ARTICLE 1. TITLE, SCOPE AND GENERAL CONDITIONS

1.0 GENERAL PROVISIONS.

1.1 GENERAL.

1.1.1 **TITLE**. These Technical Standards and Specifications make up Part 2 of Volume I of the Roxborough Water and Sanitation District Rules and Regulations, and will be referred to herein as the Technical Standards and Specifications.

1.1.2 **PURPOSE**. The purpose of these Technical Standards and Specifications is to provide acceptable standards of design and construction for all improvements to the District's facilities that includes water and wastewater systems and facilities.

1.1.3 **APPLICABILITY**. These Technical Standards and Specifications shall apply to the construction, alteration, removal, or repair of District facilities. These Technical Standards and Specifications shall apply to District contracts, Customer/Owner contracts, Owner/Developer contract and private contracts.

All work on District water and wastewater systems shall comply with these Technical Standards and Specifications, including the applicable standard detail drawings that will be provided as needed or upon request.

1.1.4 **DISTRICT REPRESENTATION**. The District may appoint an engineer, construction inspector, or District employee to act on its behalf with respect to these Technical Standards and Specifications.

1.1.5 **ALTERNATE MATERIALS AND METHODS OF CONSTRUCTION**. The provisions of these Technical Standards and Specifications are not intended to prevent the use of materials or methods of construction not specifically prescribed by these procedures. The District will require that sufficient evidence or proof be submitted to substantiate quality and suitability of alternates. Alternate materials or methods shall not be used without written approval of the District.

1.1.6 **MODIFICATIONS**. When special conditions are encountered, the District may require modifications to, or deviations from these Technical Standards and Specifications to protect interests of the District. In such cases the decision of the District shall be final. Modifications or deviations shall be in conformity with the intent and purpose of these Technical Standards and Specifications and shall not lessen any design requirement or any degree of system integrity. The District shall issue authorization for modifications or deviations to the Technical Standards and Specifications in writing.

1.1.7 **TESTS**. The contractor as required by these Technical Standards and Specifications shall perform testing. In cases where there is insufficient evidence of compliance with the provisions of these Technical Standards and Specifications, or evidence that any material or construction does not conform to these Technical Standards and Specifications, the District may direct the contractor to perform additional testing as required to demonstrate compliance. Test methods will be as specified by these Technical Standards and Specifications or by other recognized test standards. If recognized and accepted test methods do not exist, the District will determine test procedures.

All testing will be performed by a testing agency approved by the District. A copy of all test reports shall be submitted directly to the District, by the testing agency. The contractor shall pay the cost of testing.

1.1.8 **INTERPRETATION AND ENFORCEMENT**. The District, or a District appointed representative, will interpret and enforce these Technical Standards and Specifications. Interpretations issued by the District will be final.

If work is performed contrary to the provisions of these Technical Standards and Specifications, the District may order the work stopped by a written notice to persons engaged in the doing or causing such work to be done, and such persons will immediately stop work until authorized by the District to proceed.

1.1.9 **LIABILITY.** The liability of the District and its employees is controlled and limited by the Colorado Governmental Immunity Act, 24-10-101 *et seq., C.R.S.* The District assumes no responsibility for contractors constructing facilities for private developers, whether or not the District has consulted with the developer or inspected any such construction and whether or not such facilities may eventually be conveyed to the District for the maintenance of facilities and for their safety commences only when such facilities are actually conveyed to the District. Consultants to the District, including but not limited to the District's engineer and contract operations firm, likewise assume no responsibility for the safety or sufficiency of any construction or work conducted by or for a private developer.

Where the District contracts with any contractor, the particular obligations of the District to that contractor shall be specified in the contract.

1.1.10 **PROHIBITED ACTIONS**. No person, firm, or corporation shall construct, alter, repair, or improve, any District facilities, or permit the same, in violation of these Rules and Regulations as specified in **Part 1, Administrative Policies and Procedures, Article 7.2, Prohibited Acts**.

1.1.11 **EMERGENCY WORK**. Contractors hired by the District to perform emergency work such as repair of pipeline leaks, shall comply with any applicable sections of these Technical Standards and Specifications, including insurance requirements. To ensure that contractors performing emergency work comply with the insurance requirements of these Technical Standards and Specifications, only pre-approved contractors will be allowed to perform emergency work within the District.

Contractors performing emergency work shall not be required to obtain a permit prior to performing the work.

1.1.12 **INSURANCE REQUIREMENTS**. The Contractor shall not commence work pursuant to any permit until he has obtained all insurance required by these Technical Standards and Specifications, nor shall the contractor allow any subcontractor to commence work until all similar insurance required of the subcontractor has been obtained and approved.

1. **PUBLIC LIABILITY AND PROPERTY DAMAGE INSURANCE**. The contractor shall carry Comprehensive General Liability / Auto Liability insurance in the amount specified. All subcontractors shall be required to carry Comprehensive General Liability and Automobile Liability insurance in an amount equal to that required by the contractor. The District shall be listed as

an additional insured on the contractor's, and on each subcontractor's, comprehensive general liability insurance policy and auto liability insurance policy. Each additional insured endorsement shall contain a primary insurance clause providing that the coverage afforded to the District as an additional insured is primary and that any other insurance or self-insurance available to the District is non-contributing.

Contractor agrees that it will indemnify and hold harmless the District, the District's engineer and all of their consultants, agents and employees from any loss, cost, damage, expense and liability including attorney's fees, by reason of property damage, personal injury, or both, arising out of or as a result of the contractor's work, or any negligent act or negligent failing to act, or on account of the use of improper or defective materials, or on account of any poor workmanship or on account of any act of omission or commission in connection with the performance of work by contractor, its employees, agents and subcontractors. In any and all claims by or against the District, the District's engineer and their consultants, agents and employees, the indemnification obligation of this paragraph shall not be limited by any required policy of insurance.

2. **PROOF OF INSURANCE**. Prior to the commencement of any work under this contract, the contractor shall furnish to the District certificates of insurance to prove that all required insurance is in force, including the required additional insured endorsement described above, and shall require any subcontractor to submit similar evidence before undertaking work under this contract. Each insurance policy shall contain a clause providing that it shall not be canceled or materially altered without ten (10) days' written notice to the District. The District reserves the right to review the insurance coverage and to deny a permit if, in the Districts sole discretion, such coverage is not adequate. Neither acceptance by the District of any insurance supplied by a contractor or subcontractor, nor failure to deny a permit due to inadequacy of insurance, shall relieve the contractor or subcontractors of their obligation to maintain the required insurance in full force during the period of time work is performed under the permit.

3. **COVERAGES**. Contractors performing work under a field work permit, other agreement, and a **Water/Sewer Connection Permit/Availability of Service Certificate, Part 1, Administrative Policies and Procedures, Article 6.2,** shall maintain the following minimum insurance coverage and limits:

a. **Commercial General Liability**

General Aggregate	$2,000,000
Products and Completed Operations	$1,000,000
Personal & Advertising Injury	$1,000,000
Each Occurrence	$1,000,000

In order to ensure that there are no impaired aggregates, a per job aggregate is required.

All coverage's shall be continuously maintained to cover all liability, claims, demands and other obligations assumed by the Contractor pursuant to this agreement. A claims-made policy may satisfy these insurance requirements, provided that the necessary retroactive dates and extended

reporting periods are procured by the Contractor to maintain such continuous coverage.

b. Comprehensive Automobile Liability Insurance. Coverage shall include all motor vehicles owned, hired, leased or borrowed, with a minimum combined single limit for bodily injury and property damage of not less than $1,000,000 each occurrence, and $1,000,000 aggregate.

c. Umbrella Policy. Coverage to be in excess of the commercial general liability and automobile liability limits of $1,000,000.

d. Workers Compensation. All contractors and subcontractors shall maintain workers compensation insurance in accordance with state law.

1.2 CONDITIONS OF THE WORK

1.2.1 **WORKING HOURS**. All work completed under these Technical Standards and Specifications shall be performed during posted Regular Working Hours. The Contractor shall not perform work outside of Regular Working Hours or on Saturday, Sunday or any District holiday without written consent of the District.

1.2.2 **EMERGENCIES**. When, in the opinion of the District, an emergency arises due to work under these Technical Standards and Specifications, and immediate action is necessary to protect public or private interests, the District may, with or without notice to the contractor or the developer, perform the required work to mitigate the emergency. The contractor or developer will pay for the cost of such work. The performance of emergency work by the District shall not relieve the contractor of responsibility for damages resulting from the performance of work under these Technical Standards and Specifications**.**

In the event of an emergency that threatens loss of life or extensive damage to the work or to adjoining property, the developer or contractor is authorized to take the necessary action to prevent such loss or damage. **Part 1, Article 9.1.3, Emergencies**.

1.2.3 **DAILY CLEANUP**. At all times during construction, the contractor shall maintain the site, partially finished structures, streets, material stockpiles and other like areas in a fit and reasonable state of order and cleanliness.

1.2.4 **FINAL CLEANUP**. Upon completion of the work, the contractor shall remove from the project area all surplus and discarded materials, rubbish, and temporary structures, and leave the project area in a neat and presentable condition. The contractor shall restore all work that has been damaged by his operations.

The contractor shall inspect the interior of all manholes and catch basins within the construction limits for construction materials, dirt, stones, or other debris resulting from the activities of the contractor, and shall remove all debris found.

1.2.5 **AUTHORITY OF DISTRICT**. The District will have the authority to stop the work whenever such stoppage may be deemed necessary. The District will resolve all questions that arise as to the quality and acceptability of materials furnished, work performed, interpretation of the plans and specifications, and acceptable fulfillment of the requirements of these Technical Standards and Specifications.

1.2.6 **AUTHORITY AND DUTIES OF INSPECTOR**. The District inspector will inspect, and accept or reject, all work completed and all material furnished. Inspections may extend to any part of the work, and to the preparation, fabrication, or manufacture of the materials. The inspector is not authorized to revoke, alter, or waive any requirements of these Technical Standards and Specifications. See **Part 1, Administrative Policies and Procedures, Article IX, Inspections and Enforcement of Water and Wastewater Regulations**.

The inspector shall not act as foreman or perform other duties for the contractor, nor interfere with the management of the work performed by the contractor. Instructions or advice given by the inspector will not be binding upon the District, or release the contractor from fulfilling the terms of these Technical Standards and Specifications.

The presence or absence of the inspector will not relieve the contractor of the responsibility of complying with these Technical Standards and Specifications.

The inspector will at all times have reasonable and safe access to the work, and the contractor shall provide proper facilities for such access. See **Part 1, Administrative Policies and Procedures, Article 3.3, Right of Entry**.

1.2.7 **CONTRACTOR'S RESPONSIBILITY FOR WORK**. The contractor shall be responsible for controlling and supervising the work. It shall be the responsibility of the contractor to ensure that all work is constructed in accordance with these Technical Standards and Specifications.

1.2.8 **REMOVAL OF UNACCEPTABLE WORK**. Work that does not conform to these Technical Standards and Specifications will be considered unacceptable work. Unacceptable work shall be immediately removed and replaced, or otherwise corrected by the contractor.

1.2.9 **SCHEDULING OF WORK**. Work shall be accomplished in accordance with a schedule approved by the District. Deviations from the approved schedule shall be made only with written approval of the District.

1.2.10 **SAMPLES AND TESTS**. Sampling and testing will be in accordance with standard practices unless methods and procedures are otherwise set forth in these Technical Standards and Specifications.

The contractor shall furnish all samples, tests and reports required by the District to determine compliance of materials with these Technical Standards and Specifications. The contractor may be required to furnish a written statement identifying the origin, composition and process of manufacture of a material.

1.2.11 **STORAGE OF MATERIALS**. Materials shall be stored in a manner that insures the preservation of their quality and suitability for the work. Materials shall be stored only in locations approved by the District.

1.2.12 **DEFECTIVE MATERIALS**. Materials not in conformance with requirements of these Technical Standards and Specifications will be considered defective and will be rejected. Rejected materials shall be removed from the work site within 24 hours.

1.2.13 **LOCAL LAWS, ORDINANCES AND CODES**. The contractor shall comply with all current federal, state and local laws, codes and ordinances pertaining to the work

being performed. The contractor shall obtain all necessary permits and approvals prior to commencement of the work.

1.2.14 **PUBLIC CONVENIENCE AND SAFETY**. The contractor shall erect the appropriate barricades, signs, or other safety measures, provide for adequate drainage around the work, and take other necessary precautions to safeguard the work and the public.

Fire hydrants shall remain visible from the street and accessible to the Fire Department at all times. No obstructions shall be placed within ten (10) feet of a fire hydrant.

1.2.15 **LOCATION OF EXISTING UTILITIES**. The contractor shall have all underground utilities located by the appropriate utility company prior to commencing work. The contractor shall avoid unnecessary exposure of underground utilities and shall protect underground utilities from damage due to performance of the work. The contractor shall not hinder or interfere with any person engaged in the protection or operation of underground utilities.

The District will locate existing water and sewer system underground facilities. The contractor shall request location of District facilities at least 48 hours prior to commencing excavation. Excavation shall not begin until the District has located pipelines and other facilities.

1.2.16 **PROTECTION AND RESTORATION OF PROPERTY AND SURVEY MONUMENTS**. The contractor shall prevent damage to public or private property adjacent to the work. The contractor at his expense shall restore property damaged by the contractor's operations. At least seventy-two (72) hours prior to commencing work the contractor shall give written notice to owners of property that may be affected by the contractor's operations.

The contractor shall protect and preserve existing survey monuments. Monuments disturbed or removed by the contractor shall be referenced and replaced by a professional land surveyor registered in the State of Colorado, at the contractor's expense.

1.2.17 **USE OF EXPLOSIVES**. When blasting is permitted, the contractor shall use the utmost care to protect life and property. Blasting will be permitted only when approved in writing by the District. A licensed Blasting contractor shall perform blasting.

Excessive blasting or Overshooting will not be permitted. The District may order discontinuance of any method of blasting which leads to overshooting, is dangerous to the public, or destructive to property or to natural features.

1.2.18 **PROTECTION OF STREAMS, LAKES AND RESERVOIRS**. The contractor shall take the necessary precautions to prevent pollution of streams, lakes, and reservoirs with fuels, oils, bitumen's, calcium chloride, or other harmful materials. Contractor operations shall be conducted in a manner that prevents or minimizes the release of silt or other materials to drainages, streams, lakes and reservoirs. An erosion control plan shall be submitted to the District for approval prior to starting work. The erosion control plan shall comply with the Douglas County Storm Drainage and Technical Criteria Manual.

1.2.19 **DUST CONTROL**. The Contractor shall take the necessary steps to control dust arising from operations connected with the work. Sprinkling with water, or other approved methods shall control dust.

1.2.20 **TRAFFIC CONTROL, BARRICADES AND WARNING SIGNS**. Provide safe methods for movement of pedestrians and motorists traveling through the work zone, and a safe work area for all workers engaged in construction activities. All control devices shall be installed and maintained in accordance with Douglas County, Colorado, Colorado Department of Transportation, or Roxborough Park Foundation requirements.“”

The traffic Plan shall be submitted to the District. Work shall not be commenced until the District receives Douglas County, Colorado, Colorado Department of Transportation, or Roxborough Park Foundation approved traffic plans .

1.2.21 **USE OF DISTRICT WATER**. The contractor may purchase, when available, reasonable amounts of water from the District for construction purposes. Water shall be obtained at points designated by the District. All water obtained from the District's system shall be metered by obtaining a Hydrant Meter Permit and hydrant meter from the District. The cost of water shall be as set forth in the District's current **Part 1, Administrative Policies and Procedures, Exhibit A, Schedule of Fees, Rates and Charges**.

1.2.22 **MAINTENANCE OF DRAINAGE**. The contractor shall not prevent or obstruct the flow of water in street gutters or natural drainages, and shall utilize proper methods to maintain the flow of surface water while work is in progress.

1.2.23 **INTERRUPTION OF SERVICES**. Before starting work, the contractor shall plan and coordinate for the disconnection or interruption of all services including water, sewer, cable T.V., telephone, gas, and electric power. Disconnections or interruptions shall be made in accordance with the regulations of the utility that controls the supply of the service.

District approval shall be obtained a minimum of 48 hours prior to disconnection or interruption of water or sewer service. Twenty-four (24) hours prior to the interruption of service, the contractor and or District shall provide written notice to all users whose service will be interrupted. No line shall be shut down for more than a four (4) hour period at one time.

1.2.24 **EQUIPMENT OPERATED ON STREETS**. Only pneumatic-tired equipment shall be permitted to operate over paved surfaces. The contractor shall be responsible for damage to the street surface resulting from his operations.

1.2.25 **MATERIAL SUBMITTALS**. The Contractor shall submit detailed information specifications and drawings for each type of material or equipment proposed for incorporation into the work. The information submitted shall be in sufficient detail to demonstrate compliance with these Technical Standards and Specifications. Materials and equipment shall not be incorporated into the work until approved by the District.

1.2.26 **OPERATION OF DISTRICT SYSTEMS**. Only District personnel shall operate district systems. Developers, contractors, private owners and other persons shall not operate District facilities including valves, fire hydrants, pumps and other system components.

1.2.27 **RESTRICTIONS ON EXCAVATIONS FOR SERVICE LINES**. Excavation for installation of service lines to a single structure will not normally be permitted during the period from December 1 through March 31 of each year. The District may adjust the no-excavation period based on actual weather conditions. Persons wishing to perform excavation during this period will be required to furnish the District with a bond in the amount of $5000, as security for repairs which may be required due to damage the District's existing facilities.

Excavation for installation of service lines to a single structure shall not commence after 1 p.m., without written approval of the District.

1.3 APPROVALS AND INSPECTIONS

1.3.1 **APPROVALS REQUIRED**. Work covered by these Standards and Specifications shall not be commenced until the District has issued a permit covering the proposed work. The District shall be notified two (2) weeks before the planned start of construction.

1.3.2 **APPLICATION FOR DEVELOPER/FIELD WORK PERMIT**. Applicants shall submit an application for a permit for all work covered by these Standards and Specifications. All work except installation of water and sewer services to a single structure, and water and wastewater service stub-outs to a single structure, shall require a separate agreement with the District or an application for Developer/Field Work Permit. See **Part 1, Administrative Policies and Procedures, Article III, Ownership and Operation of Infrastructure,** and **Article VI, Permitting for Individual Service**.

Each application shall:

1. Identify and describe the proposed work.
2. Describe the land on which the proposed work is to be done by legal description, street address, or similar description that will readily identify and definitely locate the proposed work.
3. Indicate the type of work or improvement.
4. Be accompanied by plans, diagrams, computations, specifications, and other data conforming to this **Article 1, Section 1.5, Plans and Specifications**.
5. State the valuation and the quantities of the work to be performed.
6. Be signed by the applicant or his authorized agent.
7. Include a starting and completion date for the work.
8. Provide other data and information as required by the District.

1.3.3 **APPLICATION FOR WATER/SEWER CONNECTION PERMIT/ AVAILABILITY OF SERVICE CERTIFICATE**. When the proposed work includes only the installation of water and wastewater service lines to a single structure, the applicant shall submit an application for Water/Sewer Connection Permit/Availability of Service Certificate, **Part 1**, **Administrative Policies and Procedures**, **Article 6.2, Required Permits**. If water and wastewater service lines are not constructed in a single, continuous operation

from the main to the structure, a Water/Wastewater Stub-in Permit, **Part 1**, **Administrative Policies and Procedures**, **Article 6.2, Required Permits**, will be required, in addition to the Water/Sewer Connection Permit/Availability of Service Certificate.

1.3.4 **APPLICATION FOR WATER/WASTEWATER STUB-IN PERMIT**. When the proposed work includes only the installation of water and/or wastewater service line stub-ins to a single lot, the applicant shall submit an application for Water/Wastewater Stub-in Permit, **Part 1**, **Administrative Policies and Procedures**, **Article 6.2, Required Permits**. The permit application will be completely filled in. A Water/Wastewater Stub-In Permit shall not be required if a Water/Sewer Connection Permit/Availability of Service Certificate, **Part 1, Administrative Policies and Procedures**, **Article 6.2, Required Permits**, has been issued, and the entire service line from the main to the structure will be constructed in one continuous operation.

1.3.5 **APPROVAL OF APPLICATIONS**. The permit application, plans, specifications, insurance certificates and other data submitted by an applicant for a permit will be reviewed by the District. If the District finds that the work described in an application conforms to the requirements of these Technical Standards and Specifications, and that all required fees have been paid, a permit will be issued.

When the District issues a permit for work for which plans are required, the District Manager will endorse the plans in writing. The endorsed plans and specifications shall not be changed, modified, or altered without authorization from the District.

The approval of an application or issuance of a permit will not be construed to be an approval of any violation of the provisions of these Technical Standards and Specifications.

The approval of an application based on submitted plans, specifications or other data shall not prevent the District from requiring the correction of errors in said plans, specifications and other data, or from stopping construction operations which are in violation of these Standards and Specifications.

1.3.6 **FAILURE TO CONNECT/TERMINATION OF WATER/SEWER CONNECTION PERMIT AND THE DEVELOPER FIELD WORK PERMITS**. The Water/Sewer Connection Permit/Availability of Service Certificate shall expire 18 months after the date of issuance. The Developer Field Work Permits shall expire 12 months after the date of issuance.

1.3.7 **SUSPENSION OR REVOCATION OF PERMITS**. The District may suspend or revoke a permit issued under the provisions of these Rules and Regulations if the permit was issued in error, or on the basis of incorrect information supplied by the applicant. In the event a permit is suspended or revoked, permit fees will not be refunded. See **Part 1, Administrative Policies and Procedures Article 6.13, Revocation of Permit**.

1.3.8 **APPROVED PLANS**. The contractor shall keep one copy of the District endorsed plans on site at all times during the work. The District shall have access to the contractor's District endorsed plans at all times during the work.

1.3.9 **INSPECTIONS**. All construction work covered by these Technical Standards and Specifications shall be subject to inspection by the District. **Part 1, Administrative**

Policies and Procedures Article 9, Inspections and Enforcement of Water and Wastewater Regulations.

It shall be the responsibility of the person performing the work to notify the District that such work is ready for inspection. Each request for inspection shall be filed at least one (1) working day before such inspection is required unless otherwise required by these Technical Standards and Specifications. It shall be the responsibility of the person requesting inspections to provide access for proper inspection of the work.

The District will give the contractor written notice of deficiencies noted during an inspection, and may order further construction to cease until all deficiencies are corrected. No partial inspections will be allowed unless prior written approval by the District.

1.3.10 **ADDITIONAL INSPECTIONS AND REINSPECTIONS**. The District may make or require additional other inspections if necessary to ascertain compliance with the provisions of these Technical Standards and Specifications. See **Part 1, Administrative Policies and Procedures, Article 9, Inspections and Enforcement of Water and Wastewater Regulations**.

Reinspection fees may be assessed when work requested to be inspected is incomplete, or when work does not comply with these Technical Standards and Specifications. Reinspection fees may also be assessed when approved plans are not readily available to the inspector or for failure to provide access at the scheduled time of inspection. When Reinspection fees have been assessed, no additional inspection of the work will be performed until the required fees have been paid. See **Part 1, Administrative Policies and Procedures Exhibit A, Schedule of Fees, Rates, and Charges.**

1.4 FEES

1.4.1 **PLAN REVIEW FEES**. Plan review fees shall be paid in full at the time plans and specifications are submitted for approval. Plan review fees shall be as set forth in the District's Schedule of Fees. Plan review fees shall be in addition to permit fees. Plans which require more than two revisions will be assessed a fee, based on the additional time spent by District or District Representative in reviewing. **Part 1, Administrative Policies and Procedures, Exhibit A, Schedule of Fees, Rates, and Charges**.

1.4.2 **PERMIT FEES**. The fee permit fees shall be as set forth in the District's schedule of fees, rates and charges. Permit fees shall be paid prior to issuance of a permit.

1.4.3 **INVESTIGATION FEES**. Work performed without the required District inspections shall be subject to investigation to verify compliance with these Technical Standards and Specifications. The District will determine the extent of the investigation. Fees for inspections and re-inspections will be determined according to the District's current **Part 1, Administrative Policies and Procedures, Exhibit A, Schedule of Fees, Rates, and Charges**.

1.5 PLANS AND SPECIFICATIONS

1.5.1 **GENERAL**. A registered professional engineer, licensed to practice in the State of Colorado, shall prepare plans, computations and specifications for work covered by these Technical Standards and Specifications.

1.5.2 **SUBMITTAL REQUIREMENTS**. The District shall review all construction plans for conformance with these Technical Standards and Specifications. Engineering design shall remain the responsibility of the design engineer.
Plans, specifications and engineering computations shall be submitted to the District for review signed and sealed electronically. CAD file may be required in submittal. No requirement for hard copies submitted. Electronic documents will be returned with review comments.

Once plan comments have been addressed, drawings shall be submitted to the District in pdf format for signature and CAD format for implementation into the GIS system. The shall be signed and sealed by the design engineer. After signature by the District, the signed set shall be returned to the developer. The Contractor shall have a signed electronic or printed copy of plans at the jobsite for the duration of the project.

Upon completion of the work, the developer shall submit as-built drawings electronically in PDF and CAD files for review by the District. Upon approval of the as-built drawings by the District, submit electronically signed and sealed as-builts by the design engineer.

1.5.3 **GENERAL PLAN REQUIREMENTS**. Plans and specifications shall be drawn to scale and shall have sufficient clarity to indicate the location, nature, and extent of the work proposed.

Each set of construction drawings shall include an overall utility drawing, showing water, sanitary sewer, and storm sewers included in the project. The overall utility drawing shall show all of the pipe sizes, locations, connections to existing facilities and other pertinent information that would add to the overall understanding of the project.

The following items shall be shown on all plans:

1. Title Block (lower right-hand corner preferred).

2. Scale (1"=50' horizontal and 1"=5' vertical for plans and profiles).

3. Date and revision.

4. Name of professional engineer or firm.

5. Professional engineer's seal and signature.

6. Provide specific coordinate system and projection information for horizontal and vertical datums including any ground scale factors. Reference the Douglas County a minimum of two (2) specific control points listed below:

POINT NUMBER	LAT/LONG		COLORADO STATE PLANE (ZONE CENTRAL 0502)		DESCRIPTION
	LATITUDE	LONGITUDE	NORTHING	EASTING	
10	39D27’12.35993”	-105D04’04.47409”	1590332.61	3122009.435	ROMANSKI
11	39D28’17.08156”	-105D04’22.48045”	1596874.182	3120566.311	DC 2056310
12	39D30’25.60794”	-105D04’20.30184”	1609878.818	3120675.927	COPP
13	39D27’22.54679”	-105D03’16.24950”	1591381.538	3125786.901	DC 2044120
14	39D28’11.80167”	-105D05’13.37426”	1596321.532	3116577.874	DC 2052137
15	39D26’44.21872”	-105D01’44.91540”	1587539.824	3132970.542	DC 2037106
17	39D26’09.54531”	-105D03’44.26712”	1583984.926	3123624.999	DC 2031125
18	39D30’26.60909”	-105D02’35.04502”	1610020.277	3128924.995	J305
21	39D28’40.08760	-105D03’16.86375	1599226.542	3125700.268	DC 2059120

7. Drawing numbers.

8. Statement:

   All work shall be constructed to the Roxborough Water and Sanitation District Technical Standards and Specifications This drawing has been reviewed and found to be in general compliance with these Technical Standards and Specifications and other District requirements. THE ENGINEERING DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE APPEAR HEREON.

Approved by: _____
Approved Title Date

9. General notes shall include:

   GENERAL NOTES:

   1. A PRECONSTRUCTION MEETING SHALL BE SCHEDULED A MINIMUM OF 48 HOURS AND A MAXIMUM OF 96 HOURS PRIOR TO THE START OF CONSTRUCTION. A PRECONSTRUCTION MEETING WILL NOT BE SCHEDULED UNTIL THE GRADING PERMIT AND ALL OTHER PERMITS HAVE BEEN OBTAINED.

   2. THE CONTRACTOR SHALL HAVE ONE (1) SIGNED COPY OF THE PLANS WHICH HAVE BEEN APPROVED BY ROXBOROUGH WATER AND SANITATION DISTRICT AND ONE (1) COPY OF THE RWSD RULES AND REGULATIONS OF THE ROXBOROUGH WATER AND SANITATION DISTRICT.

   3. ALL CONSTRUCTION SHALL CONFORM TO THE LATEST VERSION OF THE RULES AND REGULATIONS OF THE ROXBOROUGH WATER AND SANITATION DISTRICT.

   4. POTHOLE TO CONFIRM UTILITY CONNECTION POINTS.

   5. ALL SERVICES SHALL BE PERMANENTLY MARKED ON CURB FACE AS FOLLOWS:

      - “X” FOR SANITARY SEWER SERVICES
      - “V” FOR WATER SERVICES

1.5.4 **PLAN SHEET REQUIREMENTS**. All plan sheets shall contain the following information:

1. North arrow.

2. Property lines: indicate lots to be served by solid lines; other property lines dotted.

3. Ownership and/or subdivision information.

4. Street names and easements with width dimensions.

5. Existing utility lines (buried) location and depth water, gas, telephone, storm drain, irrigation ditches, sanitary sewers, and other pertinent details, i.e., houses, curbs, water courses, etc.

1.5.5 **PROFILE SHEET REQUIREMENTS**. All profile sheets shall contain the following information:

1. Vertical and horizontal grids with scales.

2. Ground surface existing (dotted) and proposed (solid)

3. Existing utility lines where crossed.

4. Benchmarks (USGS Datum).

5. Existing manhole invert and rim elevations.

6. Crossings of other pipelines

1.5.6 **WATER SUPPLY CONSTRUCTION DETAILS**. In addition to the requirements listed above, water supply construction plans shall include the following items:

1. Water mains.

    a. Size.
    b. Length.
    c. Materials used and types of joints.
    d. Location dimensions.

2. Fittings.

    a. Tees.
    b. Crosses.
    c. Reducers.
    d. Bends.
    e. Plugs.
    f. Blow-offs.

3. Valves.

4. Fire Hydrants.

5. Plan, profile and complete details for off-site transmission mains, pump stations, special valves, and vaults, tanks, etc.

6. Standard bedding detail (cross-section).

7. Service connections or stub-ins.

8. Complete material list.

9. Applicable District Standard Details

1.5.7 WASTEWATER LINES CONSTRUCTION DETAILS. In addition to the requirements listed above, all sanitary sewer construction plans shall include the following:

1. Sanitary sewer mains.

    a. Diameters.
    b. Materials.
    c. Gradients.
    d. Length between manholes.

2. Manholes and cleanouts.

    a. Stationing and number designation shall meet District numbering convention.
    b. Elevation of inverts in and out of manhole.
    c. Elevation of manhole rim.

3. Location control dimensions.

4. Manhole stub-outs.

5. Proposed future extensions.

6. Wye and riser connection for services.

7. Service connections or stub-outs.

8. Underdrain.

9. Standard bedding cross-section

10. Concrete encasement, locations.

11. Cut-off walls.

12. Complete material list.

13. Applicable District Standard Details

1.5.8 SPECIFICATIONS AND SUPPORT DOCUMENTATION. The following shall be included with submitted construction plans:

1. Reference on plans to District Technical Standards and Specifications.

2. Reference on plans to other agency standards and specifications that are required or proposed.

3. Where reference to other commonly available standards and specifications will not suffice, copies of specifications are to be provided.

4. Copies of written approval from other affected agencies as required.

5. Soils test data including but not limited to subsurface profile, moisture content, gradation, water-soluble sulfates, pH, Atterberg limits, percent passing No. 200 sieve, compressive strength, electrical resistivity, swell/consolidation analysis, over-excavation requirements, corrosiveness, and other test data. Test data shall be performed within fifty feet (50') of main line.

1.6 DEFINITIONS AND ABBREVIATIONS.

1.6.1 DEFINITIONS. Additional definitions are in **Part I, Administrative Policies and Procedures, Exhibit B, Definitions**. Whenever the following terms are used in these Technical Standards and Specifications, they will be defined as follows:

Technical Standards and Specifications shall mean the body of directions, provisions, and requirements contained herein, describing the method or manner of construction, and the quality of materials furnished.

1.6.2 ABBREVIATIONS.

AASHTO shall mean the American Association of State Highway and Transportation Officials.

ACI shall mean the American Concrete Institute.

AISC shall mean the American Institute of Steel Construction.

ANSI shall mean the American National Standards Institute.

APWA shall mean the American Public Works Association.

ASA shall mean the American Standards Association

ASTM shall mean the American Society for Testing and Materials.

AWG shall mean the American Wire Gauge.

AWWA shall mean the American Water Works Association.

BPR shall mean the Bureau of Public Roads.

CDOT shall mean the Colorado Department of Transportation.
FCC shall mean the Federal Communications Commission.

gpcd shall mean gallons per capita per day.

gpm shall mean gallons per minute.

GRC shall mean galvanized rigid conduit.

IMSA shall mean the International Municipal Signal Association.

IPCEA shall mean the Insulated Power Cable Engineers Association.

ITE shall mean the Institute of Transportation Engineers.

MGD shall mean million gallons per day.

NEC shall mean the National Electrical Code.

NEMA shall mean the National Electrical Manufacturers Association.

NFPA shall mean the National Fire Protection Association.

PVC shall mean polyvinyl chloride.

psi shall mean pounds per square inch.

UBC shall mean the Uniform Building Code.

UPC shall mean the Uniform Plumbing Code.

UL shall mean Underwriters Laboratories, Inc.

USDA shall mean the United States Department of Agriculture.

1.6.3 **TERMS**. Whenever, in these Technical Standards and Specifications, the words "as ordered", "as directed", "as required", "as permitted", "as allowed", or words or phrases of like import are used, it will be understood that the order, direction, requirement, permission, or allowance of the District is intended.

The words "approved", "reasonable", "suitable", "acceptable", "accepted", "properly", "satisfactory", or words of like effect and import, shall mean approved, reasonable, suitable, acceptable, accepted, proper, or satisfactory in the judgment of the District.

Whenever the word "District" is used in these Technical Standards and Specifications, it shall mean the Roxborough Water and Sanitation District or its designated representative.

1.6.4 **SPECIFICATIONS BY REFERENCE**. All standards/specifications (i.e., ASTM, AWWA, ACI, etc.) referenced in these Technical Standards and Specifications, shall refer to the latest edition of the referenced standard/specification.
Throughout these Technical Standards and Specifications, any section referenced shall include all sub-sections of that section. Any portion of these Technical Standards and Specifications that may be applicable to any other section, whether referenced or not, shall apply.

ARTICLE 2. WATER SUPPLY FACILITIES

2.0 GENERAL PROVISIONS.

2.1 GENERAL.

2.1.1 APPLICABILITY. All water main construction within the District and all water service line construction connecting to the District's water mains shall be designed and constructed in accordance with these Technical Standards and Specifications. The requirements stated herein shall apply to new water system construction and to repairs to existing facilities.

2.1.2 REFERENCES. All references cited in these Technical Standards and Specifications as the Denver Water Board Specifications shall mean the latest edition of the Engineering Standards of the Board of Water Commissioners of Denver, Colorado.

2.1.3 TAPPING EXISTING WATER MAINS. All residential service line taps shall be wet taps. The shut down of any portion of the water system will be allowed only when uncontrolled circumstances do not permit a wet tap. Tapping existing water mains shall be either wet taps or a shut down of a portion of the main line to facilitate a tie in. The District shall approve any shut down of the water system in writing.

A contractor who specializes in the type of work being performed shall perform tapping of all mains. The District shall be notified forty-eight (48) hours prior to the commencement of any tapping work.

2.1.4 TRENCHING, BACKFILLING AND COMPACTING. Trenching, backfilling and compacting shall be performed in accordance with all applicable portions of these **Technical Standards and Specifications, Article 4, Site Work and Earthwork**.

2.1.5 CROSS CONNECTION CONTROL. All facilities served by the Districts water system shall comply with the provisions of these **Technical Standards and Specifications, Exhibit A, Cross Connection Control** and **Part 1**, **Administrative Policies and Procedures, Article 7.3.2, Backflow/Cross- Connection**.

2.1.6 WATER CONSERVATION DEVICES. All facilities served by the District's water system shall utilize water conservation devices as specified in **Exhibit B, Water Conservation Standards**, of these Technical Standards and Specifications.

2.2 DESIGN CRITERIA

2.2.1 GENERAL. Water distribution systems shall comply with the requirements of these Technical Standards and Specifications for water main and service line construction and may include special criteria established by the District for the overall hydraulics of the water utility system. Special criteria shall be outlined at pre-design meetings scheduled, as determined necessary by the District.

2.2.2 DESIGN FLOW REQUIREMENTS. The design of the water distribution system shall be based on the following water demands:

UNIT WATER DEMANDS FOR FUTURE LAND USE

Land Type	Avg. Demand	Max. Day/ Avg. Day	Peak Hr./Max Day
Residential	100 GPCD*	2.8	1.5
Commercial	1650 GPD/Acre	2.8	1.5
Industrial	1650 GPD/Acre	2.8	1.5
Park	3060 GPD/Acre	2.8	1.5

*Gallons per Capita/Day
People / EQR = 2.9

Minimum fire flow shall be as noted below:

Type of Development	Duration (hrs.)	Needed Fire Flow (gpm)
Residential	2	1,500
Multifamily/Apartment	3	3,000
Industrial/Commercial	3	3,500

A reduction in minimum fire flow may be allowed by up to 50% on a case-by-case basis if a building fire sprinkler system is installed and approved by the jurisdictional fire department and building department. In no circumstances shall fire flow be lower than 1,500 gpm.

2.2.3 **OPERATING PRESSURE REQUIREMENTS.** All areas shall be designed to have a maximum static head of three hundred (300) feet (one hundred thirty [130] psi) and a minimum static head of one hundred (100) feet (forty-three [43] psi). Distribution systems shall also be designed to maintain a twenty (20) psi residual pressure during a maximum day plus fire flow event, and a forty psi (40) residential residual during peak hour residential flows. The maximum pressure drop from static head to maximum day plus fire flow, or peak hour residential flow, shall not exceed thirty psi (30).

2.2.4 **FIRE HYDRANT LOCATIONS.** All structures shall be located within 300 feet of a fire hydrant, as measured along an approved fire vehicle access.

In residential areas, fire hydrants shall be spaced a maximum of five hundred feet (500') apart as measured along street curb line and at an overall spacing that will average not less than one hydrant to two hundred thousand (200,000) square feet throughout an individual subdivision. Where blocks are over eight hundred feet (800') in length, intermediate hydrants shall be placed in the center of the blocks. A hydrant shall be placed in the end of each cul-de-sac over three hundred feet (300') in length. Fire hydrants shall be located on the northeast corner of intersections and at lot lines whenever possible.

In business and industrial areas, hydrants shall be spaced not more than three hundred feet (300') apart.

Fire hydrant locations and spacing shall be as approved by the District.

2.2.5 **FIRE LINE TO NON-RESIDENTIAL AREA**. The Owner shall maintain all fire lines extending from the valve on the District water main. Valves on newly constructed fire lines shall be located on the tee at the main line. Fire lines shall be used exclusively for fire protection. Domestic water taps or irrigation taps shall not be allowed on a fire line.

2.2.6 **DISTRIBUTION SYSTEM LAYOUT.** Distribution mains and lateral lines shall be located as indicated on the approved plans. Minimum pipeline diameter for lateral lines shall be eight inches (8"). At dead-ends less than three hundred feet (300') long six-inch (6") diameter pipe may be used.

Dead ends shall be minimized by looping whenever possible. Lines at ends of long cul-de-sacs shall be looped along lot lines to adjacent streets. Dead ends shall be provided with a permanent blow-off or fire hydrant. Mains and laterals shall be extended to the boundaries of filings and completely across the frontage of individual lots.

In business and industrial areas, dead ends shall not extend more than 300 feet and looping shall be required.

2.2.7 **VALVE SPACING.** The maximum spacing for valves shall in all distribution mains and lateral lines shall be six hundred feet (600'). Intermediate valves shall be installed where blocks exceed six hundred feet (600') in length. Valves shall also be placed at each fire hydrant and permanent blow-off.

Four-way and three-way street intersections shall require four (4) and three (3) valves respectively, one located on each extended property line. For a succession of short blocks perpendicular to the direction of the distribution main, and without residential or commercial services between intersections, one of the mainline valves at an intersection may be omitted, provided the six hundred foot (600') maximum spacing requirement is maintained.

Valves shall be placed at each end of a line running through an easement on private property, on each side of a major creek or channel crossing, and on each side of a distribution line that provides service to a hospital, school or large industrial user.

2.2.8 **COMBINATION AIR VALVES.** Combination air valves shall be installed at each high point in all distribution mains and laterals. Combination air valves shall be installed in pre-cast manholes or vaults fitted with air vents open to the atmosphere. Combination air valves shall be Aquestia (A.R.I.) D-040 or approved equal.

2.2.9 **BLOW-OFF ASSEMBLIES.** Provisions shall be included in the design to allow for the flushing of distribution mains and lateral lines at all low points in the system, at all dead ends, or at any point noted on the approved plans. The blow-off assembly shall be installed perpendicular to and on the downhill side of the main or line and shall drain to the nearest gutter line or drainage channel.

2.2.10 **PIPE.** Pipe class shall be as required for specific project conditions.

2.2.11 **HYDRAULIC DESIGN.** Distribution mains and lateral lines shall be designed using the Hazen-Williams friction coefficients and maximum head losses noted below. The given head losses shall apply at peak hourly flows.

Maximum Head Loss by Pipe Size

Pipe Size	Hazen-Williams Friction Coefficient	Max. Head Loss
6" - 12"	C-100	2' per 1,000'
14" - 16"	C-110	2' per 1,000'
20"	C-130	1.5' per 1,000'
Over 20"	As directed by the District	TBD

All pipes shall be designed to have a maximum velocity of ten feet (10') per second, at max day flow plus fire flow.

2.2.12 LOCATION OF WATER MAINS. Water mains shall be located twelve feet (12') north or east of the centerline of the street unless otherwise approved by the District.

At street intersections, valves shall be located at extension of the property lines.

Fire hydrant gate valves shall be connected to the main with a swivel tee. Water mains shall extend to the boundary line of the property or subdivision served. A main serving one lot shall extend across the entire frontage for that lot. Mains serving a subdivision shall extend to the center of boundary streets, to boundary lines or to the outside of paved areas as noted on the approved plans.

2.2.13 MINIMUM DEPTH. All pipes shall be installed with a minimum of five feet (5'-0") and a maximum of ten feet (10') of cover from finished grade of street to the top of the pipe.

2.2.14 RELATION TO WASTEWATER MAINS AND STORMWATER LINES. Water lines shall be located a minimum of ten feet (10), horizontally, from existing or proposed stormwater and wastewater mains (edge to edge measured distance). Where wastewater lines cross water mains, the water line shall be a minimum of eighteen inches (18"), clear, above the wastewater main. If this clear distance is not feasible, the crossing shall be designed and constructed so as to protect the water main. The District shall approve the crossing design.

Minimum protection shall consist of the installation of an impervious and structural wastewater line. The wastewater line shall be encased in reinforced concrete. The encasement shall be at least six inches (6") thick around the entire pipe and shall extend a distance of ten feet (10') on either side of the water main.

Stormwater lines shall be located a minimum of eighteen inches (18") vertical clearance in relation to a water main.

2.2.15 CORROSION PROTECTION SYSTEMS. Polyethylene wrap shall be used on all cast iron or ductile iron pipe, fittings, rods, and appurtenances per AWWA C-105. Soil resistivity measurements shall be conducted by an independent geotechnical laboratory and tested in accordance to ASTM G-187-05. Testing frequency shall not be less than one test for every 400 linear feet of pipe. If soil resistivity is less than one thousand (1,000 ohm-cm), a corrosion protection system shall be designed by a corrosion engineer. Anodes will be required for all ductile iron pipe and fittings when

the soil resistivity is less than 1,000 ohm-cm and must be designed by a corrosion engineer.

2.2.16 **SERVICE CONNECTIONS.** Refer to **Article 2.5, Water Service Lines** of this section for service line requirements and specifications.

2.3 MATERIALS

2.3.1 **PIPE.** All pipes for water main construction shall be ductile iron. If the soil resistivity is less than 1,000 ohm-cm, polyvinyl chloride (PVC) pipe can be used as an alternative.

Ductile iron pipe shall be in conformance with AWWA C151. Class designation shall be as shown on the approved plans or as designated by the District for each individual project. Ductile iron pipe shall be thickness class 52 unless stricter requirements are needed. Ductile iron pipe shall have a standard cement mortar lining in conformance with AWWA C104, and an asphaltic outside coating per AWWA C151. Each pipe shall be marked with the weight, class designation, and size.

PVC pipe shall be in conformance with AWWA C900 for 4 inch through 60 inch pipe sizes. All PVC pipe shall conform to a Dimension Ratio of 14. Class designation shall be as shown on the approved plans. Each pipe shall be marked with dimension ratio, pressure class, AWWA designation number, seal of the testing agency verifying the suitability of the pipe for potable water service, and size.

2.3.2 **JOINTS.** Buried pipelines shall have mechanical or push-on joints in conformance with AWWA C111. Buried fittings and valves shall have mechanical joints in conformance with AWWA C111. Exposed piping, valves, and fittings, in vaults and manholes, shall have flanged joints in conformance with AWWA C115.

2.3.3 **RESTRAINED JOINTS.** Restrained joints shall be Series 1500TD Tru-Dual as manufactured by EBAA Iron Sales, Inc for PVC pipe and shall be Series 1700 as manufactured by EBAA Iron Sales, Inc. for DIP pipe, or approved equal. 316 Stainless Steel shall be provided for all rods and nuts.

An alternate to a restrained joint fitting for Ductile Iron Pipe includes internal pipe joint restraints. Internal pipe joint restraints shall be Field Lok 350 Gasket as manufactured by US Pipe and Foundry Co. or TR Flex restrained joint pipe as manufactured by US Pipe and Foundry, Co. or approved equal.

2.3.4 **FITTINGS.** Fittings for ductile iron pipe and PVC pipe shall be in conformance with AWWA C110 and AWWA C111. Class designation shall be compatible with the pipe class designated for the project. A standard thickness cement mortar lining shall be applied in conformance with AWWA C104. All fittings shall receive a bituminous outside coating approximately one (1) mil thick.

2.3.5 **GATE VALVES.** Gate valves in sizes four inches (4") to ten inches (10") shall be of the iron body, non-rising bronze stem, and resilient-seated type conforming to AWWA standard C509 and the specific requirements outlined.

Gate valves shall provide zero leakage at working pressures up to two hundred (200) psi in either direction. Valves shall open left (counter-clockwise). Valves shall be furnished with a two-inch (2") square operating nut for buried locations, and with a hand wheel operator for exposed locations. End connections shall be furnished with

all necessary joint materials. Valves shall have a full opening flow-way of equal diameter to the nominal size of the connecting pipe.

Coatings shall be in conformance with AWWA C550 and the following specific requirements. Internal ferrous metal surfaces shall be fully coated, holiday free, to a minimum thickness of four (4) mils. The coating shall be a two-part thermosetting epoxy suitable for field over coating and for touchup with the same coating material without special surface preparation or extreme heat. The supplier shall furnish detailed performance tests of adhesion, hardness and abrasion resistance of the furnished coatings. Coating shall have a successful record of performance in valves, pipe or other allied equipment, for a minimum of ten (10) years.

2.3.6 **BUTTERFLY VALVES.** Valves having a nominal diameter twelve inches (12") or greater shall be geared butterfly valves designed for direct burial and shall conform to AWWA specification C504, Class 150-B. Valves shall be of the tight closing rubber seat type with rubber seats that are bonded to the valve body. Metal to metal sealing surfaces shall not be permitted. Valves shall be bubble tight at one hundred fifty (150) psi rated pressure with flow in either direction. Valve discs shall rotate 90° from the fully open position to the fully closed position. Coatings shall conform to standards specified above for gate valves. Valve bearings shall be sleeve-type corrosion-resistant, and self-lubricating with the load not to exceed twenty-five hundred (2500) psi.

Manual operators shall have worm gearing or traveling nut operating in a lubricating bath. The required maximum input force on a hand wheel or chain wheel shall be not more than 80 pound pull to develop the required operator seating torque. Manual operators shall comply with AWWA C-504. Hand wheel operators in structures shall be furnished with a direct valve position indicator. Buried valves shall be rated for underground installation. Valves shall open left (counter-clockwise).

2.3.7 **PRESSURE REDUCING/SUSTAINING VALVES (PRV/PSV).** PRV/PSVs shall maintain a constant downstream pressure regardless of fluctuations in demand. When the upstream pressure becomes equal to the spring setting of the pressure sustaining control, the valve shall throttle to maintain a constant inlet pressure. If the downstream pressure is greater than the upstream pressure, the valve shall close automatically to prevent return flow. The valve shall be equipped to provide for slow opening and closing by means of independent, field adjustable opening and closing speed controls.

Valves shall be a hydraulically operated, diaphragm-actuated, globe or angle pattern valve. Valves shall have a resilient, synthetic rubber disc, having a rectangular cross section, contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. This diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall not be used as a seating surface. Packing glands and stuffing boxes are not acceptable. There shall be no pistons operating the valve or pilot controls.

Valve design shall allow the repair of all internal parts through the top flange without removing the valve from the pipe.

The pressure reducing pilot control shall be direct-acting, adjustable, spring-loaded, normally open diaphragm valve, which closes when downstream pressure exceeds the spring setting.

The pressure-sustaining pilot shall be a direct-acting adjustable, spring-loaded, normally closed diaphragm valve, which opens when upstream pressure exceeds the spring setting.

The end details shall be 125 ANSI B16.1 in order to meet the pressure ranges required.

The main valve body and cover shall be made of cast iron conforming to ASTM A48. The main valve trim shall be Bronze (ASTM B-61) or 303 Stainless Steel. The pilot controls material shall conform to ASTM B-61 Bronze.

Pressure reducing/pressure sustaining valves shall be as manufactured by OCV Control Valves or Cla-Val, Company.

2.3.8 **FIRE HYDRANTS.** Hydrants shall be the Manufacturer's latest design, manufactured and tested in compliance with AWWA C-502, "Standard for Dry Barrel Fire Hydrants". Fire hydrants shall be American Flow Control Waterous 5 1/4 Pacer, WB-67-250 Traffic Model, rated at 250 psi. American AVK Series 27 is an acceptable manufacturer. Hydrants shall include bronzed bushed shoe providing bronze to bronze seating for the main valve, complete with O-rings for sealing, and a bronze shaft coupling.

Hydrants shall be "Traffic" type with replaceable "Breakable" units six inches (6”) above the ground line for minimizing repairs due to traffic damage.

The buried portion of the hydrant shall be given a bituminous coating in accordance with AWWA C-151. All ferrous metal parts shall be coated in accordance with AWWA C-550. The upper exposed section of the hydrant above ground shall be given a prime coat of synthetic red lead primer Type IV-TFP-86a followed by one shop coat of heavy duty alkyd enamel paint conforming to the District's standards.

Hydrants shall have a five and one-quarter inch (5-1/4") main valve opening with a six-inch (6") mechanical joint end. Each hydrant shall be equipped with a four and one-half inch (4-1/2") pumper nozzle and with two, two and one-half inch (2-1/2") hose nozzles with National Standard threads. Hydrant valve shall open counterclockwise from a standard operating nut. Hydrant bury shall be a minimum of 5'-6" in areas without curb and gutter, and 6'-0" in areas with curb and gutter. Fire Hydrants shall be six inches (6”) above final grade or back of sidewalk and have a distance of no less than three feet (3’) in circumference clear of all obstructions around the fire hydrant. Longer hydrants shall be provided if required by specific grading conditions. Refer to Standard Drawing No. 2-1.

The hydrant manufacturer shall furnish an affidavit stating that all hydrants furnished comply with all applicable provisions if AWWA C-502 (dry barrel ok) standards as modified or supplemented herein. A copy of the certification shall be forwarded to the District.

2.3.9 **VALVE BOXES.** The manufacturer of valve box components shall be experienced in the design and manufacture of valve boxes, and shall be regularly engaged in the

manufacture of valve boxes. The manufacturer shall have produced valve boxes, which have given successful service for a period of at least five (5) years.

Valve box parts shall be made of gray cast iron in compliance with the requirements of ASTM A48 or ASTM A 126.

Valve boxes shall be complete with bases and accessories.
Valve box shall be of sufficient length to reach from the pipe to at least 1-inch above the final ground elevation.

Extension pieces shall be those recommended by the manufacturer.

Valve boxes shall be the three-piece adjustable screw type. The following patterns are acceptable:

Mueller screw-type 51/2" H-10357 with No. 160 oval base.

Tyler screw-type 6" cast iron valve box assembly series 6860 with No. 160 oval base.

Clay and Bailey screw-type 6" cast iron valve box assembly No. P-108 with No. 160 large oval base.

The operating nut depth shall not exceed 5 $^{1}/_{2}$ feet. If the depth of the operating nut is to be deeper than 5 $^{1}/_{2}$ feet, then an extension shall be attached to the operating nut. The extension shall extend to be a minimum of 8" from finished grade.

The operating nut shall be centered in the valve box and turn freely.

The word "WATER" shall be embossed with large letters across the lid for potable water installations only.

2.3.10 **COMBINATION AIR RELEASE VALVES.** Combination air release valves shall be designed to exhaust large volumes of air when the system is filled with water and to allow large volumes of air to enter the pipeline when the system is drained. The air and vacuum relief portion of the valve shall have a discharge orifice area, which is equal to or greater than the valve inlet. The valve shall also be capable of venting small quantities of entrained air, which typically accumulate at high points in the pipeline during system operation. Entrained air shall be vented under pressure by means of a small, independently controlled orifice. The combination air release valve shall be designed for a minimum working pressure of 150 psi.

The combination air release valve body, cover and baffle shall be cast iron conforming to ASTM A48 or ASTM A126. The valve float shall be stainless steel conforming to ASTM A240. The float retainer, outlet orifice plug, float cushion retainer, restraining screws and internal lock nuts and washers shall be stainless steel conforming to ASTM A276. The float cushion and outlet orifice seat shall be synthetic Buna-N rubber manufactured in compliance with ASTM SB800.

The combination air release valves shall be Aquestia (A.R.I.) or approved equal.

2.3.11 **BLOW-OFF ASSEMBLY.** The standard blow-off shall be through a two-inch (2") ball valve with a two-inch (2") gate valve operating nut, box, piping and cover. All piping

shall be threaded copper and valves shall be brass. Galvanized piping or fittings shall not be allowed. The blow-off pipe shall be no deeper than 4 inches (4") from the top of the valve box. For valve box standards refer to **Article 2.3.8 of these Technical Standards and Specifications**. Refer to Standard Drawing Number 2-2 for blow-off detail.

2.3.12 **WATER SAMPLE STATIONS.** Water sample stations shall provide District a sampling point for direct sampling of the water main. Sample station shall include a lockable enclosure and shall be non-draining. Sample station shall be Kupferle Eclipse #88-SS, or approved equal.

2.3.13 **VAULTS.** Vaults shall be pre-cast or cast-in-place concrete and shall be constructed in accordance with these Standards and Specifications. Pre-cast vaults shall be designed so that joints and corners are waterproof. Vaults shall be waterproofed after construction by use of sealants, epoxies, or other approved methods.

Vaults shall be designed to resist all lateral and vertical loads imposed. Vault roofs shall be designed to support the overhead fill, any surcharge and an H-20 traffic loading.

2.3.14 **MANHOLES.** Refer to **Article 3.3.4, Manholes and Riser Rings through 3.3.7, Manhole Rings and Covers**, of these Technical Standards and Specifications.

2.3.15 **MANHOLE BASE SLABS AND BASE BEAMS.** Refer to **Article 3.3.5, Manhole Base Slabs and Base Beams,** of these Technical Standards and Specifications.

2.3.16 **SUMP PITS FOR VAULTS AND MANHOLES.** Gravel sumps shall be provided in all vaults. In areas where groundwater is anticipated, the gravel sump shall be replaced with a concrete sump to prevent entry of groundwater into the vault. In areas where groundwater is anticipated, the vault shall be designed with adequate safety features against floating. Developer's engineer shall submit buoyancy calculations to District engineer for review and approval.

A gravity drain line or sump pump shall be provided when a concrete sump is utilized.

2.3.17 **VENT PIPES.** Vent pipes shall be installed in all vaults and pits. Installations that contain electrical equipment shall have a blower attached to the vent system. Vent pipes shall be field located at the nearest intersection of the street property line and the side lot line.

Above ground vent pipe shall be six-inch (6") nominal diameter galvanized steel pipe, Grade 40, conforming to A.S.T.M. Standard Designation A 53. The vent screen shall be a three-fourths inch (3/4") No. 9-11 flattened expanded galvanized metal screen. Below ground vent pipe shall be six inch (6") nominal diameter galvanized steel pipe, Grade 40, conforming to A.S.T.M. Standard Designation A 53 with 10 mil PVC pipe wrap tape for buried pipe. Refer to Drawing number 2-6.

2.3.18 **POLYETHYLENE ENCASEMENT MATERIAL.** Polyethylene encasement material shall conform to the most current AWWA C105.

Twenty-four inch (24") flat width tubing shall be used with four inch (4"), six inch (6"), and eight-inch (8") diameter pipe. Thirty inch (30") flat width tubing shall be used with all twelve-inch (12") diameter pipes. Thirty-six inch (36") flat width tubing shall be used

for sixteen-inch (16") diameter pipe. Fifty-two (52") inch flat width tubing shall be used with twenty inch (20") and twenty-four inch (24") diameter pipe.

Harness rods shall be covered by four inch (4") flat width polyethylene tubing.

The entire joint shall be covered by a cigarette-wrap of forty-eight inch (48") wide polyethylene sheet material over each set of lugs. Irregular shaped valves and fittings shall be covered with flat forty-eight inch (48") wide polyethylene sheet material.

The polyethylene seams and overlaps shall be wrapped and held in place by means of two-inch wide plastic-backed adhesive tape. The tape shall be Polyken #900 (polyethylene), Scotchrap #50 (polyvinyl) or equal. The tape shall be such that the adhesive will bond securely to both metal surfaces and polyethylene film.

2.3.19 **MECHANICAL JOINT RESTRAINTS.** Mechanical joint restraints shall be MEGALUG as manufactured by EBAA Iron Sales, Inc. or Uni-Flange by The Ford Meter Box Company, Inc., or approved equal.

2.3.20 **BEDDING MATERIALS.** Bedding materials shall be in accordance with **Article 4.2.1, Pipe Bedding Materials**, of these Technical Standards and Specifications.

2.3.21 **CONCRETE.** Concrete shall conform to **Article 5, Concrete Work**, of these Technical Standards and Specifications.

2.3.22 **PLASTIC LINER PIPE (SLIPLINING).** Water main slip lining materials shall comply with all applicable requirements of **Article 3.3.9, Plastic Liner Pipe** (Slip lining), of these Technical Standards and Specifications.

2.3.23 **STEEL CASINGS FOR BORES.** Steel casing pipe shall comply with all applicable requirements of **Article 3.3.10, Steel Casings for Bores**, of these Technical Standards and Specifications.

2.4 WATER MAIN CONSTRUCTION.

2.4.1 **GENERAL.** All work will conform to applicable portions of the most current AWWA C600 for ductile iron pipe and AWWA C605 for PVC pipe. Installation of Ductile Iron and PVC Water Mains and Appurtenances, and to the pipe manufacturer's recommendations, as modified herein.

2.4.2 **PIPE INSTALLATION.** The Contractor shall provide proper equipment, tools and facilities required for convenient performance of the work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench in such a manner as to prevent damage to pipe materials and to protect coatings and linings. Under no circumstances shall pipe or fittings be dropped or dumped into the trench; any pipe or fittings that are dumped shall be removed from the work site and shall not be used.

All pipe and fittings shall be carefully examined for cracks and other defects immediately before installation in final position. The groove in the bells of ductile iron pipe shall be full and continuous. Defective pipe or fittings shall be tagged and removed from the job site within twenty-four (24) hours. All foreign matter or dirt shall be removed from the interior and ends of pipe and accessories before they are lowered into position in the trench.

Precautions shall be taken to prevent foreign material, including trench water from entering the pipe. During construction, no debris, tools, clothing, gravel or other foreign materials shall be placed in the pipe. The Contractor shall provide and maintain adequate equipment to properly remove and dispose of all water entering the trench or other part of the work. At times when pipe laying is not in progress, the open ends of pipe shall be closed by means of a water tight plug.

Cutting of pipe for inserting valves, fittings, or closures pieces shall be done in a neat and workman-like manner without damage to the pipe or lining. Cuts shall result in a smooth end, at right angles to the axis of the pipe. Pipe ends shall be smooth and beveled with a file or other tools according to the pipe manufacturer's recommendations.

Rubber gaskets shall be lubricated and installed according to the manufacturer's recommendation. Extreme care shall be used to keep joints clean during assembly.

Ductile iron pipe, fittings and appurtenances shall be protected with polyethylene film wrap per the most current AWWA standard C-105. Miscellaneous steel or other ferrous pipe for blow-offs, etc., shall be similarly protected.

After installation of the polyethylene protective wrap, pipe shall be secured in place by installation of bedding material, up to the spring line of the pipe.

2.4.3 **ALIGNMENT AND GRADE.** Field survey parties under the supervision of a registered land surveyor shall determine alignment and grade of the pipe and the location of fittings, valves, and hydrants. The required minimum depth of cover between the top of the pipe barrel and the finished street grade shall be five (5) feet. The water main shall be laid to the required lines and grades with fittings, valves, and hydrants at the required locations.

2.4.4 **THRUST BLOCKS.** Thrust blocks shall be constructed at all horizontal bends and fittings and vertical bends which do not include mechanical restraint. Care shall be taken not to block outlets or to cover bolts, nuts, clamps or other fittings or make them inaccessible. A bond breaker shall be placed between the pipe and the thrust block to aid in ease of future removal. Thrust blocks shall bear against undisturbed earth. Mechanical restraints shall be required to anchor the fittings to the main if a thrust block cannot bear against undisturbed earth.

Formwork for thrust blocks and anchors shall be constructed using wood forms. Wood forms shall be removed before backfilling. Refer to detail sheet no. 2-7.

Newly placed thrust blocks shall be allowed to set, undisturbed, for a minimum of twenty-four (24) hours prior to backfilling, tamping or compacting.

2.4.5 **MECHANICAL JOINT RESTRAINTS.** Mechanical joint restraints shall be used at all bends fittings, and valves. Mechanical joint restraints shall be installed at the following locations:

1. Fire hydrants.

2. Fire sprinkler connections.

3. Domestic connection.

4. Horizontal and vertical bends.

5. Vertical offsets.

Harness rods may be used only when the use of thrust blocks or a mechanical joint restraint is not feasible. Harness rods shall be used only at locations shown on the approved plans.

2.4.6 **SETTING VALVES AND HYDRANTS.** Immediately prior to the installation of a valve or hydrant the valve or hydrant shall be carefully inspected; the interior shall be thoroughly cleaned; the valve or hydrant shall be operated as many times as necessary to determine that all parts are in proper working order with the valve seating properly and the hydrant drain valve operating properly. Valves and hydrants shall be set plumb, in a vertical position and securely braced in place.

Each hydrant shall have a six-inch (6") gate valve on the inlet line and shall be connected to the main by a six-inch (6") ductile iron, polyethylene wrapped pipe. The gate valve shall be connected directly to a swivel tee installed in the main.

Hydrants shall be set six-inches (6”) above the established finished grade, with hose nozzles parallel to the curb or centerline of the street, and the pumper nozzle facing the curb or street. In areas with curb and gutters, the pumper nozzle shall be located at least six inches (6") behind the curb or sidewalk.

Valves shall be provided with valve boxes centered and plumb over the operating nut of the valve. The boxes shall be supported by the soils and isolated from the valve to prevent any shock or stress being transmitted to the valve. Valve boxes shall be maintained in position during backfilling. Valve box covers may be set to sub grade elevation to prevent damage during street construction, and adjusted to finished grade at the time of paving.

Hydrants shall be provided with a drainage pit with nine (9) square feet of surface area and two feet (2') of depth below the barrel of the inlet. Pits shall be backfilled with one and one-half inch (1-1/2"), washed, crushed rock to a level six inches (6") above the barrel drain hole. A concrete thrust block shall be provided at the bowl of each hydrant (as shown on Standard Drawing No. 2-1) and shall be placed so as to not obstruct the barrel drain hole. Hydrants and valves shall be backfilled to the ground surface as specified in **Article 4, Site Work and Earthwork**, of these Technical Standards and Specifications.

2.4.7 **PLASTIC LINER PIPE (SLIPLINING)**. Plastic liner pipe shall be installed in accordance with all applicable portions of **Article 3.3.9, Plastic Liner Pipe** (Slip lining), of these Technical Standards and Specifications**.**

2.4.8 **STEEL CASING AND CARRIER PIPE INSTALLATION.** Steel casing and carrier pipe shall be installed in accordance with **Article 3.3.10, Steel Casings for Bores**, of these Technical Standards and Specifications.

2.4.9 **TEST STATIONS.** Underground pipeline test stations shall be installed at the locations shown on the approved plans. Tracer wire test stations shall be installed at all fire hydrants, curb stops, blow offs, and valves in un-improved surface areas at a minimum.

2.4.10 **PLUGGING OF DEAD ENDS.** Standard plugs or caps shall be installed at dead ends of all fittings and pipes, and adequate thrust blocks shall be provided.

2.4.11 **FILLING AND VENTING THE LINE.** Only District personnel shall operate valves. Pipelines shall be slowly filled with water and all air expelled from the pipe. All hydrants, air and vacuum relief valves, and other vents shall be open during the filling of pipelines. Where hydrants or other permanent vents are not available in the line, the Contractor shall install the required temporary vents. The rate of filling pipelines shall not exceed the venting capacity.

2.4.12 **DISINFECTION AND FLUSHING MAINS.** Disinfection and flushing shall be performed in accordance with AWWA C651, "Standard for Disinfecting Water Mains".

The chlorine solution shall be retained in the line for at least twenty-four (24) hours. If the water temperature is less than 41°F (5°C), the chlorine solution shall remain in the pipe for at least forty-eight (48) hours. The chlorine residual at the pipe extremities and other representative points shall be at least twenty-five (25) parts per million at the end of the twenty-four (24) hour or forty-eight (48) hour period. If the test is not satisfactory, the disinfection shall be repeated until a twenty-five (25) parts per million of chlorine residual is obtained.

Following chlorination, the main shall be thoroughly flushed until the water runs clear with no chlorine residual in excess of that carried in the existing system.

The contractor shall take the necessary precautions to prevent any chlorine solution or residual flow into existing water facilities or receiving waters and shall assume responsibility for any damages caused by heavily chlorinated water.

Water mains shall not be placed in service or tapped until successful chlorination and bacteriological testing have been performed.

Bacteriological testing for total coliform bacteria shall be performed utilizing two options:

- An initial set of samples immediately after flushing and then resample again after a minimum of 16 hours (24 hours if water temperature is less than 41°F (5°C)).
- Let the water sit for a minimum of 16 hours (24 hours if water temperature is less than 41°F (5°C)) after flushing. The collected without flushing the main, two sets of samples a minimum of 15 minutes apart while the sample taps are left running.

Samples shall be collected for every 1,200 linear feet of new water main, plus one set from the end of the line, and one from each branch greater than the one pipe length. District personnel will take samples for bacteriological testing. If the test fails, the line shall be re-chlorinated, re-flushed and retested. The District will require at least forty-eight (48) hours' notice for testing. No Testing/Samples on Mondays or Fridays. If bacteriological test fails three (3) times then an alternate method for cleaning s required by District such a mechanical cleaning by pigging or high pressure jetting of the water main.

2.4.13 **LEAKAGE TESTING.** Pressure and leakage tests shall be conducted in accordance with AWWA C600. Test pressure shall be the greater of working pressure plus fifty

(50) psi or one hundred fifty (150) psi, measured at the high point of the section being tested. The maximum length of line to be tested shall be two thousand five hundred feet (2,500'). All joints in connections shall be watertight within tolerances set forth in AWWA C600. Any leakage that is discovered by observation or tests shall be located and corrected by the Contractor, regardless of the allowance used for testing. Pressure and leakage tests shall not be conducted until the line has been disinfected. Please refer to AWWA standard C-600, "Installation of Ductile Iron Pipe Water Mains and their Appurtenances."

Any failed pressure and leakage tests will require re-disinfection of the water main per **Article 2.4.12**.

2.4.14 **MANHOLES**. Refer to **Article 3.3.4, Manholes & Riser Rings**, of these Technical Standards and Specifications.

2.4.15 **TRACER WIRE**. Tracer wire shall be installed on all water main pipeline and water service lines. Tracer wire test stations are to be located at all blow offs, curb stops, and fire hydrants. Wire shall be a minimum of 12 AWG High-Molecular Weight Polyethylene (HMWPE) insulated wire. After installation there shall be a minimum of twelve inches (12") of slack wire available in the test box or valve box. Refer to detail drawings 2-1 and 2-2, for location of wire and box.

2.4.16 **TRENCHING.** Trenching for water and sewer lines shall be separated horizontally at least ten (10) feet apart. Trenches shall remain open after taps are made until the District's operations personnel can inspect all installations. Water service lines shall be a minimum of 5 feet deep. Common trenching is not allowed unless approved in writing by the District.

2.5 WATER SERVICE LINES.

A Water/Sewer Connection Permit is required before any digging can take place.

Purchase of a Water/Sewer Connection Permit obligates the Owner/Developer to strictly adhere to all of the District's Technical Standards and Specifications that pertain to water and sewer service line connections. Exceptions to the District's Technical Standards and Specifications may be made only upon application in writing to the District Manager.

1. Jumpers are not allowed in this District. Water use is prohibited without the use of a meter or without prior written permission from the District. If this provision is violated, the Owner of the offending service shall be immediately assessed a fine per incident. The fine for unmetered water usage is set forth in the District's current **Part I, Administrative Policies and Procedures, Exhibit A**, **Schedule of Fees, Rates and Charges**.

Reminders:

1. A Water/Sewer Connection Permit Is required before any digging can take place.

2. If at any time a problem or questions occurs, please be sure to contact the District for instructions before proceeding with a connection.

Any variances must be requested in writing and approved by the District.

2.5.1 GENERAL REQUIREMENTS.

1. **SERVICE SIZE.** Water services shall be adequately sized to meet the requirements of the facility being served. The minimum size water service shall be three-quarter inches (3/4").

   The service line and meter shall be sized according to AWWA manual M22: "Sizing Water Service Lines & Meters" and shall be approved the District on the basis of:

   a. Number of units serviced.

   b. Number of fixtures.

   c. Length of service line.

   d. Total GPM required.

   e. Annual consumptive demand.

   The District may require the installation of a meter a size smaller than the service pipe in cases where the full capacity of a previously used service pipe is not required.

   Service lines shall be of the same type material from beginning to end, unless the appropriate insulator is installed at the junctions of dissimilar metals and unless approved by the District.

   Service lines shall be the same size as the Corporation Stop unless written permission is given by the District.

2. **WATER SERVICE LINE LOCATIONS.** District approval of service line locations is required for all services. Water service lines at the Curb Stop shall be no deeper than six feet (6'). Water service lines shall be a minimum of two feet (2') from the property line. If any portion of the service line is to be located under a hard surface such as driveway then the service line will be sleeved in SDR-35 pipe, or if joint trenching is approved by the District.

3. **METERS.** Meters sized $^{3}/_{4}$" or 1" will be furnished and installed by the District. The District will furnish the meter and remote reader for all services. All other service line components such as pipe, fittings, meter pits and meter setters, shall be furnished and installed by the developer. The developer will be responsible for furnishing and installing meters 1-1/2" or larger. The charge for District furnished meters is set forth in the District's current **Part I, Administrative Policies and Procedures, Exhibit A, Schedule of Fees, Rates and Charges**.

   Water meters shall be set when the Owner/Developer requests water for the structure. Meter sets shall be ordered from Roxborough Water and Sanitation District at least 24 hours in advance. Note: If the meter cannot be set due to improper installation, a fee shall be assessed for each return inspection as set

forth in **Part I, Administrative Policies and Procedures, Exhibit A**, **Schedule of Fees, Rates and Charges**. If the building is occupied prior to a meter set, a fine shall be assessed by the District as set forth in **Part I, Administrative Policies and Procedures, Exhibit A**, **Schedule of Fees, Rates and Charges**. Meter sets in cold months must have a heat source available.

The District will supply and maintain the water meters 1" or smaller, which was paid for when the fee for the Water and Sewer Connection Permit was collected.

It is the Owner's responsibility to ensure that the water billing address is correct and bills are paid promptly. The Owner shall notify the District of any change of ownership or of any change of billing responsibility. For all commercial meters and water meters 1-1/2" or larger, it is the Owner's responsibility to perform accuracy tests and provide the District with the results. Tests shall be completed and in compliance with the following:

Meter Size (Inches)	Interval Between (Years)	Tests Accuracy (%)
1-1/2	4	3
2	4	3
3	3	3
4	2	3
6	1	3

If the tested meter does not meet the accuracy indicated in the above table, the Owner will be responsible for replacement of the meter.

4. **LOCATION OF METERS AND REMOTE READOUTS.** Meters for all services in the District shall be installed inside with remote readouts. Remote readouts shall be mounted in an approved location**.** All meter set and remote readouts locations will be approved by the District and will not be covered in any way at any time as to allow the District total access for repairs.

5. **METER SIZE.** Meters shall be of the same size as the corporation stop.

Meters in sizes three inches (3") through six inches (6"), regardless of type of installation, shall be compound type meters. Compound meters shall consist of two (2) meters, one (1) to measure small flows and the other to measure large flows. The two (2) meters may be assembled in one (1) case or in separate cases coupled together. The meter shall meet the most current AWWA C702.

A bypass line shall be required for all meters one and one-half inch (1-1/2") and larger. Bypass lines shall contain an independent control valve and shall contain no tees, plugs, or other outlets through which water could be withdrawn. Please refer to Drawing 2-13.

6. **CURB STOPS.** Curb stops shall be installed on all service lines to provide a means to shut off the service line. The Curb Stop and stop box shall be located as shown on the standard details. Curb stops shall be buried a minimum of five feet (5') and a maximum of six feet (6'). The Curb Stop box shall be a minimum

of two-inches (2”) and a maximum of four-inches (4”) above final grade or back of sidewalk.

7. **PRESSURE REGULATORS**. A pressure regulator, adjustable from twenty-five (25) to seventy-five (75) psi, shall be installed on all service lines in which normal operating pressure exceeds 50 psi. For services with inside meter settings, the pressure regulator shall be installed between the meter yoke and downstream valve. For services with outside meter settings, the regulator shall be located in an accessible area as described for inside meter settings. Please refer to Drawing 2-16.

8. **PRESSURE BOOSTER SYSTEMS.** In locations where the District's water distribution system is not capable of providing adequate pressure to certain individual lots, the District may require installation of pressure booster systems within the affected houses. Booster systems will be required when static pressure at the meter is less than 43 psi. Booster systems will be sized to provide adequate flow and will generally consist of a booster pump and a pressure tank. The District shall approve booster systems prior to installation.

   In lieu of a pressure booster system, the District may require installation of a pipeline from a higher pressure zone to serve houses with pressure less than 43 psi.

   Generally, booster systems will not be allowed when the service pipeline can be at sufficient size to not impact pressure and flow.

9. **SERVICE LINE STUB-INS.** Service line stub-ins shall extend behind any other utilities, such as gas and electric lines. Water services shall be in a separate trench and shall be a minimum of ten feet (10') from sewer service lines. Water service lines shall be a minimum of eighteen inches (18") above any sanitary sewer crossing.

10. **SERVICE LINE TAPS.** Direct tapping of the main will be permitted for 3/4" taps in ductile iron pipe with a diameter of 8" or greater. All other taps shall be made using the specified tapping saddle and conform to C-105 for Polyethylene and Dielectric Coupling of service tap.

    All 3/4” taps shall be wet taps, using a double strap tapping saddle with Corporation Stop and 3/4” K-copper tubing. A Curb Stop shall be installed at least two feet inside the property line and two feet off the property line. The meter shall be installed inside the structure in an area approved by the District.

2.5.2 SERVICE LINE EQUIPMENT AND MATERIALS.

1. **SERVICE LINE PIPE AND FITTINGS.** Service lines shall be seamless copper tube, Polyethylene (PE) or ductile iron pipe. Service line materials shall conform to one of the following specifications:

   a. Seamless copper tube, Type K (soft), shall be used for service lines three-fourths inch (3/4") through three inches (3").

   b. PE shall be three-fourths inch (3/4”) through three inch (3”) and shall be in accordance with AWWA C-901, AWWA C-904, or AWWA C-906. The

dimension ratio shall be 9 or a dimension ratio that exceeds the pressure rating of dimension ratio of 9. The pipe shall be listed as meeting NSF-61.

c. Ductile Iron Pipe may be used for three-inch (3") service lines, and shall be used for all service lines larger than three inches (3").

Pipe fittings for DIP service lines shall be cast-iron, mechanical joint in compliance with **Article 2.3.3, Fittings**, of these Technical Standards and Specifications.

Pipe fittings for "K" copper service lines shall be all brass construction in accordance with AWWA C-800. Fittings used inside a building or a meter vault (2" meter and larger) may be of the sweat copper type.

2. CORPORATION STOPS. Corporation Stops shall be manufactured in accordance with AWWA C800 (most current), with AWWA taper thread on the inlet side.

The outlet connection shall be flare type. Style shall be Ford FB600, or approved equal. All corporation stops will have a dielectric coupler installed to isolate the copper from the Corp Stop. **In all service line installations, the corp. stop shall be insulated from the copper service line.**

After tapping the Corporation Stop and the service line shall be wrapped in polyethylene extending from the main line eighteen inches (18”) up the service line per AWWA C-105 (most current) Standard Drawing Number 2-15.

3. CURB STOPS. Curb stops/ball valves shall have a body constructed of 85-5-5-5 waterworks brass with flared outlets. Styles shall be Ford Ball #B-22, Mueller #H15204, or approved equal.

Curb Stop shall be no deeper than 5’ 6”. Curb Stop shall be a minimum of 2”and a maximum of 4” above final grade.

4. CURB STOP BOXES. Curb Stop boxes shall be arch pattern base, which do not permit the transfer of loading onto the Curb Stop valve. Curb boxes shall be constructed of cast iron and steel, as manufactured by The Mueller Company or approved equal.

5. PRESSURE REGULATORS. The regulator shall be a Watts Model 25AUB. If the property falls into a high-pressure zone the developer or builder will need a high-pressure zone meter installation. See Drawing 2-14B for installation placement.

6. METER COUPLINGS. Meters one and one-half inch (1-1/2") and larger shall be provided with a coupling to allow for the removal of the meter without disturbing the pipe. Couplings shall be Ford LOK-PAK Meter Couplings or approved equal.

7. METER SETTERS. Meter setters shall be of an all copper and brass construction and shall have a positive 1/4 turn shut-off valve on the inlet side of the setter with padlock wings. Vertical meter settings for inside-house installation shall be Ford Copperhorn or approved equal. Horizontal meter

settings for outside-house (meter pit) installation shall be Ford Series 70 Coppersetter or approved equal. Provide a 7 $^{1}/_{2}$" meter yoke for meter installation.

The water meter setting shall provide a continuous, electrically conductive path around the water meter. If a bonding jumper is required, it shall be made of copper with fittings suitable for the bonding jumper and the water pipe material. The meter setting installation shall be in compliance with the NEC, Articles 100, 250-81, 250-94, 250-112 and 250-115(a).

8. **VALVES FOR USE WITH METERS.** Gate or ball valves three inch (3") and smaller to be used with copper service pipe shall be brass, with non-rising stems and solid wedge disc. Gate valves shall meet the requirements of AWWA Standard C800. Valves shall be Nebco #T22 or Approved equal.

   Valves larger than three inches (3") for use with ductile iron service pipe shall be gate valves conforming to **Article 2.3.4, Gate Valves**, of these Technical Standards and Specifications.

9. **TAPPING SADDLES.** Water service tapping saddles for service lines 2-inch diameter and smaller shall be bronze casting with double silicone bronze straps. Single strap saddles shall not be permitted.

   Tapping saddles being used shall be Smith-Blair #232, Ford 202B, Mueller #16100 Series, or approved equal.

10. **METER PITS AND COVERS.** Meter pits for meters shall consist of twelve-inch (12") high pre-cast concrete rings, 24" I.D., with two-inch (2") wall thickness. The top section shall be tapered to accommodate a 20" I.D. frame.

    Meter pit covers shall be airtight with a double cover. The meter pit cover shall have a cast iron or traffic rated composite, cap type, top lids. The body of the meter pit cover shall be cast iron or aluminum. Aluminum shall have a polymer coating such as epoxy. Meter pit covers shall be Ford Model W3 or approved equal**.** Meter pits shall be 2 to 4 inches above final grade.

11. **COMPOUND METERS.** Compound meters shall conform to most current AWWA C702. Meters shall be manufactured by Badger Meter or approved equal. Final meter selection shall be submitted to the District for approval prior to ordering.

    Specifications shall be furnished upon request for meters larger than six inches (6") or for installations where the service requirements require a meter other than the type specified above.

12. **METER CHECK VALVES.** Check valves shall be required for all meters one and one-half inch (1-1/2") and larger. Reduced pressure principle backflow preventers may be required where conditions exist that could cause a flow of water from the property to the main.

2.5.3 SERVICE LINE EXTENSION.

1. **EXCAVATION, BEDDING AND BACKFILL.** Excavation, bedding and backfill shall be performed in accordance with **Article 4, Site Work and Earthwork**, of these Technical Standards and Specifications.

2. **SERVICE LINE TAPS.** Tapping shall be performed after the water main has passed pressure and bacteriological tests.

   Service line taps shall be made under full line pressure. Taps shall be made in the upper half of the main at the ten o'clock and two o'clock positions. The tap shall be made on the same side of the main as the water meter.

   Service taps shall have a minimum separation of 18 inches and shall be no closer than 18 inches to a coupling or bell. After the tap has been completed, polyethylene wrap and the bedding shall be repaired or replaced. Upon completion of all service taps, a visual inspection shall be made by the District to check for leakage. If any leakage exists which cannot be corrected by tightening the corporation stop, upon approval by the District a repair saddle may be used.

   No partial inspections for water service will be permitted without prior approval to the excavation by Roxborough Water and Sanitation District.

3. **OUTSIDE METER SETTINGS WITH REMOTE READOUTS.** Outside meters shall be installed in a horizontal position and housed in a concrete manhole or vault. Remote readouts shall be located in an approved location.

4. **INSIDE METER SETTING AND REMOTE READOUTS.** Inside meter settings shall be installed in a manner which will allow free access and adequate room for inspection and maintenance and will protect the meter from freezing. Meters installed inside of buildings shall be not more than eighteen inches (18") from the wall through which the service pipe enters the building. The meter yoke shall have a minimum of one-foot (1') clearance from all surrounding obstructions. All fittings shall be brass or copper.

   Inside meter settings shall not be allowed in crawl spaces, closets or other locations that are not easily accessible. Meter sizes one and one-half inch (1-1/2") and two inch (2") installed inside buildings shall be provided with a floor drain.

   Remote readouts shall be installed in an approved location within five feet (5’) of the meter. The remote readout will remain accessible to the District at all times.

2.6 PUMPING FACILITIES.

2.6.1 GENERAL. In locations where the District's water distribution system is not capable of providing adequate water pressure to a development area, the District may require the construction of a pumping facility in order to provide proper service. The District may not approve the installation of a pumping facility where, in the opinion of the District such an installation would have an adverse effect on the operation, or future operation, of the District's water system. The Developer shall provide the District with a set of

design calculations and drawing for review and acceptance by the District. Drawings shall conform to **Article 1.5, Plans and Specifications**, of these Technical Standards and Specifications.

The pumping facility shall satisfy all requirements of the Colorado Department of Public Health and Environment and of these Standards and Specifications. The Developer shall prepare a set of "as built" drawings of the pumping facility in accordance with **Article 1.5, Plans and Specifications**, of these Technical Standards and Specifications. Upon completion of the pumping facility, the Contractor shall also provide the District with two (2) copies of an "Operation & Maintenance Manual" for the facility.

2.6.2 DESIGN CRITERIA.

1. **GENERAL**. The District on a case-by-case basis will establish specific design criteria for water pumping facilities. Prior to commencing design, the developer and his engineer shall meet with the District to develop design criteria for the project.

2. **PUMPS AND PUMP STATION.** Pump stations shall have a minimum of two (2) pumps and shall be capable of pumping the peak design flow with one pump out of service. All pumping equipment shall be manufactured and supplied by the same company.

   The station shall be sized to accommodate all pumps, electrical equipment and controls required to operate the facility. The station shall be lighted, heated and well ventilated, and if required shall be designed for easy expansion. The architectural finish of the station shall blend with that of the surrounding architecture.

   A standby generator, capable of operating the entire station for a minimum of four hours, shall be provided and shall be located outside of the building in an all- weather enclosure.

3. **CONTROLS AND TELEMETRY.** Pump operation shall feature automatic sequencing of the pump operation to balance pump wear. A telemetry system shall be incorporated at the pump station into the system for control monitoring and reporting. The system shall be capable of differentiating between varieties of emergency conditions including high and low pressures, pump failures and power failure. The telemetry system shall be compatible with the District's system and will be reviewed and accepted by the District prior to installation.

4. **SITE IMPROVEMENTS.** A six-foot (6') high vinyl coated chain link fence with barbed wire shall be installed around the perimeter of the pump station site. Upon completion of the pump station construction all disturbed areas within the site shall be fertilized, seeded and mulched in accordance with **Article 4.8, Site Restoration**, of these Technical Standards and Specifications.

   Depending on site location, landscaping improvements may be required by the District.

ARTICLE 3. WASTEWATER FACILITIES

3.0 GENERAL PROVISIONS.

3.1 GENERAL.

3.1.1 **APPLICABILITY.** All wastewater main construction within the District system and all wastewater service line construction connecting to the District's wastewater mains shall be completed in accordance with these Technical Standards and Specifications and the approved plans. These Technical Standards and Specifications shall cover new construction and repairs to existing facilities.

3.1.2 **TRENCH, BACKFILLING AND COMPACTING.** Trenching, backfilling and compacting shall be performed in accordance with **Article 4.6, Trenching**, **Backfilling and Compacting**, of these Technical Standards and Specifications.

3.1.3 **PRESERVATION OF MONUMENTS.** Monuments which are moved or disturbed will be replaced by a licensed professional land surveyor at the contractor's expense.

3.1.4 **CONNECTION TO DISTRICT WASTEWATER SYSTEM.** The District shall not allow flow of any kind into the existing wastewater system until final acceptance of the wastewater lines. All wastewater flow shall meet the **Classification of Wastes and General Prohibitions** as indicated in **Appendix A** of these Technical Standards and Specifications.

3.1.5 **CONNECTION TO DISTRICT WASTEWATER SYSTEM FROM AN OUTSIDE ENTITY.** The District shall not allow flow of any kind into the existing wastewater system without District approval. Wastewater flow entering the District system from an outside entity shall be monitored flow. Please refer to standard details 3-13A and 3-13B.

3.2 DESIGN CRITERIA

3.2.1 **DESIGN FLOW.** The design shall include consideration of providing service for the entire area tributary to the outfall point. The following wastewater flow rates shall be used:

Wastewater Flow Rates by User Type

User Type	Unit Wastewater Flow Rate
Residential	71 gallons/capita/day
Commercial	1,500 gallons/acre/day
Industrial	1,300 gallons/acre/day
Park/Recreation	50 gallons/acre/day
Elementary Schools	13 gallons/student/day
Jr. & Sr. High Schools	20 gallons/student/day

Minimum residential population density, household density and land usage shall be as noted on the approved PD.

Wastewater peaking flows shall be computed using the following equation:

PF = 3.39 x ADF

Where ADF = average daily flow

3.2.2 **HYDRAULIC DESIGN.** Wastewater mains ten inches (10") in diameter and smaller shall carry the peak design flow at a maximum flow depth of seventy-five percent (75%) of the pipe diameter. Wastewater mains twelve inches (12") in diameter and larger may be designed to flow full at the peak design flow rate.

The minimum velocity at the average design flow rate shall be two (2) feet per second. Where actual flow will be considerably below the design flow for several years, the District may require that the minimum velocity be attained by suitable grades at the partial peak design flow rate. Maximum allowable velocity shall not exceed ten (10) feet per second at seventy-five percent (75%) flow depth in the pipe.

Care shall be taken to design invert elevations at manholes in such a manner that the energy gradient is consistently falling in the direction of flow. In addition, when the velocity of an upstream wastewater line entering a manhole at peak flow is above critical velocity, the hydraulic gradient shall be computed to insure that a surcharge will not occur at a service connection, and that the energy gradient will remain level across the manhole.

3.2.3 **WASTEWATER MAINS AND SERVICE LATERALS.** Wastewater mains shall be eight inch (8") diameter or larger. Wastewater service connections shall be four inch (4") diameter or larger. The following minimum grades (based on a Manning's formula n = 0.015) shall apply:

Minimum Grades for Sewers

Sewer Diameter	Minimum Grade (Percent)
4 service lateral	2.0 or 1/4 inch/foot
6 service lateral	2.0 or 1/4 inch/foot
6	1.0 or 1/8 inch/foot
8	0.40
10	0.33
12	0.22
15	0.15
18	0.12
21 or larger	As Approved by District Engineer

Wastewater mains shall ordinarily have a minimum of eight feet (8') of cover to finished ground surface. Where pipe has less than feet (4') of cover, provisions shall be made to protect the pipe from impact and loading.

Wastewater mains shall be extended at least ten feet (10') uphill from the lowest lot corner of the uppermost lot to be served. Wastewater mains shall terminate in a manhole. Service connections shall not be made at manholes, but shall be provided above or below the manhole. Manholes shall be stubbed out with suitable size pipe wherever future extension of the wastewater main is anticipated.

3.2.4 **MANHOLES.** Manholes shall be a minimum of forty-eight inch (48") diameter and shall be provided at every change in direction, grade, or at connections with intersecting sewer mains. Maximum spacing between manholes shall be four hundred feet (400') for lines fifteen inches (15") diameter or smaller or five hundred feet (500') for lines eighteen inches (18") diameter or larger. Wastewater lines between manholes shall be straight in line and grade.

Outside drop manholes (Drawing 3-9) shall be provided for a wastewater line entering a manhole at an elevation eighteen inches (18") or more above the manhole invert. Where the difference in elevation is less than eighteen inches (18"), the invert shall be filleted to prevent solids deposition. Inside drop manholes shall not be allowed, except by written permission of the District.

Pipe penetration gaskets shall be used for connection of pipes to precast manhole bases. The space between the pipe wall and the edge of the block out shall be grouted inside and outside, after the pipe is inserted into the gasket.

See **Article 3.3.4, Manholes & Riser Rings**, for construction specifications.

Manhole steps shall be twelve inches (12”) on center as demonstrated in Figure3-1. The first step shall be eighteen inches (18”) below finished grade.

Corrosion protection from hydrogen sulfide gas shall be required for manholes if a drop manhole is provided or slope of wastewater main results is greater than ten feet per second (10 fps). Manholes shall be lined, or approved equal by the District.

3.2.5 **WASTEWATER SERVICE CONNECTIONS.** Wyes shall be provided in the wastewater main for service connections at each lot or building site. These fittings shall ordinarily be located five feet (5') below the centerline of the lot. Fittings shall be angled upwards so that the upper invert of a one-eighth bend connected to the fitting will have an elevation equal to or higher than the inside crown of the wastewater main. (See Drawing 3-8) Riser connections shall be installed where the elevation of the top of the fitting is more than twelve feet (12') below finished ground. Riser connections shall ordinarily reach to a grade ten feet (10') below finished ground surfaces. Refer to Paragraph 3.5 of this Section for additional details on wastewater service stub-ins and wastewater service connections.

Wastewater service lines shall not be located closer than three feet (3') to a side property line, and shall not be constructed through or in front of an adjoining property. Wastewater service lines shall be located a minimum of ten feet (10') to the low side of the water service.

A manhole shall be installed instead of a wastewater service connection when a greater than 4” connection is to be made to an eight-inch (8") or smaller main.

Buildings constructed as a shell, with the intention of being used for subdivided suites for commercial purposes, shall have wastewater service connections extending a minimum of six feet (6') outside of the building with a clean out for each set of proposed bathrooms or suites. All commercial and industrial facilities shall have a clean out on the outside of the building, located a minimum of three feet (3') from the building, on the wastewater service connection.

Rainwater leaders, roof drains, surface drains or ground water drains shall not be connected to the wastewater system. Each wastewater service system shall be separate from the drainage system.

3.2.6 **LOCATION DETAILS.** Wastewater mains installed in local or collector streets shall be located West or South of the centerline of the street. Mains installed in easements shall be located in the center of the easement. Mains and manholes shall be located to provide reasonable access for maintenance crews.

3.2.7 **RELATION TO WATER MAINS AND STORMWATER LINES.** Wastewater lines shall be located a minimum of ten feet (10), horizontally, from existing or proposed water mains or stormwater lines (edge to edge distance measured). Where wastewater lines cross water mains and stormwater lines, the wastewater line shall be a minimum of eighteen inches (18"), clear, below the water main or stormwater line. If this clear distance is not feasible, the crossing shall be designed and constructed so as to protect the water main. The District shall approve the crossing design.

Minimum protection shall consist of the installation of an impervious and structural wastewater line. The wastewater line shall be encased in reinforced concrete. The encasement shall be at least six inches (6") thick around the entire pipe and shall extend a distance of ten feet (10') on either side of the water main.

3.2.8 **UNDERDRAIN PIPE.** The Developer may install an underdrain system to collect the discharge of peripheral drain systems from individual house foundations from sump pumps installed as a part of a peripheral drain system for house foundations. Such a system shall be constructed for the convenience of the Developer and will not be maintained by the District. Underdrain systems shall not be connected to the wastewater collection system. Clean outs may not be installed within a wastewater manhole. Underdrain systems shall require the approval of the District.

3.2.9 **GREASE INTERCEPTORS.** Grease interceptors shall be installed in all food serving, food preparing, food catering, or other establishments capable of discharging large amounts of grease into the wastewater system. Grease interceptors shall be located outdoors, on private property, within thirty feet of the facility served, and shall be easily accessible at all time for maintenance and examination. Grease interceptors shall comply with the requirements of the most current Uniform Plumbing Code, South Platte Water Renewal Partners (SPWRP) most current Fat, Oil, and Grease (FOG) Policy, and **Appendix B, Pretreatment Program** of these Technical Standards and Specifications. SPWRP may be reached at 303-762-2600 or, spwaterrenewalpartners.org.

3.2.10 **PETROLEUM OIL, GREASE, AND SAND TRAPS.** Sand and oil traps shall be installed at all service stations, truck or car wash facilities, vehicle maintenance facilities, machine shops, garden nurseries, warehouses, parking garages, and other establishments capable of discharging large amounts of sand and oil into the wastewater system. Sand and oil traps shall be located outdoors, on private property, within thirty feet of the facility served, and shall be easily accessible at all time for maintenance and examination. Sand and oil traps shall comply with the requirements of the most current Uniform Plumbing Code, SPWRP most current Petroleum Oil, Grease, and Sand (POGS) Policy, and **Appendix B, Pretreatment Program** of these Technical Standards and Specifications.

3.2.11 **GRINDER PUMPS.** In those areas where the District's wastewater collection system cannot provide gravity service to certain individual lots, the District may approve the installation of grinder pumps. Grinder pumps and wet wells will be sized to provide adequate service to the individual lots being served. Grinder pump installation shall be approved by the District prior to installation. Grinder pumps shall be installed inside the residence or will fall under **Article 3.6, Wastewater Lift Stations** of these Technical Standards and Specifications.

3.3 MATERIALS.

3.3.1 **WASTEWATER PIPE.** Wastewater pipe and fittings shall be Polyvinyl Chloride (PVC) and shall conform to the requirements of ASTM D3034, SDR 35. Joints shall be factory prepared compression type (Elastomeric Gasket Joint), providing a watertight seal. Solvent cement joints shall not be used.

3.3.2 **UNDERDRAIN PIPE.** Underdrain pipe and fittings shall be Polyvinyl Chloride (PVC) and shall conform to the requirements of ASTM D3034, SDR 35. Pipe shall be perforated in the lower quadrant. Joints shall be factory prepared compression type (Elastomeric Gasket Joint), providing a watertight seal.

Where underdrains are to be constructed under wastewater mains, clean outs for the underdrain shall be provided near each wastewater line manhole. Suitable fittings shall be provided for construction of clean-outs.

3.3.3 **PLUGS.** A compression stop as recommended by the pipe manufacturer shall be provided to seal the end joint of wye connections and dead-end stubs. The location of wyes and stubs shall be marked with a #20 copper wire with yellow insulation extending from the plugged end to twelve inches (12") below the ground surface and tied off to a twenty-four inch (24") piece of two inch by four inch (2"x4") lumber.

3.3.4 **MANHOLES & RISER RINGS.** Manholes shall be constructed of precast concrete conforming to ASTM Designation C-478. Cones shall be of the eccentric type.

Manhole steps shall be one-half inch (1/2") diameter, grade 60, steel-reinforcing rod completely encapsulated in Copolymer Polypropylene as manufactured by M.A. Industries, Inc. The maximum distance from the finished ground (street) surface to the first step shall be eighteen inches (18”). See Drawing 3-1.

Manhole barrels shall use butyl rubber sealants and conform to ASTM C-990 to ensure watertight joints.

Mortar for manholes shall be mixed in the following proportions by volume: One (1) part Portland cement; one-half (1/2) part hydrated lime; and three (3) parts sand or masonry cement. The cement, lime, and sand shall be thoroughly mixed dry and only enough water added to form a mortar of proper consistency. Mortar shall be used within one (1) hour after mixing with no retempering permitted. Mortar that has taken a partial set shall not be used.

Riser Rings shall be pre-cast concrete or HDPE as manufactured by Ladtech or approved equal.

Manhole boot connectors shall be A-LOK Products, Inc. Z-LOK, G3 Boot System or approved equal.

3.3.5 **MANHOLE BASE SLABS AND BASE BEAMS.** Manhole base slabs may be poured in place or precast. The slab shall be designed to uniformly support the earth load and any other reasonable loads that may occur. The minimum slab thickness shall be six inches (6"). The minimum reinforcement shall be welded wire fabric, 4x4/W4xW4. Splicing of the welded wire fabric shall be by lapping one space and securing the wire mesh together. All wire fabric shall conform to the requirements of the "Wire Reinforcement Institute, Inc."

3.3.6 **CONCRETE.** Concrete shall conform to **Article 5, Concrete Work**, of these Technical Standards and Specifications. Type II cement shall be used.

3.3.7 **MANHOLE RINGS AND COVERS.** Cast iron manhole ring and covers shall conform to ASTM A-48 with a minimum tensile strength of 25 KSI (Class 25). All casting are to be dipped in asphalt base paint or approved equal. The quality shall be such that a blow from a hammer will produce an indentation on a rectangular edge of the casting without flaking the metal.

Manhole covers shall be furnished with one (1) pick hole 1.25” x 1”, shall be twenty four inches (24”) diameter, shall be heavy duty with checkerboard style cover design, and shall have the word "sewer" cast in the cover with three inch (3”) text height. Manhole frames and covers shall be D&L Foundry and Supply Model No. A-1161, or approved equal.

For locations that require a thirty-six inch (36”) diameter ring and cover, manhole cover shall include two pieces, one twenty-four inch inner cover and one outer donut cover with 36” outer diameter and 24” inner diameter. Manhole frames and covers shall be D&L Foundy and Supply Model No. A-1425, or approved equal.

The use of ductile iron manhole rings and covers is acceptable to the District. Ductile Iron Manholes shall be approved by the District prior to installation.

3.3.8 **MANHOLE LINING.** Manholes that require lining as defined in **Article 3.2.4,** shall be lined SpectraShield, Sprayroq, or approved equal by District.

3.3.9 **BEDDING MATERIALS.** Bedding materials shall be in conformance with **Article 4.2.1, Pipe Bedding Materials**, of these Technical Standards and Specifications.

3.3.10 **PLASTIC LINER PIPE (SLIPLINING).** Wastewater main liner pipe and fittings shall be made of a polyethylene pipe compound that meets the requirements for Type III, Grade P34 polyethylene material as defined in ASTM D-1248 and D-3350. The National Sanitation Foundation shall approve both resin and manufacturing plant.

The outside diameter and wall thickness, when measured in accordance with ASTM D-2122, shall conform to the following:

Sewer ID. Min. OD (Inches)	Liner (Inches)	Minimum Wall Thickness (Inches)			
		SDR-32.5	SDR-26	SDR-21	SDR-17
4	3.5	-	-	0.167	0.206
6	4.5	-	-	0.215	0.265
6	5.375	0.166	0.207	0.256	0.317
8	6.625	0.204	0.255	0.316	0.390
8	7.125	0.220	0.274	0.340	0.420
10	8.625	0.266	0.332	0.411	0.508
12	10.75	0.331	0.414	0.512	0.633
15	12.75	0.393	0.491	0.608	0.750
16	14.00	0.431	0.539	0.667	0.824
18	16.00	0.493	0.616	0.762	0.942
21	18.00	0.554	0.693	0.858	1.059
24	22.00	.0677	0.847	1.048	1.295
27	24.00	0.739	0.924	1.143	1.412
30	28.00	0.862	1.077	1.334	1.648
36	32.00	0.985	1.231	1.524	-
40	36.00	1.108	1.385	1.715	-

Standard lengths shall be forty feet (40'). Pipe for service lines shall be SDR-21. Where construction restraints prevent the use of the above noted pipe sizes, other pipe sizes may be utilized with the written approval of the District.

The wastewater liner pipe shall be capable of withstanding long-term water table depth for the various SDR's as shown below:

SDR	Height of Water Above Pipe (ft.)
32.5	4.0
26	8.0
21	15.6

Pipe shall be joined to the specified polyethylene fittings by thermal butt-fusion in accordance with ASTM D-2657 and D-3350. Butt-fusion of the pipe and fittings shall be performed in accordance with the procedures recommended by the pipe manufacturer. Service connections shall be made to the liner pipe by a heat fused polyethylene saddle, compatible to the resins in the liner. Joints between pipe sections shall be smooth on the inside and internal projection beads shall not exceed one-tenth inch (0.1"). The tensile strength of the butt-fusion joint shall not be less than the pipe tensile strength.

3.3.11 **STEEL CASINGS FOR BORES.** Steel casing pipe for bores shall be seamless welded steel tubing having an inside diameter of at least four inches (4") greater than the outside diameter of the bell or joint of the carrier pipe to

Wall Thickness	Casing O.D.
3/16"	< 24"
1/4”	27"
5/16”	30" - 36"
3/8"	42"

Carrier pipe supports shall be stainless steel Pipeline Casing Spacers as manufactured by Cascade Waterworks Manufacturing Company, or approved equal. Casing pipe shall include Rubber End Seal as manufactured by Cascade Waterworks Manufacturing Company, or approved equal.

3.4 WASTEWATER MAIN INSTALLATION.

3.4.1 GENERAL. Installation of PVC wastewater main shall conform to ASTM D-2321, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe". All work shall conform to the accepted plans, specifications, special provisions and the above designation, except as modified herein.

3.4.2 ALIGNMENT AND GRADE. Wastewater mains, structures and appurtenances shall be constructed accurately to the line and grade as shown on the approved plans. Construction stakes shall be placed by field parties under the direct supervision of a registered professional land surveyor licensed to practice in the State of Colorado.

The grade and alignment shall be maintained by use of suitable surveying instruments (checking the invert of each piece of pipe) or laser equipment, operated continuously during the construction.

3.4.3 UNDERDRAIN PIPE. Underdrains shall be installed where shown on the approved plans. Underdrains shall be installed below the wastewater line, with a minimum vertical clear distance of 4" between the underdrain and the wastewater line.

Under drain pipes shall be provided with clean-outs near each manhole. Underdrain pipe shall not be installed directly beneath manholes. Underdrains shall be routed around manholes by use of suitable bends and other fittings. Under drain pipe stub in to property shall be three-inch (3”) pipe.

3.4.4 HANDLING PIPE AND FITTINGS. All pipe, fittings, and specials shall be unloaded, stockpiled, hauled, distributed, installed and otherwise handled in a manner that will prevent breakage or other damage thereto and which will insure delivery and installation in a sound and acceptable condition. PVC pipe shall be stored or covered in a manner to protect against direct sunlight exposure.

3.4.5 WASTEWATER LINE INSTALLATION. Wastewater lines shall be constructed continuously upgrade from an existing wastewater lines except when otherwise approved by the District. Special care shall be taken to lay wastewater pipe to exact line and grade with spigot ends pointing in the direction of flow.

Bedding material shall be placed per detail 4-1. A continuous trough shall be excavated in the bedding to receive the bottom quadrant of the pipe barrel. Bell holes shall be excavated so that after placement, only the barrel of the pipe bears on the bedding.

Prior to making pipe joints, all surfaces of the joint shall be clean and dry. Lubricants shall be used as recommended by the pipe manufacturer. The joint shall be carefully pushed home using approved methods of leverage. Care shall be taken to prevent pinching or rolling of the gasket. Adjustment to final line and grade shall then be made. PVC wastewater pipe shall be secured in place by installation of bedding material tamped under and along it up to a level of twelve inches (12") over the top of the pipe.

Wastewater lines shall be kept thoroughly clean and free of gravel, dirt and debris. Whenever work ceases for any reason, the unfinished end of the pipe shall be securely closed with a temporary plug.

Tracer wire shall be installed on all wastewater mains and service laterals. Test station location shall be in open spaces when possible. If a wastewater line is in the road, the test station location shall be shown on the plan drawing close to the wastewater line location. The test location shall be in areas outside asphalt and concrete finished surfaces.

Pipe shall not be covered until a representative of the District has inspected it.

3.4.6 **CONNECTIONS TO EXISTING MANHOLES.** Wastewater pipe connections to existing manholes, where there is no pipe stubbed out, shall be made in such a manner that the finished work will conform as nearly as practicable to the essential requirements specified for new manholes. The contractor shall break out as small an opening in the existing manhole as necessary to insert the new wastewater pipe. The existing concrete foundation bench shall be chipped to the cross-section of the new pipe in order to form a smooth continuous invert similar to what would be formed in a new concrete base. Non-shrink grout shall be used as necessary to smoothly finish the new invert and to seal the new line so the junction is watertight.

3.4.7 **CONSTRUCTION OF MANHOLES AND CLEAN-OUTS.** Concrete bases shall extend at least six inches (6") below the bottom of the pipe and shall be benched up to at least two inches (2") over the top of the pipe (See Drawing 3-1). The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be constructed with as large a radius of curvature as possible (See Drawing 3-3A). Inverts shall be plastered with cement mortar and left smooth and clean.

Precast manhole sections shall not be placed on the foundation until after it has reached sufficient strength to provide support without damage. The top of the bench shall be thoroughly cleaned. Sealant shall be applied to the precast section-bearing seat. The first precast section shall be carefully lowered onto the bench so that the sealant is forced out from under the section evenly on all sides. Each succeeding precast section shall be jointed in a similar manner. Sealant shall be raked back in all joints to a minimum depth of one half inch, and all joints shall be grouted, inside and outside the manhole. All lifting holes and other imperfections in manhole walls shall be filled with non-shrink grout.

The top of the manhole vault shall be a minimum of twelve inches (12") and a maximum of eighteen inches (18") below the finished street or ground surface elevation. Concrete extension risers or collars shall be used to bring the manhole ring and cover up to finished street or ground surface elevation.

3.4.8 **PLASTIC LINER PIPE (SLIPLINING).** The Contractor shall by-pass the wastewater around the section or sections of the line that are to be slip lined. The by-pass shall be made by plugging an existing upstream manhole if necessary and pumping the wastewater into a downstream manhole or adjacent system. The pump and by-pass wastewater lines shall be of adequate capacity and size to handle the flow. Under no circumstances will the dumping of raw wastewater on private property or on District streets be allowed. At the end of each working day, temporary tie-ins shall be made between the relined section and the existing section, and the by-pass removed.

Prior to commencing slip lining, the Contractor shall televise and thoroughly clean the line that is to receive the liner. It shall be the responsibility of the Contractor to clear the line of any protruding service connections or solids that might prevent the pulling of the liner through the existing wastewater main.

Excavation shall conform to all applicable portions of **Article 4, Site Work and Earthwork**, of these Technical Standards and Specifications. Excavation shall be required at each building service connection to the main, after insertion of the liner pipe into the existing sewer main. Excavation shall provide sufficient working room to properly reconnect the building service lead to the new liner pipe. Access shaft excavations shall also be required at intermediate manholes, or other intermediate points, where the liner pipe will be "fed" into the existing wastewater main. When possible, these intermediate access shaft excavations should coincide with building wastewater service connection excavations or critical deviations in line or grade. Where excavations for the insertion of the liner are made in a line section between the two manholes, the liner pipe shall be joined together with a circular seal clamp, or equivalent connection. The exposed liner clamp shall then be encased (all around) with twelve inches (12") of cement stabilized sand.

The sections of liner pipe shall be assembled and joined on the site, above ground.

Where installation of the liner pipe is to be made through an access shaft, the top of the existing wastewater main shall be exposed to springline for the full length of the shaft prior to removal of the crown portion of a section of the existing main.

A power winch shall be connected to the end of the liner by the use of a pulling head. Precautions shall be taken to prevent damage to the liner and joints. The length of the liner pipe to be pulled into an existing wastewater main at any one time shall be governed by the size of the liner and the condition of the existing wastewater main.

After the liner has been pulled into place, secured in the manhole walls and tested in accordance with **Article 3.4.11, Testing and Inspection**, of this section, each existing wastewater service connection shall be connected to the new liner. A portion of the existing wastewater main around each service connection shall be removed to expose the liner pipe and provide sufficient working space for making the new service connection. Service laterals shall be connected to the liner pipe by using a heat fused polyethylene saddle, compatible with the resins in the liner. If extreme conditions prevent heat fusion of this saddle, it may be secured to the liner with stainless steel bands, with a neoprene gasket between the liner and the saddle. The entire wastewater service connection shall be encased with a twelve-inch (12") cover (all around) of cement stabilized sand.

In those places where the main access shaft is excavated at an existing manhole, the manhole shall be replaced with a new precast concrete manhole. Where new manholes are not required at the access shaft locations, the line shall be encased in cement stabilized sand.

The annular space between the liner and the existing wastewater main shall be sealed where the wastewater main enters and exits each manhole. This annular space may be sealed with a mechanical seal, chemical seal, or combination of both.

The District prior to construction shall approve the method in writing. The liner shall be allowed to stabilize for several hours at the wastewater main temperature before grouting the annular spaces at the manholes.

At all points where the liner pipe has been exposed, such as access shafts, service connections, and outside of manholes, cement stabilized backfill shall be placed in six inch (6") lifts to an elevation one foot (1') over the top of the exposed liner pipe. Each lift shall be hand tamped and care shall be exercised at all times to prevent damage or collapse to the liner, service connections, etc. After the cement stabilization is in place and accepted by the District, the trench shall be backfilled to the required finished grade.

3.4.9 STEEL CASING AND CARRIER PIPE INSTALLATION. Pits shall be excavated such that the timber blocking can be installed to give an unyielding backing for the hydraulic boring machine or jacks and to prevent sloughing of the header face. Sub grade on which rails or guides are to be set shall be stabilized with washed rock where soft or springy ground is encountered. Excavation and casing installation shall be performed simultaneously. At no time shall the advancing edge of the casing trail the excavation by more than twelve inches (12").

Sections of the steel casing shall be trimmed, beveled and aligned in the pit so that when welded together the thrust of the boring machine will be uniformly transmitted through the casing in a horizontal plane. Welds shall be made to provide a solid firm watertight connection without the use of butt straps.

The casing pipe shall be installed by boring or jacking upgrade from the outlet end. When the carrier pipe to be installed is for gravity flow, the horizontal and vertical alignments of the casing pipe, when in place, shall not vary from those called for on the accepted plans by more than the following:

Alignment	Entrance	Midpoint	Outlet
Horizontal	+0.02'	+0.35'	+0.70'
Vertical	+0.02'	+0.10', -0.05	+0.20', -0.10

Voids created along or above the casing shall be filled with grout after installation of the casing. Grout shall be equal parts of Portland cement and mortar sand mixed with sufficient water to provide a workable mix. Grout shall be pumped through grout holes in the casing until all voids are filled. Grout holes, one inch (1") to two inches (2") in diameter, shall be provided or drilled in the casing on four foot (4') centers along the pipe arch and at eight foot (8') centers along each springline. As grouting advances each of the completed grout holes shall be plugged to a watertight condition.

Each section of carrier pipe shall have two (2) stainless steel casing spacers. Sections of carrier pipe shall be properly joined to each other as they are set and the assembled line gradually threaded through the casing by means of applying force at the exposed end of the carrier pipe. Care shall be exercised to provide watertight joints and to protect the ends of the pipe as they are pushed by uniformly transferring said force through the pipe in a horizontal plane. It may be necessary to vary the size of risers on casing spacers to obtain a uniform grade through the carrier pipe.

Following threading and aligning the carrier pipe, the void between the carrier and the casing shall be filled with clean sand. Sand under pressure shall be blown into the void until the entire void is filled.

3.4.10 **WYES AND RISERS FOR SERVICE CONNECTIONS.** Wyes, stubs, and risers shall be placed where shown on the accepted plans. Wyes shall be angled upwards so that the upper invert of a one-eighth (1/8) bend connected to the fitting shall have an elevation equal to or higher than the inside crown of the wastewater main. Riser connections shall be installed where the elevation of the top of the branch is more than twelve feet (12') below finished ground. Riser connections shall ordinarily reach to a grade ten feet (10') below finished ground surface. Watertight plugs shall be installed in each branch pipe or stub. Wye and riser locations shall be marked with a #20 copper wire with yellow insulation run from the plugged end up twelve inches (12") below the ground surface and tied off to a twenty-four inch (24") piece of two inch by four inch (2"x4") lumber. As-built measurements shall be made by the contractor to reference the wye or riser connection to the nearest manhole before backfill. Measurements shall be carefully and accurately made and recorded and shall be shown on the as-built plans.

3.4.11 **TESTING AND INSPECTION.** The District shall visually inspect all wastewater lines for cleanliness and accurate alignment. Discrepancies noted during visual inspection shall be corrected prior to further testing.

Prior to final acceptance, the contractor shall conduct, at his own expense, tests for water tightness for all new wastewater line construction. Tests shall be completed under the direction of the District. The District may require that the first two (2) manholes, including the main between them, of all wastewater line projects be tested before further construction to permit initial observation of the quality of construction workmanship. The District may require additional testing during the course of construction if infiltration appears to be excessive or the quality of workmanship is questionable.

All pipelines shall be tested for excessive deflection. Deflection testing shall be performed by pulling a properly sized mandrel through the pipeline.

Low pressure air testing shall be performed on all wastewater lines. Vacuum testing of manholes may be required by the District, depending on specific project conditions. Air and vacuum testing shall be completed in accordance with ASTM C- 828 and as described herein. The District shall record times and pressure and vacuum readings during the test period. A test section shall not be longer than the length of pipe between adjacent manholes.

The low-pressure air test for wastewater lines and the vacuum test for manholes shall be performed after completion of backfilling and compaction.

1. **AIR TESTING PROCEDURE.** The ends of the sewer pipe being tested shall be plugged and braced and the test section shall be pressurized to four (4) psi. The pressure pump shall be turned off and the air in the pipe allowed to stabilize for a minimum of two (2) minutes. The time shall be monitored as the line either holds pressure or drops no more than one (1) psi (if the ground water is higher than the top of the pipe, the test pressure shall be increased to account for the high groundwater). The pressure shall remain within the allowable limits for the time indicated by using the following formula:

$$T = 0.0237 (L) (D^2)$$

where: T = time of test (in seconds)
L = length of pipe being tested (in feet)
D = diameter of pipe (in inches)

or as indicated in the following table:

Specified Test Duration for Length of Pipe Indicated (min:sec)

Pipe Diameter	Pipe Length (Feet)						
	0-150	**200**	**250**	**300**	**350**	**400**	**500**
4 “	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6 ”	5:40	5:40	5:40	5:40	5:40	5:42	7:07
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

Sections of pipe that fail the air test shall have the defects repaired and the test shall be repeated. Repair and repeat testing shall be continued until the testing requirements are met.

2. VACUUM TESTING MANHOLES. Manholes shall be tested before the ring and cover and grade adjustment rings have been installed. All pipes entering the manhole shall be plugged and braced and a vacuum of ten inches (10") of mercury shall be drawn. The vacuum pump shall be turned off and the time monitored as the vacuum drops one inch (1"). The vacuum shall not drop more than one inch (1") for the duration of the time indicated in the following table.

Specified Test Duration for Diameter of Manhole

Manhole Diameter (inches)	Test Duration (min:sec)
48	1:00
60	1:15
72	1:30

Manholes that fail the vacuum test shall have the defects located and repaired and the test shall be repeated. Repair and repeat testing shall be continued until the testing requirements are met.

When required, infiltration tests shall conform to the requirements of ASTM C969. Infiltration tests shall be conducted by placing an approved, calibrated V-notch weir in the line and measuring infiltration flow. Successive readings shall be taken until consistent results are attained. Infiltration shall not exceed the allowable leakage limit 50 gallons per inch of internal pipeline diameter per mile per day when the average head on the test section is six feet (6’) or less.

When required, exfiltration tests shall conform to the requirements of ASTM C969. Exfiltration tests shall be conducted by plugging the section of line to be tested, filling the line and manholes with water to a depth of four feet in the

upper manhole. If groundwater is present above the elevation of the pipe, the water level in the upper manhole shall be increased by the height of the groundwater surface above the pipe. The water shall be allowed to stand for a minimum of eight (8) hours to allow absorption to take place in the walls of the manhole and pipe. If required, water shall be added to bring the water surface back to a depth of four feet in the upper manhole. The drop in elevation of the water surface in the upper manhole shall be monitored over a 60 minute period, and converted to an exfiltration rate. Exfiltration testing shall not be used if the hydraulic head in the lower part of the test section would exceed 25 feet. Exfiltration shall not exceed 50 gallons per inch of internal pipeline diameter per mile per day when the average head on the test section is three feet (3') or less.

3.5 WASTEWATER SERVICE LINES.

Sewer Connection Instructions

A Water/Sewer Connection Permit is required before any digging can take place.

Purchase of a Water/Sewer Connection Permit obligates the Owner/Developer to strictly adhere to all of the District's Rules and Regulations that pertain to sewer service line connections. Exceptions to the District's Rules and Regulations may be made only upon application in writing to the District Manager.

Reminders:

1. A Water/Sewer Connection Permit Is required before any digging can take place.

2. If at any time a problem or questions occurs, please be sure to contact the District for instructions before proceeding with a connection.

3. Any variances must be requested in writing and approved by the District.

3.5.1 GENERAL REQUIREMENTS.

1. **LOCATION AND ALIGNMENT OF WASTEWATER SERVICE.** Wastewater service lines shall be constructed in the shortest and straightest route possible. The service may be constructed with one or more horizontal one-eighth (1/8) bends between the house plumbing and the wastewater main with the written approval of the District. Clean-outs shall be installed in accordance with UBC, the UPC and as described herein. Wastewater service lines shall have a minimum depth of three feet (3').

2. **WASTEWATER SERVICE STUB-INS TO PROPERTY LINE.** Wastewater Service stub-ins shall be extended to at least the back of the sidewalk or to the property line if no sidewalk is present or planned. Where necessary, wastewater service shall be extended past any other utilities such as gas, electric, etc., that have been installed behind the sidewalk. Service stub-ins shall be plugged with a compression stop.

No partial sewer inspections will be permitted without prior approval to the excavation by the District.

3. **SERVICE CONNECTIONS.** Wastewater service connection shall be positioned at either the 2 o'clock or the 10 o'clock position on the circumference of the wastewater main. On new installations, either wye or tee fittings shall be used. When tapping into an existing wastewater main, a saddle connection and approved coring method shall be used. The minimum distance between service connections made along the pipe shall be 3 feet. The minimum distance from either the bell or spigot end of a pipe shall be 3 feet. The minimum distance from the center of a manhole to a service connection shall be either 5 feet or the transition point from the manhole trench to the normal pipe trench, whichever is greater. A maximum of 4 wastewater service connections shall be allowed per 20-foot length of pipe.

4. **ABANDONMENT OF AN EXISTING SEWER SERVICE**. If a property has an existing sewer service stub in that is not to be used for any reason they will need to abandon the existing stub in accordance with Standard Drawing Number 3-11. The property owner will need prior approval of the abandonment from the District and will need to show the abandonment on a set of as-built plans.

3.5.2 WASTEWATER SERVICE LINE MATERIALS. Pipe and fittings for wastewater service lines shall be as specific in **Article 3.3, Materials**, of this Article.

3.5.3 WASTEWATER SERVICE LINE INSTALLATION.

1. **GENERAL.** Installation of wastewater service shall conform to applicable portions of ASTM 2321 and to the pipe manufacturer's installation instructions.

2. **CONNECTING TO THE WASTEWATER MAIN.** Where wyes have not been installed in the wastewater main, the main shall be connected by machine drilling a hole into it sized to fit the saddle being used for the connection. The District shall approve the drilling machine and the method of drilling. A representative of the District shall inspect the main and saddle at every connection and shall be shown the “donut” or cut out as to ensure proper tapping of the pipe prior to backfilling. In the event that a connection is covered before it is inspected, the contractor, at his own expense, shall uncover the connection and remove any concrete or mortar from around the fitting to allow for a visual inspection of the connection and the main. If the wastewater main is cracked or broken during the process of locating and tapping, the contractor shall, at his expense, immediately replace the broken pipe.

3. **PIPE INSTALLATION.** Pipe installation for wastewater service lines shall conform to **Article 3.4.5, Wastewater Line Installation**, of this Article.

   In those cases where the wastewater service cannot be installed a minimum of ten feet (10') horizontally away from a water service, concrete encasement of the wastewater line shall be required. Encasement shall be C-900 pipe encased on either end. The water pipeline shall be sleeved in SDR-35.

Where the water and wastewater service lines must cross one another, installation shall be completed in accordance with **Article 3.2.7, Relation to Water Mains**, of this Article.

4. **CROSSING SIDEWALK OR CURB.** Wastewater service line trenches shall not extend beneath an existing sidewalk or curb. The pipe shall be bored, jacked or tunneled through the earth under the sidewalk or curb. Wastewater service lines that will be under any hard surface shall be C-900 pipe.

5. **TRENCHING.** Trenching for sewer service lines shall be separated horizontally at least ten (10) feet apart. Trenches shall remain open after taps are made until the District's operations personnel can inspect all installations. Sewer service lines shall be a minimum of 3 feet deep. Common trenching is not allowed, variances may be considered upon submission of engineered drawings showing the excavation plan and special circumstances.

3.6 WASTEWATER LIFT STATIONS

3.6.1 GENERAL. In those locations where a development area cannot be served by gravity into the existing District system, the District may approve the construction of a wastewater lift station. The developer shall provide the District with a set of design calculations and drawings for review and acceptance by the District.

The wastewater lift station shall satisfy all of the requirements of the Colorado Department of Public Health & Environment and of these Technical Standards and Specifications.

The District shall require that the developer's engineer prepare the "Application for Site Approval" for submittal to the Colorado Department of Public Health & Environment and to prepare a set of "as built" drawings of the wastewater lift station. Upon completion of the lift station, the contractor shall also provide the District with two (2) copies of an Operation and Maintenance Manual for the lift station.

3.6.2 DESIGN CRITERIA.

1. **GENERAL.** The District will establish on a case-by-case basis specific design criteria for wastewater lift stations. Prior to commencing design, the developer and his engineer shall meet with the District to develop design criteria for the project.

2. **PUMPS AND PUMP STATION.** Lift stations shall have a minimum of two (2) pumps and shall be capable of pumping the peak design flow with one pump out of service. All pump equipment shall be manufactured and supplied by the same company.

The station shall be sized to accommodate all of pumps, electrical equipment and controls required to operate the facility. The station shall be lighted, heated and well ventilated, and if required shall be designed for easy expansion. The architectural finish of the station shall blend with that of the surrounding architecture as much as possible.

A standby generator, capable of operating the entire station for a minimum of four hours, shall be provided and shall be located outside of the building in an all-weather enclosure.

3. **CONTROLS AND TELEMETRY.** Pump operation shall feature automatic sequencing of the pump operation to balance pump wear. Pre-determined wet well levels measured by mercury float switches shall control pumps.

   A telemetry system shall be incorporated into the system to automatically contact the District in case of an emergency. The telemetry system shall be capable of differentiating between varieties of emergency conditions including high and low wet well levels, pump failures and power failure. The telemetry system shall be compatible with the District's system and will be reviewed and accepted by the District prior to installation.

4. **SITE IMPROVEMENTS.** A six-foot (6') high vinyl coated chain link fence with barbed wire shall be installed around the perimeter of the wastewater lift station site. Upon completion of the lift station construction all disturbed areas within the site shall be fertilized, seeded and mulched in accordance with **Article 4.8, Site Restoration**, of these Technical Standards and Specification.

   Depending on site location, landscaping improvements may be required by the District.

ARTICLE 4. SITE WORK AND EARTHWORK

4.0 GENERAL PROVISIONS.

4.1 GENERAL. Site work shall consist of demolition and removal of structures and obstructions; clearing and grubbing; over lot grading; subgrade preparation; removal of topsoil; site preparation; excavation and embankment; excavation, trenching, bedding and backfill of pipelines and service lines; excess excavation; borrow; and restoration and cleanup. All site work and excavation shall comply with the requirements of these Technical Standards and Specifications.

4.1.1 DISPOSAL. The contractor shall make all necessary arrangements for suitable disposal locations. If disposal will be at other than established dump sites, the District may require the contractor to furnish written permission from the property owner on whose property the materials will be placed.

4.1.2 COMPACTION TESTING. Compaction testing shall be performed by a consulting engineering or geotechnical firm at the contractor's expense. Final soils compaction reports shall be prepared and signed by a registered professional engineer who is registered in the State of Colorado. Reports shall be submitted to the District within one (1) week of testing.

4.2 MATERIALS

4.2.1 PIPE BEDDING MATERIALS. Bedding material for water lines shall be a clean well-graded sand or squeegee sand and shall conform to the following limits when tested by means of laboratory sieve.

WELL-GRADED SAND

Sieve Size	Total Percent Passing By Weight (%)
3/8 “	100
No. 4	70-100
No. 8	36-93
No. 16	20-80
No. 30	8-65
No. 50	2-30
No. 100	1-10
No. 200	0-3

SQUEEGEE SAND

Sieve Size	Total Percent Passing By Weight (%)
3/8 “	100
No. 200	0-5

Bedding material for PVC wastewater pipe shall meet the gradation of the Colorado Department of Transportation (CDOT) "No. 67 Coarse Aggregate" as specified in Section 703.02 of the CDOT "Standard Specifications for Road and Bridge Construction" (1986).

Bedding for underdrain pipe shall be three-quarter inch washed gravel.

4.2.2 **STRUCTURE BACKFILL MATERIAL.** Imported structure backfill (Class I) shall meet the general gradation of "Class 1 Structure Backfill Material" as specified in Section 703.08 of the CDOT "Standard Specifications for Road and Bridge Design".

On site Class 2 structure backfill shall meet the requirements of Section 703.08 of the CDOT Specifications.

4.2.3 **ASPHALT PAVING.** Asphalt pavement shall conform to road owners requirements. Road owners in the District include Douglas County, Colorado, Colorado Department of Transportation, and Roxborough Park Foundation.

4.3 DEMOLITION AND REMOVAL OF STRUCTURES AND OBSTRUCTIONS.

4.3.1 **GENERAL.** The contractor shall remove, wholly or in part and satisfactorily dispose of all foundations, signs, structures, fences, old pavements, abandoned pipelines, traffic signal material and any other obstructions that are designated for removal. All salvageable material will be clearly marked by the District and shall be removed without unnecessary damage, in sections or pieces that may be readily transported. Materials so removed shall be stored in locations approved by the District. Materials to be salvaged may include, but shall not be limited to, manhole frames and covers, inlet grates, fence material, handrails, culverts, guardrail, walkway, roadway and parking appurtenances and irrigation systems and appurtenances. The contractor will be required to replace any materials lost from improper storage methods or damaged by negligence.

Where portions of structures are to be removed, the remaining parts will be prepared to fit new construction. The work will be done in accordance with plans and in such a manner that materials to be left in place will be protected from damage. The contractor at his expense will repair any damage to portions of structures that are to remain in place. Reinforcing steel, projecting from the remaining structure, will be cleaned and aligned to provide bond with new extension. Dowels are to be securely grouted with approved grout. Depressions resulting from the removal of structures, footings, and other obstructions, shall be filled and compacted with clean fill materials so as to eliminate hazards of cave-in, accumulation and ponding of water.

Immediately following demolition and removal of rubbish from the site, the contractor shall grade the site by filling, compacting, and leveling the site to existing adjacent grades.

4.3.2 **REMOVAL OF PIPE.** Unless otherwise provided, all pipe will be carefully removed and cleaned; every precaution will be taken to avoid breaking or damaging the pipe. Pipes to be re-laid shall be removed and stored in a manner that prevents loss or damage before relaying.

Any temporary water or sewer line put in by the developer, whether for the developer or the District, for any reason will be removed after the use of the line is complete. If the developer wishes to leave the line in place they will need to have the temporary line surveyed into the as-builts for that area and take sole ownership and responsibility for the temporary line. This may include but is not limited to responding to locate requests by UNCC or any other party requesting information on the temporary line.

Where culverts or wastewater lines are to be left in place and plugged, the ends will be filled with Class III concrete. Culvert and wastewater ends are to be sufficiently filled to prevent future settlement of embankments.

When removing manholes, catch basins and inlets, any live wastewater line connected with these items will be properly reconnected, and satisfactory bypass service will be maintained during such operations.

4.3.3 REMOVAL OF PAVEMENTS, SIDEWALKS, AND CURBS. Concrete or asphalt that is to remain shall be cut to straight, true line with a vertical face. Concrete or asphalt shall be cut with a saw. The sawing shall be done carefully, and the contractor at his expense shall repair all damage to the concrete or asphalt that is to remain in place. The minimum depth of saw cuts in concrete shall be two (2) inches.

The contractor shall be responsible for the cost of removal and replacement of all over breakage as determined by the District.

4.4 SITE PREPARATION

4.4.1 GENERAL. The contractor shall complete all work necessary to satisfactorily prepare the site as shown on the accepted drawings and as specified herein. Following this preparation, the site shall be in such a condition as to easily continue with the next operation. Site preparation includes clearing, grubbing, grading, tree and shrub removal, and native grass stripping and removing and disposing of all debris. This work will also include the preservation from injury or defacement of all vegetation and objects not designated for removal.

4.4.2 CLEARING. Branches on trees or shrubs will be removed as indicated on the plans. Branches of trees extending over the roadbed will be trimmed to give a clear height of 20 feet above the road bed surface. All trimming will be done by skilled workmen and in accordance with good tree trimming practices.

All objects, trees, stumps, roots and other objects designated for removal shall be removed to a minimum of two (2) feet below subgrade.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted in accordance with these Technical Standards and Specifications.

The contractor shall strip areas where excavation or embankment is to be made. Stripping shall include the removal of material such as brush, roots, sod, grass, residue of agricultural crops, sawdust, and other vegetable matter from the surface of the ground.

Clearing shall be performed in a careful and orderly manner that protects adjoining property, the public and workmen. Damage to streets, parking lots, utilities, plants, trees, buildings or structures on private property, or to bench marks, survey monuments and construction staking due to clearing operations shall be repaired and restored to its original condition by the contractor at his expense.

4.4.3 TOPSOIL. The contractor shall salvage within the project limits, or acquire when needed, loose friable loam reasonably free of admixtures of subsoil, refuse, stumps,

roots, rocks, brush, weeds, heavy clay, toxic substances or other material which would be detrimental to the proper development of vegetative growth.

Topsoil shall not be placed until the areas to be covered have been properly prepared and grading operations in the area have been completed. Topsoil shall be placed and spread at locations and to the thickness shown on the plans and shall be keyed to the underlying material.

4.5 EARTHWORK

4.5.1 **GENERAL.** This work shall consist of excavation, fill, backfill, disposal, shaping or compaction of all material encountered within the limits of the project. Work shall be performed to the line and grade indicated on the approved plans.

Excavation, dewatering, sheeting, and bracing shall be carried out in such a manner as to eliminate any possibility of undermining or disturbing the foundation of any existing structures or any work previously completed.

Refer to **Article 4.6, Trench, Backfilling and Compacting**, of this Article for requirements for trenching, backfilling and compacting.

The District may require the contractor to provide an earthmoving diagram and haul routes.

4.5.2 **DEFINITIONS.**

Bedding Material shall mean material that is installed under and around pipelines.

Borrow shall mean backfill or embankment material which must be acquired from designated borrow areas.

Proof Rolling shall mean the application of test loads over a subgrade surface by means of a heavy pneumatic-tired vehicle to locate weak areas in subgrade.

Rock shall mean rock formations that cannot be excavated with a D-9 tractor in good repair with a single hydraulic ripper.

Stabilization Material shall mean material that is to be placed in areas of over excavation, of unsuitable insitu material, or in areas of high water table to stabilize the insitu material.

Structure Backfill shall mean earthen material that is installed around and over any structure.

Structure Excavation shall mean excavation materials over an area extending three (3) feet out from the outer most bottom edge of a proposed structure, up to existing grade or top of proposed grade.

Suitable Material shall mean any earthen material consisting of on-site or similar non-organic sands, gravels, clays, silts and mixtures thereof with a maximum size of six inches (6"). Bedrock that breaks down to specified soil types and sizes during excavation hauling and placement may be considered suitable material.

Unclassified Excavation shall mean excavation of all materials encountered.

Unsuitable Material shall mean any earthen material containing vegetable or organic silt, topsoil, frozen materials, trees, stumps, certain man made deposits, or industrial waste, sludge or landfill, or other undesirable materials.

4.5.3 GRADING TOLERANCES. All earthwork shall be carried out in such a manner that final grades shall conform to those indicated on the approved plans. Final grades shall not vary from the design elevations by more than 0.1 feet. In addition, positive surface drainage shall be provided on the entire site so that no depressions or ponds are formed, regardless of depth. It shall be the contractor's responsibility to insure that all portions of the site drain as shown on the accepted plans.

Grading shall be performed in conjunction with all of the necessary clearing, grubbing, stripping, filling, and compacting operations to the satisfaction of the District.

Grading shall be done by approved means. Areas adjacent to structures and other areas inaccessible to heavy grading equipment shall be graded by manual methods.

4.5.4 EXCAVATION.

1. GENERAL. Excavated areas shall be graded in a manner that will permit adequate drainage, will not disturb material outside the limits of slopes and will be within the tolerances noted in **Article 4.5.3, Grading Tolerances**, of this Article. Suitable material removed from the excavation shall be used for the construction of embankments, for backfilling, and for other approved purposes.

The Contractor shall dispose at his expense of all unsuitable or surplus material.

Water pumped or drained from the work shall be disposed of in an approved manner.

2. STRUCTURE SUBGRADES. If the material at or below the depth to which excavation for structures would normally be carried is unsuitable for the required installation, it shall be removed to such widths and depths as directed by the District and shall be replaced with stabilization material.

Unauthorized over excavations shall be refilled to grade with Class 1 structure backfill material.

If the surface of the subgrade is in an unsuitable condition for proceeding with construction, the contractor shall, remove the unsuitable material and replace it with concrete, structure backfill, or other approved material.

3. PROTECTION OF EXISTING STRUCTURES AND UTILITIES. Existing poles, pipes, wires, fences, curbs, property line markers, and other structures that must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from damage by the contractor. In case of damage, the contractor shall notify the property owner.

Unless property owners wish to make the repairs themselves, the contractor shall repair all damage.

The utility company shall locate all utility lines well ahead of the work. All such locations shall be plainly marked by coded paint symbols on pavement or by marked stakes in the ground.

All existing utility services shall be supported by suitable means to prevent damage during construction activities.

4. **EXCAVATED MATERIAL.** Excavated material shall be stockpiled in locations to minimize the impact on traffic, driveways and adjoining properties. Excavated material shall not be deposited on private property unless written consent of the property owner(s) has been filed with the District.

   Excavated materials shall not be removed from the site or disposed of by the contractor except as approved by the District.

   Suitable excavated material shall be used as backfill, fill for embankments, or other parts of the work.

   Surplus material shall be disposed of as directed by the District.

5. **PROOF ROLLING.** Proof rolling may be required to determine whether certain areas of subgrade meet compaction requirements. Where required by the District, proof rolling shall be carried out as designated, with a heavy rubber tired proof roller with a minimum weight of fifty (50) tons or a single axle dump truck loaded to provide an equivalent wheel loading.

   Subgrade found to be unacceptable during proof rolling shall be scarified, and recompacted at the proper moisture content.

4.5.5 FILLS AND EMBANKMENTS.

1. **GENERAL.** Earth fills shall be constructed in accordance with this Section, including placing and compacting of all embankment material, and all related work required to ensure proper bond of materials with previously placed embankment.

   Material shall not be placed in any section of embankment until the foundation for that section has been cleared, stripped, and dewatered and compacted in accordance with these Technical Standards and Specifications.

   The suitability of each part of the foundation for placing embankment material thereon and of all materials for use in the embankment construction shall be as determined by the District. Materials shall be placed and compacted in approximately horizontal layers of the specified thickness. The thickness of each layer shall not exceed six inches (6") before compacting.

2. **PLACEMENT OF FILL MATERIAL.** After subgrade has satisfactorily been prepared, the fill material shall be placed and compacted thereon and built-up in successive layers until the required elevation is reached. Fill materials shall be a homogenous mixture of stockpiled suitable material. Fill shall be placed within the lines and grades shown on the accepted plans. Fill material shall not be placed on frozen surfaces, and shall not contain snow, ice, or other frozen materials.

The contractor shall maintain the embankment in a manner satisfactory to the District until the District has given final acceptance of all work.

Excavated materials too wet for immediate compaction, shall be dried to the proper moisture content.

3. **COMPACTION REQUIREMENTS.** Fills and embankments less than 10 feet in height shall be compacted to 95% of maximum density (AASHTO T 99). Fills and embankments 10 feet and greater in height shall be compacted to 100% of maximum density. Moisture content will be maintained within + two percent (2%) of optimum moisture during compaction.

4.5.6 STRUCTURE BACKFILL.

1. **MATERIALS.** Structure backfill material shall be used to backfill reinforced concrete structures. Class 1 backfill material shall be used when on-site excavated material does not meet the requirements for Class 2 backfill.

2. **PLACEMENT OF BACKFILL MATERIAL.** Backfilling shall consist of placing materials in horizontal, uniform layers brought up uniformly on all sides of the structure. The thickness of each layer of backfill shall not exceed six inches (6") before compacting to the required density.

   Areas adjacent to structures and other areas inaccessible to mobile compaction equipment shall be compacted with suitable power-drive hand tampers or other acceptable devices.

   Backfill material shall not be deposited against the back of concrete abutments, concrete retaining walls, or the outside of cast-in-place concrete structures until the concrete has developed it’s full 28 day strength.

   Unless otherwise indicated on the approved plans, sheeting and bracing used in making the structure excavation shall be removed prior to backfilling.

3. **COMPACTION REQUIREMENTS.** Structure backfill shall be compacted to a density of not less than ninety- five percent (95%) of maximum density determined in accordance with AASHTO T 99 (Standard Proctor). When structure backfill occurs in roadways, backfill shall be compacted to 100% of maximum density.

4.5.7 **BORROW.** In case an insufficient quantity of material is available on site for completion of the necessary embankment and structure backfill operations, the contractor shall furnish approved backfill material from off site.

4.6 TRENCHING, BACKFILLING AND COMPACTING.

4.6.1 **GENERAL.** This work shall consist of furnishing all labor, materials, tools and equipment for trenching, bedding, backfill and compaction for all underground utilities. Excavations shall be made to lines and grades shown on the approved plans. Except as specifically approved by the District trench excavation shall be made by the open cut method to the depth required to construct the pipelines as shown on the approved plans. All trench excavation shall be unclassified.

Surface materials such as concrete and asphalt shall be disposed of separately from the underlying soil; base course and gravels that are to be salvaged shall be stockpiled and protected from contamination. Unsuitable materials shall be disposed of in accordance with these Technical Standards and Specifications.

Excavated material that meets the requirements for backfill material shall be stockpiled in a safe manner, at a sufficient distance from the banks to avoid overloading.

Excavation shall not be permitted to advance more than one hundred fifty (150) feet ahead of pipe laying and two hundred (200) feet in advance of the backfill operations. Trenches shall not be left open overnight.

4.6.2 **CONNECTIONS TO EXISTING FACILITIES.** Prior to the connection of a new utility line to an existing facility, the contractor shall expose the existing facility at the point of connection to verify the elevation and materials of construction. The District shall be notified a minimum of two (2) business days before such an investigation is performed. The contractor shall also expose existing utilities that cross new construction to allow for verification of elevation and materials of construction.

4.6.3 **TRENCH EXCAVATION FOR PIPELINES AND SERVICE LINES.** Trenches shall comply with the requirements of the Occupational Safety and Health Administration (OSHA) "Safety and Health Regulations for Construction". Sheeting and shoring shall be utilized where required to prevent any excessive widening or sloughing of the trench.

Excavated material shall not be placed nearer than two (2) feet from the sides of the trench. Heavy equipment shall not be used or placed near the sides of the trench unless the trench is adequately braced.

The width of the trench shall comply with the requirements set forth in these Standards and Specifications and shall permit the pipe to be laid and joined properly. The allowable trench width at the top of the pipe shall not exceed the outside diameter of the pipe barrel plus twenty-four inches (24"), nor be less than the outside diameter of the pipe barrel plus twelve inches (12").

If the width of the lower portion of the trench exceeds the maximum width herein stated, the contractor, at his expense, shall furnish and install special pipe embedment or concrete encasement to protect the pipe from the additional loading. The pipe manufacturer shall determine the type and quantities of special pipe embedment, using trench-loading criteria based upon saturated backfill weighing 120 pounds per cubic foot and allowance for truck and other superimposed live loads.

If the soil test data indicates claystone bedrock is present, overexcavation shall be four feet (4’) below the pipe bedding material. The soils shall be compacted appropriately to stabilize the material below the pipe bedding material.

4.6.4 **REMOVAL OF WATER.** The contractor shall provide and maintain at all times ample means and devices with which to remove and properly dispose of all water entering the trench excavation. Water shall be disposed of in a suitable manner without damage to adjacent property or without being a nuisance to public health and convenience. Water level in the trench shall be maintained a minimum of 6" below the pipe.

Well points, sumping or any other acceptable methods that will insure a dewatered trench shall accomplish dewatering. All dewatering methods shall be subject to the approval of the District.

4.6.5 PREPARATION OF FOUNDATION FOR PIPE LAYING. When the excavation is in firm earth, care shall be taken to avoid excavation below the established grade plus the required specified over depth to accommodate the pipe bedding material.

When soft or otherwise unsuitable foundation material is encountered in the bottom of the trench, the unsuitable material shall be removed and replaced with stabilization material to provide a suitable foundation for the pipe.

Stabilization material shall meet the gradation of "No. 4 Coarse Aggregate" as specified in Section 703.02 of the CDOT "Standard Specifications for Road and Bridge Construction".

4.6.6 BEDDING FOR PIPELINES AND SERVICE LINES. Bedding material shall be placed to uniformly support the entire pipe barrel. Bedding material shall be placed to a depth of twelve inches (12") above the top, and six inches (6”) below the bottom of all pipe. Service lines shall have four inches (4”) of bedding above and below the service line.

4.6.7 BACKFILL FOR PIPELINES AND SERVICE LINES. Trench backfill shall be placed in loose six-inch (6") lifts and each lift thoroughly consolidated by tamping or vibrating.

Hydro hammers shall not be used until the trench backfill has been placed and compacted to within three (3) feet of the finished grade by the lift method. Large rollers, tractor drawn equipment or hydro hammers, shall not be used within eighteen (18) inches of the pipe.

Flooding or jetting of trenches will not be permitted.

Bracing installed to prevent cave-ins will be withdrawn in a manner that will maintain the desired support during the backfill operations. Driven sheet pilings will be cut off at or above the top of pipe, and the portion below the cut-off line will be left in the ground.

Backfill material that shows signs of visible frost will not be allowed to be used as backfill for pipelines or service lines.

4.6.8 COMPACTION. Trench backfill shall be compacted to a density of not less than one hundred percent (100%) of maximum density determined in accordance with AASHTO T 99 (Standard Proctor). The moisture content shall be maintained within ± two percent (2%) of optimum moisture during compaction.

Pipes outside the roadway prism or sidewalk and not subject to traffic loads or heavy loads for a period of two (2) years shall be backfilled in layers as described above but shall be compacted to approximately the density of the surrounding earth.

4.6.9 COMPACTION TESTING. Trench backfill shall be tested at a rate of at least one (1) test per 200 cubic yards of backfill material, but not less than one (1) test per 250 feet of trench. The testing shall be performed at various depths and locations. Additional testing shall be performed around items such as structures, manholes, valve boxes. One compaction test shall also be performed for each service lines.

4.6.10 **MAINTENANCE OF BACKFILL.** Backfill shall at all times during construction be maintained to the satisfaction of the District. Access across trenches for driveways and streets shall be maintained free of hazards to traffic or pedestrians.

4.7 **PAVEMENT REPLACEMENT**. Pavement cuts shall be repaired using an approved hot mix asphalt concrete. If a permanent patch cannot be installed within twenty-four (24) hours, the contractor shall place a temporary, cold mix, asphalt patch immediately after completing backfill and compaction. Refer to Drawing 4-2, which is available upon request.

4.8 SITE RESTORATION

4.8.1 **RESTORATION.** The surface grade and condition of all un-surfaced areas disturbed by construction activities shall be restored immediately following construction. The contractor shall replace all sod, trees, shrubbery, sprinkler systems, fences, and any other items disturbed by construction activities. All other areas disturbed during construction grading operations shall re-vegetated with native grasses. Seeding shall be performed immediately upon completion construction. The contractor shall maintain all planted materials or seeding until its growth is established.

All roadway surfacing, curbing, sidewalks, and gutters will be restored or replaced to a condition equal to that before the work began.

ARTICLE 5. CONCRETE WORK

5.0 GENERAL PROVISIONS.

5.1 GENERAL. This section covers concrete work performed in conjunction with work on District water and wastewater systems. Engineering, plans, licenses, permits, inspection, warranties and acceptance shall be as detailed in these applicable Standards and Specifications.

5.1.1 STANDARDS. All concrete work shall meet the requirements of Douglas County, Colorado Roadway Design and Construction Standards latest edition or specific job requirements.

Concrete work for thrust blocks shall meet minimum 4,000 psi compressive strength.

5.1.2 SUBMITTALS. The contractor shall submit the following items for District approval:

1. Concrete mix design.
2. Reinforcing shop drawings and bar schedules.
3. Batch tickets from each concrete truck showing the following information:
    a. Weight and type of cement.
    b. Weights of fine and coarse aggregates.
    c. Weight (in gallons) of water including surface water on aggregates.
    d. Quantity (cubic yards) per batch.
    e. Times of batching and discharging of concrete.
    f. Name of batch plant.
    g. Name of contractor.
    h. Type.
    i. Name and amount of admixture.
    j. Date and truck number.

EXHIBIT A
CROSS CONNECTION CONTROL

1.0 CROSS CONNECTION CONTROL CRITERIA

1.01 **GENERAL.** Cross-connections of any type that may permit a backflow of water from a supply other than that of the District into the District's potable water system, are strictly prohibited. A cross-connection shall mean any temporary or permanent connection to the District's potable water system that is unprotected.

Backflow prevention system designs for new construction shall be submitted to the District for approval. The District shall inspect and test all devices that are installed. All systems and applications shall be in strict accordance with the Colorado Department of Health Cross-Connection Control Manual. In the event there is a conflict between the Manual and these specifications, the more stringent requirements shall apply.

The District has adopted a Backflow Prevention and Cross-Connection Control Plan ("BPCCC Plan") to fulfill the requirements of Article 1-114 and Article 1-114.1 of Title 25, C.R.S. and Section 39 of the5 CCR 1002-11 Colorado Primary Drinking Water Regulations. This Plan is modeled after the Colorado Department of Public Health and Environment's Backflow Prevention and Cross-Connection Control Program template. A copy of the District's BPCCC Plan is available in the District's office.

1.02 **TYPES OF CROSS-CONNECTION CONTROL DEVICES.** The design, installation and maintenance of all cross-connection control devices shall be the sole responsibility of the Owner. The following standards shall apply to cross-connection control devices:

1. **AIR GAP (AG).** An Air Gap is defined as the unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, or other devices and the flood level rim of said vessel. The air-gap shall be at least double the diameter of the supply pipe, measured vertically, above the top of the rim of the vessel; and, in no case, less than two inches. When an air-gap is used at the service connection to prevent the contamination or pollution of the public potable water system, an emergency bypass shall be installed around the air-gap system and an approved reduced pressure principle device shall be installed in the bypass system. All air-gaps shall be permanently constructed with rigid piping. Flexible hose or tubing shall not be an acceptable for an air-gap.

2. **DOUBLE CHECK VALVE ASSEMBLY (DCVA).** Double check valve assemblies shall consist of an assembly of two independently operating approved check valves with tightly closing shut-off valves on each side of the check valves, plus properly located test cocks for the testing of each check valve. The entire assembly shall meet the design and performance specifications and approval of a recognized and approved testing agency for backflow prevention devices. These devices shall be readily accessible for in-line maintenance and testing.

3. **PRESSURE VACUUM BREAKER WITH INTERNAL CHECK VALVE (PVB).** Pressure vacuum breaker assemblies shall consist of at least one check valve, vacuum relief, inlet and discharge shutoff and properly installed test cocks. The pressure vacuum breaker shall have a vacuum relief valve that is internally loaded, normally by means of a spring. The PVB shall be installed a minimum

of 12 inches above the highest outlet or overflow level on the nonpotable system. Vacuum breakers shall not be installed more than five feet above the ground. Adequate room shall be made available for maintenance and testing.

4. **ATMOSPHERIC VACUUM BREAKER (AVB).** An atmospheric vacuum breaker is a device that allows air to enter the water line when the line pressure is reduced to a gauge pressure of zero or below. The atmospheric vacuum breaker is designed to prevent back-siphonage only. It is not effective against backflow due to back pressure and shall not be installed where it will be under continuous operating pressure for more than 12 hours in any 24 hour period. Poppets of all atmospheric vacuum breakers shall be precision fitted to insure positive closure. An AVB shall be installed downstream of the last shutoff valve and a minimum of 6 inches above the highest outlet or overflow level on the nonpotable system. Vacuum breakers shall not be installed more than five feet above the ground.

5. **REDUCED PRESSURE PRINCIPLE DEVICE (RPPD) OR REDUCED PRESSURE ZONE ASSEMBLY (RPZA).** A reduced pressure principle device is an assembly of two independently operating approved check valves with an automatically operating differential relief valves between the two check valves, shut-off valves on either side of the check valves, plus properly located test cocks for the testing of the check and relief valves. The entire assembly shall meet the design and performance specifications and approval of a recognized and approved testing agency for backflow prevention assemblies. The device shall operate to maintain the pressure in the zone between the two check valves at a level less than the pressure on the public water supply side of the device. In case of leakage of either of the check valves the differential relief valve shall operate to maintain the reduced pressure in the zone between the check valves by discharging to the atmosphere. When the inlet pressure is two pounds per square inch or less, the relief valve shall open to the atmosphere. These devices must be readily accessible for in-line maintenance and testing and must be installed in a location where no part of the device will be submerged.

   The device shall not be installed where the pressure can be maintained above the device's rated capacity. When the RPPD is located within a structure, it is recommended that a drain pipe be provided under the relief valve port of the device. An approved air gap between the port and the drain is required. All manufacturers' recommendations for the device shall be followed.

6. **HOSE BIBBS.** Hose bibbs shall be directional with built in backflow preventor. Hose bibbs will also have a drain down feature built in the unit.

1.03 APPLICATION OF DEVICES. The type and complexity of the cross connection control device shall be determined by the Owner/Customer’s Engineer in accordance with the District’s BPCCC Plan. All applications shall be submitted to the District for review and approval. The determination of the type of device required shall be based on the degree of hazard caused to the public from contamination.

1.04 APPROVED CROSS CONNECTION CONTROL DEVICES.

The District Engineer shall insure correct models and sizes and approve all Cross Connection Control Devices. The term "Approved Cross Connection Control Device" shall mean a device that has been manufactured in full conformance with the standards established by the American Water Works Association Standard C510 “Double Check Valve Backflow Prevention Assembly” and C511 “Reduced Pressure Principle Backflow Prevention Assembly”, and has met the laboratory and field performance specifications of the Foundation for Cross Connection Control and Hydraulic Research of the University of Southern California.

EXHIBIT B
WATER CONSERVATION STANDARDS

1.0 WATER CONSERVATION STANDARDS

1.1 COMPLIANCE. All work within the District shall comply with the following water conservation standards.

1. Toilets shall not use more than 1.28 gallons per flush. Urinals shall not use more than 0.5 gallons per flush.

2. Kitchen and lavatory faucets shall have aerators, laminar flow devices, or other fixtures that restrict flow to a maximum of 1.5 gallons per minute. No in-line flow control washers, orifices or other such fittings are permitted.

3. Shower heads shall be constructed so as to limit flow to a maximum of approximately 2.0 gallons per minute. No in-line flow control, washers, orifices, or other such fittings are permitted.

4. All parks, median strips, landscaped public areas and landscaping surrounding condominiums, townhomes, apartments, commercial establishments, developed nonurban areas and industrial parks shall utilize an automatic irrigation system. The automatic irrigation system shall be operated with an EPA WaterSense labeled irrigation controller with weather sensor.

APPENDIX A
Classification of Wastes and General Prohibitions

1.0 CLASSIFICATION OF WASTES AND GENERAL PROHIBITIONS.

1.1 WASTE CLASSIFICATIONS. Wastes shall be classified into three general categories: normal wastewater, special waste, and prohibited waste.

1. Normal wastewater shall mean wastewater that can be treated without pretreatment and within normal operating procedures, and which, when analyzed, shows by weight a daily average of not more than 300 parts per million of suspended solids and not more than 250 parts per million BOD.

2. Special waste shall mean any wastewater that does not conform to the definition for normal wastewater, but which can be treated after pretreatment by the customer or by utilization of special operating procedures.

3. Prohibited wastewater is defined as any water or wastewater falling within any category as set forth in **Section 1.2**, **Prohibited Wastes**.

1.2 PROHIBITED WASTES. Except as provided herein, no person shall discharge or cause to be discharged any of the following described waters or wastes to any public sewer:

1. Any liquid or vapor having temperatures higher than 104 degrees Fahrenheit.

2. Any water or wastewater which may contain more than 100 ppm by weight of animal or vegetable fat, oil, or grease.

3. Any gasoline, benzene, naphtha, fuel oil, or other flammable or explosive liquid, solid, gas, oil or grease.

4. Any garbage that has not been properly shredded too less than 1/2-inch in the largest dimension.

5. Any ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastic, wood, paunch manure, or any other solid or viscous substance capable of causing obstruction to the flow in wastewater lines or other interference with the proper and normal operation of the wastewater treatment plant.

6. Any waters or wastes having pH lower than 5.0 or higher than 9.0, or having any other corrosive or toxic property capable of causing damage or hazard to structures, equipment, or personnel of the wastewater treatment plant.

7. Any water or wastes containing a toxic or poisonous substance in sufficient quantity to injure or interfere with any wastewater treatment process, constitute a hazard to humans, animals or fish, or create any hazard in the receiving waters of the wastewater treatment plant effluent.

8. Any waters or wastes containing suspended solids of such character and quantity that unusual attention or expense is required to handle such materials at the wastewater treatment plant.

9. Any noxious substances or malodorous waste, waters, gases, or substance capable of creating a public nuisance, either in the wastewater lines or at the wastewater treatment plant.

10. A 5-day B.O.D. concentration greater than 250 ppm.

11. A concentration of more than 250 ppm of suspended solids.

12. Concentrated wastes from septic tanks and portable sanitary devices.

13. A peak flow rate greater than 5 times the average flow rate.

14. Any chemicals having a 24-hour proportionate composite sample concentration at the point of discharge in excess of the following:

Cadmium	0.10	mg/l
Chromium	5.0	mg/l
Copper	3.0	mg/l
Cyanides	2.0	mg/l
Iron	15.0	mg/l
Phenol	10.0	mg/l
H_2s (Hydrogen Sulfide)	1.0	mg/l
Zinc	2.0	mg/l

15. In general, any toxic or non-biodegradable waste or any wastes which cause the effluent to exceed state or federal standards after providing conventional treatment.

16. Except as specifically permitted by the District for the golf course or other special uses, no drain accepting discharge from vehicle wash racks, filling stations, restaurants, or other building wastewater lines as specified by the District shall be connected to any wastewater service line unless the discharge first passes through an acceptable grease, sand, or oil interceptor, as required.

17. All wastewater prohibitions and limitation requirements as indicated in the most Current Municipal Code of the City of Littleton Wastewater Utility Ordinance.

1.3 DISCHARGE POLICY. No wastewater other than normal wastewater may be discharged into the wastewater system unless a permit, has been issued to the customer/owner. Special waste as set forth in **Exhibit A**, **Article 1.2**, **Prohibited Wastes**, may be discharged into the wastewater system upon the issuance of such a permit and compliance with all its terms. Prohibited waste may not be discharged into the wastewater system. The prohibitions against unauthorized discharge of wastes proscribed in this section includes the dumping or pumping of wastes directly into any

part of the District's wastewater system without the prior written consent of the District Manager.

1.4 SPECIAL WASTES AND REQUIRED PERMITS.

1.4.1 PERMITTING. Any wastes that may qualify as special waste must be analyzed prior to discharge to the system. Such waste shall be analyzed under the standards established in this **Appendix A, Classification of Waste and General Prohibitions**. If required, the Customer/Owner shall obtain a permit pursuant to the provisions herein. In general, if the special waste being analyzed does not violate any of the standards established and if the Customer/Owner is not a significant industrial user as defined in U.S. Environmental Protection Agency regulations, no permit shall be required.

1.4.2 PERMITTING UNDER DISTRICT STANDARDS.

1. In general, special waste, including industrial cooling water and wastes, unpolluted process waters, bakery and restaurant wastes, car washing wastes, swimming pool drainage, and floor drainage from enclosed and covered areas, may be connected to the wastewater system only by a special permit from the District.

2. The District will consider a permit for the purpose of discharging special waste to the District's wastewater systems based upon an application containing the following general information:

    a. Name and address of owner.

    b. Location of property for which the request is made.

    c. Description of the facility or operation requested for connection.

    d. Estimated quantities and qualities of the waste to be discharged including maximum rates.

    e. Plans and specifications of related waste generating processes and any pretreatment processes.

3. Such a permit, may contain special conditions, including but not limited to:

    a. The construction of flow measuring and/or sampling devices.

    b. The construction of valves or gates to stop flows on an emergency basis.

    c. The construction of a manhole, as specified herein.

    d. The construction of grease, oil and sand traps, or other pretreatment facilities, as specified herein.

1.4.3 **MANHOLE REQUIREMENTS.** When required by the District, any Customer/Owner served by a service line carrying special waste shall install a suitable control manhole, **Article 2.3.12, Manholes**, or monitoring point in the wastewater service line to facilitate observation, sampling, and measurement of the wastes. Such manhole or monitoring point shall be accessible and safely located, and constructed in accordance with plans and specifications approved by the District. The manhole or monitoring point shall be installed and maintained by the Customer/Owner at his expense. In the event that no manhole has been required, the control manhole, for purposes of testing, shall be considered the nearest down-stream manhole in the wastewater main to the point at which the service line is connected.

1.5 PRETREATMENT AND INTERCEPTOR REQUIREMENTS.

1.5.1 **PRETREATMENT GENERAL REQUIREMENTS.** Where deemed necessary by the District, whose determinations shall be final, the customer/owner shall provide, at his expense, such preliminary treatment (hereafter, "pretreatment") as may be necessary. Where pretreatment facilities are provided for any waste or waters, they shall meet any applicable District, state, or federal specifications or design standards, and, once built, shall be maintained continuously in satisfactory and effective operation by the customer/owner.

1.5.2 **REQUIREMENTS FOR GREASE, OIL AND SAND TRAPS.** Grease, oil and sand interceptors, shall be provided at the sole cost and expense of the customer/owner when, in the opinion of the District Manager or Director of Operations they are necessary for the proper handling of liquid wastes containing grease or oil in excessive amounts, any flammable wastes, sand, or other harmful constituents.

1.5.3 **SPECIFIC REQUIREMENTS FOR GREASE INTERCEPTORS.**

1. Grease interceptors are required on all premises, other than residential properties, where food is prepared or processed, or when an industrial process produces organic waste. Grease interceptors shall be installed on the discharge line of every dishwashing sink, dishwashing machine, and every fixed receptacle or plumbing fixture designed, intended or used for the purpose of washing dishes or cooking utensils in a restaurant, cafeteria, lunchroom, hotel kitchen, hospital or health facility kitchen or similar establishment that serves, or has the capacity to serve one hundred or more meals per day. Capacity to serve one hundred (100) or more meals per day shall be determined by the serving or seating capacity of fifteen or more patrons at any time. Grease interceptors may also be required wherever necessary to prevent the discharge of excessive amounts of grease or grease containing liquids to the wastewater system.

2. All drains from the kitchen, food preparation, and dishwashing areas shall be connected to the grease interceptor. Garbage grinders shall not be used for disposal of grease. The discharge from garbage grinders shall not be connected to the grease interceptor.

3. All grease interceptors shall be located outside the building on private property, unless otherwise approved by the District. They shall be so

installed as to be readily available and accessible for cleaning, maintenance, and inspection. The customer/owner shall maintain all interceptors at their own expense, in continually efficient operation at all times.

4. Grease and oil interceptors shall be constructed of impervious materials capable of withstanding abrupt and extreme changes in temperature. They shall be watertight, and, if necessary, as determined by the District, gastight and vented. District specifications and design standards are contained in , **Article 3.2.9, Grease Interceptors** and **Article 3.2.10, Petroleum Oil, Grease, and Sand Traps** in these Technical Standards and Specifications.

1.5.4 DISTRICT APPROVAL. Interceptor plans shall be submitted to the District Engineer, who must approve them prior to installation. The cost of reviewing and approving such plans, and inspection and approval of the installation shall be charged to the applicant.

1.5.5 RESPONSIBILITY FOR CLEANING AND MAINTENANCE.

1. The responsibility of cleaning and maintaining all grease interceptors, sand and oil traps shall be the customer/owner's responsibility. The customer/owner shall be responsible for the expense of maintaining all installed equipment and/or facilities to insure continuously efficient operation at all times.

2. Grease interceptors shall be pumped and cleaned of their accumulated matter at least once every three months, or more often if necessary, as determined by the District to ensure maximum efficiency.

3. Sand and oil interceptors shall be pumped at least once every three months or more often if necessary, as determined by the District to ensure maximum efficiency.

4. Access to an interceptor shall remain unobstructed at all times. The necessity to remove large objects such as boxes, crates, or cans or to use a ladder to inspect an interceptor shall constitute a violation of these Technical Standards and Specifications.

5. Failure to maintain any interceptor in efficient working condition shall constitute a violation of these Technical Standards and Specifications.

6. Any unauthorized alteration or damage to any interceptor shall constitute a violation of these Technical Standards and Specifications.

7. The Customer/Owner shall maintain a log of each inspection and maintenance activity performed on any interceptor. This log shall be made available to the District upon request. The log shall state the date of any such inspection, the status of the interceptor, and any unusual or problematic conditions. For maintenance activity, the log shall note the date of the work, the contractor, the actions taken, and their result.

The District shall inspect all grease interceptors and sand and oil traps every six months, and, if not properly maintained, the District will initiate procedures to obtain compliance with these Technical Standards and Specifications and **Part 1, Article 9, Inspections and Enforcement of Water and Wastewater Regulations**. The cost of such scheduled inspection shall be established by the Board and billed as a part of the annual service charge.

APPENDIX B
PRETREATMENT PROGRAM

1.0 BACKGROUND

This document is intended to augment the document entitled "Classification of wastes and General Prohibitions", also located in **Appendix A** of these Rules and Regulations. The discussions, which follow, include the following topics.

- Potential solutions for reducing oil, grease, and sand in the collection system
- Clogged sewer lines and equipment coating
- Inspection of grease interceptors and sand/oil interceptors in Littleton and Englewood and the sanitation districts
- Inspection of restaurants and other food services without interceptors
- Sizing criteria for grease interceptors and sand/oil interceptors
- Pumping schedules for industries with grease interceptors and sand/oil interceptors
- Minimum criteria for new and existing sources of oil, grease, and sand
- Biological treatment (enzymes and/or bacteria)

2.0 POLICY/PROCEDURE

Grease interceptors are required for all food preparation establishments which may contribute or cause to contribute, directly or indirectly, any water or wastewater which contains oil or grease. This includes, however is not limited to, restaurants, cafeterias, cafes, fast food outlets, schools, fraternal organizations, churches, hospitals, and daycare centers. In-line interior grease traps may not be allowed, unless otherwise approved by the District. Grease interceptors are not required for private residences or dwellings.

Sand/oil interceptors are required for all non-domestic users that have the potential to discharge wastes containing sand, grit, and/or petroleum by-products into the wastewater system. This includes, however is not limited to, automobile service stations, maintenance stations, mechanical repair shops, car and truck washes, garden nurseries, warehouses, and parking garages. In-line interior sand/oil traps may not be allowed, unless otherwise approved by the District. Sand/oil interceptors are not required for private residences or dwellings.

Exceptions to the grease interceptor and sand/oil interceptor requirement are facilities granted a written variance by the District; following approval of a plan review process. Variances apply strictly to the named facility owner/operator located at the named facility address.

The grease interceptor design and sizing criteria must adhere to the requirements established by South Platte Water Renewal Partners owned by the Cities of Littleton and Englewood (SPWRP) and will be subject to approval by the District. The District is located within the SPWRP service area and has adopted their sizing criteria. Those grease interceptors not able to achieve compliance with Division standards may be subject to modification and/or replacement.

Maintenance of grease interceptors is the sole responsibility of owner or operator. The owner or operator must ensure proper operation to prevent obstruction, interference or

damage to the collection system. All maintenance shall be completed as required per SPWRP Fats, Oils, and Grease (FOG) Policy and the Petroleum Oil, Grease, and Sand (POGS) Policy. Interceptor pumping, at a minimum, must be completed every three months, unless determined more or less frequent pumping is required. This is subject to approval by the District. The District has implemented an inspection program to ensure compliance. Inspections are completed in accordance with the guidelines and procedures outlined in the District Inspection Criteria.

The use of bacteria or enzymes is prohibited.

Existing sources not contributing significant quantities of oil and grease wastes to the collection system may be granted a written waiver to the inspection criteria. The waiver to the inspection criteria applies strictly to the named facility owner/operator located at the named facility address, subject to an initial inspection and approval by the District. Facilities subject to the inspection waiver may include, however is not limited to, delicatessens, sandwich shops, and pizza take outs whereas other than the preparation of pre-cooked meals, no cooking, food preparation or food service would take place.

3.0 GREASE INTERCEPTOR AND SAND/OIL INTERCEPTOR SIZING CRITERIA

The District has adopted a grease interceptor sizing criteria developed by SPWRP. Refer to the SPWRP Fats, Oils, and Grease (FOG) Policy and the Petroleum Oil, Grease, and Sand (POGS) Policy for sizing criteria.

Please contact the District at 303-979-7286 for more information on grease interceptor and sand/oil interceptor sizing.

4.0 OIL AND GREASE INTERCEPTOR INSPECTION CRITERIA

4.1 PUMPING

At a minimum, a grease interceptor shall be pumped at approximately 75% volume retention capacity (or 25% total volume of accumulated bottom solids and top grease waste). Below 75% capacity, efficiency decreases, which allows for limited separation time and by-pass of the interceptor system.

The efficiency of an interceptor is a function of the solids/grease thickness versus the total depth of the interceptor. In a typical grease interceptor, 75% volume retention capacity can equate to approximately 6 to 12 inches of solids/grease thickness.

Refer to the SPWRP Fats, Oils, and Grease (FOG) Policy and the Petroleum Oil, Grease, and Sand (POGS) Policy for additional pumping requirements.

4.2 REPAIR/MAINTENANCE

All grease interceptors shall be inspected for the following systems:

Outside

1. Manhole covers. Easily accessible and removable.
2. Identification of single or double compartments.
3. Exterior clean-outs.

4. Vent lines.

Inside
1. Identification of inlet and outlet compartments.
2. Identification of Inlet and outlet plumbing (i.e., sanitary 'Ts' with caps or 90 degree elbows).
3. Inlet and outlet extended risers installed below water surface.
4. Location of baffle wall.
5. In the event any of the aforementioned system(s) is damaged or is missing, the system(s) must be repaired or installed, where reasonably applicable. Defective equipment can cause inadequate operating processes.

4.3 SPILL PREVENTION

All users are required to have measures in place to control unwanted discharge to the sanitary sewer. Chemicals, cooking oils, and other liquid products must be stored away from drains or within a containment to reduce the potential for spills reaching the sanitary sewer.

4.4 ELEVATOR PITS

Elevator pits are required to meet SPWRP Petroleum Oil, Grease, and Sand (POGS) Policy.

4.5 NOTICES

Facilities which are required to pump and/or repair interceptors, as documented by inspections, shall be given written notices of violation. Pumping and repairs shall be completed within 5 days and 30 days upon receipt of notice, respectively, and where reasonably applicable.

4.6 FOLLOW-UP INSPECTIONS

Facilities with violations shall be re-inspected following the elapsed time period to ensure compliance. Failure to comply shall result in further notice of violation or enforcement actions. The enforcement procedure is as follows:

- Written notice of pump or repair – issued by inspector
- Written notice of non-compliance – issued by inspector
- Written Director's Order – issued by Director of Utilities

4.7 EXISTING SOURCES

Existing sources not connected to grease traps or interceptors are identified through inspection of the collection system. Once these sources are identified, they are required to implement Best Management Practices (BMP) to keep oil and grease out of the system.

Examples of BMPs include:

- Do not use a garbage disposal.

- Scrape food from plates into a garbage can.
- Pre-wash plates by spraying them off with cold water over a small mesh catch basin positioned over a drain. This catch basin should be cleaned into a garbage can as needed.
- Pour all liquid grease and oil from pots and pans into a waste grease bucket stored at the pot washing sink. Heavy solids buildup of oil and grease on pots and pans should be scraped off into a waste grease bucket.
- If the BMPs are not successful at the facility and it continues to contribute significant amounts of oil and grease to the sewer, as documented by inspections, then the facility is required to install an adequately sized grease interceptor.

Refer to the SPWRP Fats, Oils, and Grease (FOG) Policy and the Petroleum Oil, Grease, and Sand (POGS) Policy for additional BMP recommendations.

For detail drawings of Oil and Grease Interceptors, please refer to drawings 3-4B, 3-5A and 3-5B.