improvements to determine if any repairs/replacements are required. This intermediate inspection, if scheduled, shall occur no later than 120 days prior to the expiration date of the construction warranty period. Any repairs/replacements identified must be completed prior to the final inspection.

6.4 FINAL INSPECTION OF COMPLETED IMPROVEMENTS

- A. 30 days prior to the expiration of the two-year warranty period, the district will schedule a final inspection of the completed improvements. If there are no significant problems, a final acceptance certificate will be issued, at which time the district accepts the completed public improvements and relieves the developer of any further responsibilities.
- B. If there are significant repairs/replacements unresolved, the district will require the permittee to complete the repairs/replacements, or the district, at the district's option, may utilize the financial guarantee provided to construct the needed repairs/replacements.
- C. No inspection that is conducted by the District shall represent a warranty or guarantee of performance. The District will certify that an inspection was conducted, but will not certify that any work inspected is complete and free from error. Inspections are a point-in-time evaluation and are not to be relied upon as evidence of satisfactory completion.