North Washington Street Water and Sanitation District

Engineering Standards & Construction Requirements

North Washington Street Water and Sanitation District
3172 East 78th Avenue
Denver, Colorado 80229

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1.0 GENERAL

1.1 PURPOSE

This publication provides information relative to engineering, design, material specifications, and construction procedures for water and sanitary sewer systems within the North Washington Street Water and Sanitation District (District). The Engineering Standards shall be followed by all Engineers, Contractors, Developers, and other interested persons or firms who intend to design and construct water and sanitary sewer systems in the District. These Engineering standards should be used in conjunction with the District's Rules and Regulations. The use of District's Engineer shall mean any representative of a Consulting Engineering firm or other individual designated by the District to assist in the enforcement of the District's Engineering Standards.

1.2 DISTRICT SERVICE AREA

The District is primarily located in Adams County, Colorado with a small service area within the City and County of Denver, Colorado. Generally, the District is bounded by Washington Street to the west, East 88th Avenue to the north, York St to the East and East 52nd Avenue to the south.

1.3 AUTHORITY

These Engineering Standards shall be administered by the District and shall include all interpretations, enforcement, revisions, waiver, and variance with all such actions being finally determined by the District.

1.4 DEFINITIONS

As used in these Engineering Standards and District Rules and Regulations, unless the context clearly indicates otherwise, the words defined below shall have the respective meaning set forth for them:

Actual Costs	All direct and indirect costs attributable to any project or material, equipment, administrative, and overhead expenses, calculated in accordance with the rates set forth in the District Rules and Regulations and all direct payments to third parties, at cost.
Backflow	The flow of water, or other liquid, or foreign materials into the distribution mains of the District's potable water system from another source.
Board or Board of Directors	The duly constituted Board of Directors of the District.
Contactor	Any person who performs any work, either for himself or another, on any water and/or sanitary sewer facilities, public or private, within the District, including all subcontractors, agents, employees, officers, and other representatives of such person

Construction Plans	Plans and Specifications for the construction of a specific Developer/Owner water and/or sanitary sewer system project which have been reviewed and signed by the District and the District's Consulting Engineer
District	North Washington Street Water and Sanitation District, its employees, agents, officers, directors, insurers, and professional consultants
District Engineer	A professional engineer, registered in the State of Colorado, retained by the Board of Directors to act in such capacity.
District Manager	The Manager of the District appointed by the Board of Directors, or any other person duly authorized to perform the duties of District Manager.
Facilities	The Public Water System and/or the Public Sewer System and all appurtenances and accessories.
Foreign Materials	Objects or substances which may be deleterious to water and sanitary sewer systems. For water systems this is summarized as anything other than potable water.
Grease Trap/Grease Interceptor	A plumbing device that is installed in a sanitary drainage system to 'trap' or 'intercept' non-petroleum fats, oils and grease from a wastewater discharge.
Inspector	That person retained by the Board from time to time who shall inspect all water and sewer connections, excavation, installations of and repairs to the Public Water System, the Public Sewer System, and the Facilities of the District to ensure compliance with the Rules and Regulations of the District.
Licensed Contractor	A person having a License issued by the District as required herein who performs services within the District physically affecting the Facilities of the District.
Main or Water Main	Pipes and appurtenant facilities used for distributing water along public streets or appropriate rights of way deeded or easements
Main extension	The construction of any facilities or the facilities themselves, which ware intended to become a part of the District System upon acceptance by the District in accordance with the Rules and Regulations
Manager	The person as appointed by the District, from time to time, under the direction of the Board of Directors of the District who shall manage the affairs of the District and shall be charged with the responsibility of the enforcement of these Rules and Regulations, but in no event shall the Manager have the right or authority to make any decision involving policy or committing the District to any policy without express authority of the Board.
Outfall Lines	Sanitary sewer main lines with diameter larger than 12-inches in diameter.
Property Owner/ Developer	All of these terms shall be synonymous with each other and shall mean any person who, whether solely or with others, owns real property within the District. When property is owned by more than one person, the term includes all owners thereof. As used in these specifications, the term shall apply to such persons only in connection with their ownership of any specific parcel of real property included in any specific matter governed by these Specifications or the Rules and Regulations.
Record Drawings	A separate set of construction plans marked to indicate completely and accurately the field-installed condition of facility construction in progress, as required by these Engineering Standards
Rules and Regulations	The comprehensive set of operating rules and requirements, as now or hereafter constituted, adopted by the Board of Directors for the purpose of regulating the

	design, construction, operation, maintenance, use, repair and replacement of the District System
Sewer Service Line	That part of a sewer line receiving domestic, commercial, industrial or manufacturing wastes connected with the Facilities of the District and commencing at a point located approximately five (5) feet from the outside wall of a building from which such wastes are discharged into the Facilities of the District and terminating at the tap to the public sewer connection. Except as otherwise expressly stated herein, a sewer service line is not the property of the District, and the District has no liability in respect thereto.
Stub-In	A tap made for the purpose of installing service lines prior to the paving of streets. Such connection shall include fittings necessary to extend the service line to the valve at the property line.
Tap or Service Connection	The physical connection to a District Main which, together with the Tap Permit for same, effects water service to any Permitted Premises
User	Any person who discharges or cause the discharge of the wastewater to the District System
Wastewater or Sewage	The combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants and institutions, including polluted cooling water **Sanitary Wastewater:** The combination of liquid and water carried wastes discharged from toilet and other sanitary plumbing facilities. **Industrial Wastewater**: The combination of liquid and water-carried wastes discharged from any industrial establishment and resulting from any trade process carried in the establishment, including the wastewater from pretreatment facilities and polluted cooling water.
Water Service Line	That part of any water line connecting to the public water line commencing at the shutoff valve on the inside building wall of any facility to which water is furnished and terminating at the Public Water System tap. Except as otherwise expressly stated herein, a water service line is not the property of the District, and the District shall have no liability in respect thereto

1.5 ABBREVIATIONS

These specifications utilize and otherwise make references to other Standards and Specifications. Where these references are made, they shall refer to the latest edition or revision thereof.

Organizations

AASHTO	American Association of State Highway and Transportation Officials
ABPA	American Backflow Prevention Association
ACI	American Concrete Institute
AISC	American Institute of Steel Construction, Inc.
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute, Inc.
ASA	American Standard Association
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWWA	American Water Works Association
CDOT	Colorado Department of Transportation

CDPHE	Colorado Department of Public Health and Environment
CPDWR	Colorado Primary Drinking Water Regulations
DW	Denver Water
DW CPCS	Denver Water Capital Projects Construction Standards
Metro	Metro Wastewater Reclamation District
IPC	International Plumbing Code
OSHA	Occupational Safety Health Administration
NACE	National Association of Corrosion Engineers
NFPA	National Fire Protection Association
NSF	National Science Foundation
UL	Underwriter's Laboratories
UNI	Uni-Bell Association
UPC	Uniform Plumbing Code
USC FCCCHR	University of Southern California Foundation for Cross-Connection Control and Hydraulic Research
WEF	Water Environment Federation
WQCD	Water Quality Control Division

Other Abbreviations and Acronyms

AC	Asbestos Cement
AMR	Automatic Meter Reading
AMI	Advanced Metering Infrastructure
AP	Angle Point
ASC	Automatic Sprinkler Connection
AWG	American Wire Gauge
BFP	Backflow Prevention/Preventer
BMP	Best Management Practices
Buna-N	Nitrile
CAD	Computer Aided Drafting
CI	Cast Iron
CLSM	Controlled Low Strength Material
Cm	Centimeters
CWP	Cold Working Pressure
Cy	Cubic Yard
DC	Double Check Valve
DI	Ductile Iron
DR	Dimensional Ratio
EPDM	Ethylene Propylene Diene Monomer
Fps	Feet per Second
HDD	Horizontal Directional Drilling
HMWPE	High Molecular Weight Polyethylene
HVAC	Heating, Ventilating, and Air Conditioning
ID	Inside Diameter
Irr	Irrigation
L	Liter

Lb	Pound
M	Meter
mA	Milliamperes
MCL	Maximum Contaminant Level
MS	Material Specification
NAD	North American Datum
NGS	National Geodetic Survey
No.	Number
NO	Normally Open
NPT	National Pipe Thread
NPDES	National Pollutant Discharge Elimination System
OD	Outside Diameter
PE	Professional Engineer
PLS	Professional Land Surveyor
Ppm	Parts Per Million
PRV	Pressure Regulating Valve
Psi	Pounds per square inch
PUD/PBG	Planned Unit Development/Planned Building Group
PVC	Polyvinyl Chloride
ROW	Right of Way
RP	Reduced Pressure Principle Backflow Prevention Assembly
SOP	Standard Operating Procedure
SSO	Sanitary Sewer Overflow

2.0 WATER SYSTEM STANDARDS

2.1 DESIGN REQUIREMENTS

2.1.1 General

All water lines, appurtenances, and items related to the public water system within the North Washington Street Water and Sanitation District shall be designed in accordance with these Engineering Standards, District Rules and Regulations, and other applicable local, state and federal regulations. Any intentional deviation from these Specifications shall require the written authorization of the District prior to design or construction. Design of all water system construction plans shall be performed under the direct supervision of a Professional Engineer, licensed in the State of Colorado. All water system designs must be reviewed and approved by the District prior to, including but not limited to, the construction of the development, improvement, fire system, water main connection, service lines and water main extension.

2.1.2 General Pipe, Fittings, Valves and Appurtenances

A. All water mains in the District shall be either Ductile Iron Pipe (DIP) or Polyvinyl Chloride Pipe (PVC). In general, selection of the type of pipe shall be left to the discretion of the Professional Engineer in charge of the design. However, the District reserves the right to deny the use of certain types of materials in specific circumstances. In areas where soil contamination affects the pipe selection material, a soil sample may be taken to determine acceptable pipe material.

B. When a tee fitting is required on a water main, the tee shall be a swivel tee with valve connection. Valve connections to the tee in the inline direction should be made with foster adaptors. On a case-by-case basis the District will review the tee location and may require an additional valve at property lines.

C. Gate valves shall open left when installed north of 78th Avenue and shall open right when installed in 78th Avenue or south.

D. No meter pits, curb stop valves, control valves, fire hydrants or other water main appurtenances are allowed to be in concrete driveways or sidewalks, unless otherwise approved by the District.

E. Projects which include the relocation of mater pits or the installation of a new meter pit for an existing customer shall replace the entire service line from the main to the property line. The service line shall be perpendicular from the water main to the meter.

F. Residential projects shall be assessed for individual meters per individual addresses. Prior to District final plan approval, the Developer shall submit tap and meter applications for each residential unit with an address.

G. Regardless of meter size for multi-family and dense single-family developments, development fees shall not be less than one System Development Fee per unit or greater than the tap fees.

2.1.3 Abandoned Mains, Valves, and Service Lines

A. For all valves to be abandoned on an abandoned main: close valve, remove and dispose of valve box and cover, fill hole with approved material and pave to the existing depth of roadway. Work must receive district approval before being accepted.

B. Live water lines require that valves are removed, and a solid sleeve is installed.

C. If a valve breaks when performing a shutdown on the main, the valve should be replaced.

D. For all piping to be abandoned, at minimum, unless noted otherwise on the plans, all ends are to be capped with concrete, demolished in place, or removed and disposed of.

E. It is not permissible to abandon 3-inch or larger water services with a cap at the main. Abandoned water services shall be removed from the water system and replaced with a solid sleeve.

2.1.4 Easement/ROW

A. All water mains shall either be within public ROW or North Washington Street Water and Sanitation District easements.

B. Water mains shall be located a minimum distance of five feet (5') from the lip edge of the gutter pan, unless prior approval has been obtained by the District.

C. The minimum horizontal distance between existing and proposed pipe is three feet (3') from edge of pipe to edge of pipe, unless approved by the District.

D. The design of water mains within easements in unfinished areas shall include ability to access the water main, valves and other appurtenances for maintenance and repair work. An 8-foot-wide reinforced subgrade access road is required, unless written approval is provided by the District.

2.1.5 Alignment/Profiles

A. All water mains shall be profiled on the construction plans.

B. Design engineer shall take precautions to eliminate unnecessary high points. High points shall be correlated to an ability to blow off trapped air. This can be accomplished by fire hydrant, ARV combo valve or blow off.

C. Water mains shall be designed to be parallel to street centerlines. Streets with curvilinear alignments require water mains to be deformed per the pipe materials manufacturers

recommendation. Allowable deflection shall be less than manufacturers maximum allowance. The final location of water mains shall be determined by the District.

D. Water mains shall target a minimum design depth of 4.5-feet and a maximum design depth of 8-feet. Special situational variations will be allowed upon review and approval by the District.

2.1.6 Utility Crossings

A. Thermal protection of water mains at storm sewer crossings may be required depending on the specific project location and design.

2.1.7 Hydraulics

A. The water mains shall be designed to distribute average day, maximum day, peak hour and fire flow demands. Maximum acceptable head loss for 6-inch, 8-inch, 10-inch and 12-inch water mains is 2-feet per 1,000 feet of main for the peak hour flow, using a C-value or 130 for new pipe. Special consideration shall be made when connecting to old water mains, as over time, interior pipe walls have shown to increase surface roughness.

B. Water demand calculations and estimates for a proposed development shall be stamped by a Professional Engineer and submitted to the District for review and approval. The demand flows shall be correlated to the function of the finished spaces and any operational sequences requiring the use of potable water.

C. Peak demand and maximum day demand flows must be provided by a Professional Engineering, licensed in the State of Colorado. Demand flows will be evaluated with the District's hydraulic model to confirm the existing system may support the proposed development.

D. Tap and service line sizes shall be large enough to limit the peak demand water velocity through meter and service line to less than 10 feet/second. Developer and/or owner shall submit an accredited fixture unit methodology sealed by a professional engineer for approval from the District.

2.1.8 Irrigation and Landscaping

A. Irrigation systems shall be designed to operate off peak demand periods and in accordance with any seasonal watering restrictions by the District. An irrigation plan shall be available for the District to review prior to final plan approval.

B. A copy of the Grading Plan and Landscaping Plan showing the proposed conditions of the easements shall be submitted for review by the District.

2.1.9 Fire Lines and Fire Hydrants

A. Double check valves on fire service lines to prevent cross contamination. Meters on valves or a switch which indicates water is flowing through the fire line to prevent water loss.

B. Hazardous glycol fire systems will also require a reduced pressure backflow preventer.

C. Fire lines and fire suppression systems shall be designed by a Professional Engineer who specializes in fire systems. All flows and pressures must meet the requirement of the fire department having jurisdiction. Fire line designs shall be reviewed and approved by the District.

D. Provide necessary fire hydrant barrel extension kit to meet manufacturer's minimum recommendation for clearance between finished grade and traffic flange.

2.1.10 Backflow Prevention and Cross-Connection Control

A. All new developments and tenant finishes in the District shall include protection from backflow and cross connection contamination in occurrence with CDPHE Regulation 11.

B. The District follows the requirements Denver Water's Engineering Standards 16th Edition Appendix D, or Denver Water's most recent release of their Engineering Standard and CDPHE's Cross-Connection Control Manual of the Colorado Department of Health and the Colorado Primary Drinking Water Regulations of the Colorado Department of Health, including all amendments made now or hereafter.

C. Design submittals must be reviewed by the District and will be reviewed for conformance of local and State obligations.

2.2 ENGINEERING DESIGN CRITERIA, STANDARDS AND REFERENCES

All water system design and construction shall adhere to these Engineering Standards. Should a condition not be covered by these standards, the design and construction shall follow the latest versions of:

- Denver Water Engineering Standards
- Denver Water Capital Projects Construction Standards
- Colorado Primary Drinking Water Regulations

Construction activities that occur within the public Right of Way shall adhere to the authority having jurisdiction.

- Adams County Development Standards
- CDOT's M & S Standards

The construction of Fire Protection Systems shall adhere to the Fire Department having jurisdiction. North Washington Street Water and Sanitation District is overlain by three (3) Fire Protection

jurisdictions. It is the Owner's responsibility to contact the appropriate Fire Protection Agency and establish the required fire flow and hydrant locations for each specific project.

- Adams County Fire Protection Department
- Denver Fire Department
- Thornton Fire Department

2.3 MATERIALS SELECTION

Items listed below are material specifications the District considers as a higher-quality product than what is specified in Denver Water's Engineering Standards. The District has the ability to require more stringent specifications than those defined in Denver Water's Engineering Standards. Items not included in the lists below are to follow the material specifications provided by the Denver Water Department.

2.3.1 Pipe Selection

All water mains in the District shall be either Ductile Iron Pipe (DIP) or Polyvinyl Chloride Pipe (PVC). In general, selection of the type of pipe shall be left to the discretion of the Professional Engineer in charge of the design. However, the District reserves the right to deny the use of certain types of materials in specific circumstances. In areas where soil contamination affects the pipe selection material, a soil sample may be taken to determine acceptable pipe material.

2.3.2 Ductile Iron Pipe (DIP)

Ductile iron pipe may be used for pipe sizes four inches (4") and greater within the District's water system. DIP shall be designed in accordance with the most recent version of ANSI/AWWA C150/A21.50 specifications.

Thickness Class of Ductile Iron Pipe:

Nominal Pipe Size (inches)	Outside Diameter (inches)	Thickness Class	Nominal Thickness (inches)
4"	4.80	52	0.29
6"	6.90	52	0.31
8"	9.05	52	0.33
10"	11.10	52	0.35
12"	13.20	52	0.37
14" **	15.30	52	0.39
16"	17.40	52	0.40
18"	19.50	52	0.38
20"	21.60	52	0.42

**14” pipe size is no longer accepted within the District. There are existing 14” diameter pipes within the District that may be encountered during a project.

2.3.3 Polyvinyl Chloride Pipe (PVC):

PVC water mains shall be a minimum of DR18 or high-pressure class.

Pipe bursting mains shall be DR 14 or high-pressure class.

2.3.4 Resilient Seated Gate Valves

Gate valves shall be in accordance with AWWA C515. This applies unless the valve is connected to a cast iron water main, which gate valves shall be in accordance with AWWA C509.

All gate valves shall have head bolts, nuts and washers that are 316 stainless steel.

District preferred manufacturers:

American Flow Control, Kennedy, and Mueller Company

The District reserves the right to reject submitted gate valves from manufacturers not listed above.

2.3.5 Rubber Seated Butterfly Valves

District preferred manufacturers:

Mueller

2.3.6 Tapping Valves

District preferred manufacturers:

Mueller Company

2.3.7 Fire Hydrants

Fire hydrants shall be Mueller, Centurion model 423.

Due to material shortages the District reserves the right to approve alternative hydrants manufacturers: Waterous Pacer

Factory painted red

All bolts, nuts and washers shall be 316 stainless steel.

2.3.8 Brass and Bronze Goods

District preferred manufacturers:

Ford Meter Box Company, Mueller Company

Gate Valves
Mueller Company , American Flow Control

Swing Check Valves
Ford or Mueller

2.3.9 Meter Pits
Two-piece meter pits

2.3.10 Miscellaneous Pipe Fittings

Flanged adaptors, plugs, end caps, bulkheads, cut-in-sleeves, anchor couplings, and other appurtenances shall be used where appropriate throughout the system, and are subject to the review of the District. The District does not intend to limit unreasonably, the installation of any type of fitting, joint or proprietary device. However, the installation of any such fitting not specifically identified by these standards is subject to the review of the District, prior to design or construction.

2.4 CONSTRUCTION REQUIREMENTS

All excavations affecting or involving any part of the District System, and all work on Main Extensions, Taps, or other District facilities shall be performed in conformity with and are subject to the requirements and conditions set forth herein. Additional requirements and conditions may be found in, 2.2 Engineering Design Criteria, Standards and References. Contractor shall bring conflicting requirements, if any, to the District's attention.

2.4.1 Compliance

Contractor shall comply with all District, County, State and Federal Rules, Regulations and Technical Specifications.

2.4.2 Pre-Construction

A pre-construction meeting must be arranged by the Contractor and held prior to the start of any work. The District, District's Engineer, Contractor, Developer, Adams County, Denver Water, and any other parties deemed necessary must be in attendance. Meeting should be held at the District office.

Contractors must notify the District within 48 hours prior to start of construction.

2.4.3 Schedule

The Contractor shall submit a Water Main Schedule of Construction Phases to sequence construction, main abandonment, waterline testing, water service reconnections, and temporary (if applicable) and permanent paving. This shall be submitted to the District's Engineer for review and approval prior to construction and reviewed during the pre-construction meeting.

2.4.4 Working Hours

The District working hours are from 7:30 am to 4:00 pm Monday through Friday. Any construction work that requires District personnel or a District Representative to be on site on weekends, holidays or before 7:00 am or after 4:00 pm Monday through Friday will be considered overtime work.

2.4.5 Permitting

The Contractor shall be solely responsible for determining and obtaining any and all permits required for the work from other governmental entities or agencies having jurisdiction and shall perform the work in accordance with any and all applicable ordinances, regulations, laws and order of, or permits issued by such entities or agencies.

2.4.6 Inspection

A. No work shall be backfilled, including bedding material above spring line of the pipe, until the construction has been inspected and approved for backfill by the District's authorized inspector, unless prior authorization has been obtained.

B. No observation or testing will be performed by the District on weekends or holidays without the express agreement of the District secured in advance.

C. The observations, testing and reviews performed by the District are for the sole and exclusive benefit of the District. No liability shall attach to the District by reasons of any observations, testing, or reviews required or authorized by these Specifications or Rules and Regulations, or by reason of the issuance of any approval or permit for any work subject to this section.

D. The District is not a guarantor of the construction Contractors' obligations and performance of contract.

E. The District is not responsible for safety in, on, or about the Project site, nor for compliance by the appropriate party of any regulations relating thereto.

2.4.7 Design Revisions During Construction

Should the Contractor encounter field conditions that prevent construction to occur in conformance with the reviewed and signed plans, a meeting shall be scheduled by the Contractor with the District and the District's Engineer to discuss an alternative design. The Contractor's construction shall not deviate from the signed plans without the prior review of the District and the District's Engineer.

The District inspector may provide a field order for construction conflicts which are considered a no cost change item by Contractor and District.

2.4.8 Staging and Storage

A. All piping material and appurtenances shall be stored off the ground and protected from dirt and weather. No pipe shall be installed with dirt or debris in the line.

B. All materials shall be stored, at minimum, per the manufacturers' recommendations.

C. All stored and staged equipment is the responsibility of the Contractor. The District does not accept materials until they are installed and are in usual service for the District.

2.4.9 Construction Water

The Contractor shall make his own provisions to apply all water necessary for backfill compaction, line flushing, testing or any other purpose during construction. A hydrant water meter can be obtained from the District. The Contractor will provide a deposit for a hydrant meter. The deposit will be returned when the hydrant meter is returned to the District in satisfactory working condition. The Contractor will pay the District for a water permit.

2.4.10 Groundwater

When draining an existing water main, the sump and pumps will be adequate to keep the water level of the sump below the water mains so that it does not contaminate the water system. The sump should be a minimum of two feet below the bottom of the pipe. Rock should be installed to one foot below the bottom of the pipe. The District will make every effort to provide a complete shutdown of the existing system for tie ins. However, it should be expected that existing valves do not seal, and provisions should be made by the Contractor for leaking control valves at no additional expense to the District.

Groundwater management shall follow all local, state and federal best practices.

2.4.11 Excavation

A. Excavation for pipelines, fittings and appurtenances shall be an open trench excavation to the depth required by the reviewed and signed Construction Plans. Alternative trenchless technologies are acceptable upon review during design or formal change to design review meeting.

B. All excavations shall be properly supported as required by OSHA or as required by State laws and municipal ordinances, and as may be necessary to protect life, property and the work.

C. Contractor shall carefully examine the existing conditions and roadways prior to beginning any excavation work. Photographs or videos of the site shall be taken in advance as a record of the existing conditions.

D. Excavations near asphalt or concrete in poor condition shall be performed with caution to control additional deterioration to the finished surfaces. Damage to asphalt and/or concrete during the construction shall be repaired by the Contractor to meet all Right of Way requirements.

2.4.12 Backfill and Compaction

A. The Contractor must give special emphasis to the backfill and compaction at manholes, valves, appurtenances, water services and structures. The backfill shall be placed in horizontal layers not exceeding two feet in depth and shall be adequately moistened and thoroughly tamped with air or vibrator plate or jumping jack compactor. At a minimum, two density tests will be taken at every foot for manholes and one test taken at every foot for valves. All compactions will be initially observed by the District.

B. The Contractor will be responsible for repairing or complete replacement of any deterioration or settlement of the pipe trenches and associated street surfaces. Notification of the required repair will be issued by the District. All costs of repairs and all liability, as a result of surface deterioration or settlement, shall be the responsibility of the Contractor. The Warranty Period shall be extended for the full period for the entire project to cover future settlement deterioration until the Project as a whole shows no signs of settlement deterioration.

C. All excavations at the end of the day shall be backfilled and compacted. The subgrade shall be protected per the County Standards.

D. Compaction tests shall be performed by a qualified testing laboratory at locations designated by the District. All expenses involved in these tests shall be borne by the Contractor or the Developer.

E. Backfill and compaction shall be completed with a two-year warranty.

2.4.13 Utility Coordination and Locates

A. The District will make available to the Contractor record drawings showing the location of its facilities in the vicinity of the work, but the Contractor shall be finally and solely responsible for determining the existence and location of all subsurface structures in such areas.

B. If a Contractor damages any District facilities during construction, they shall immediately notify the District and take such measures as may be reasonably necessary or appropriate to minimize damage to the District system, prevent the escape of water from the District System, and prevent and mitigate damage from the escaped water. The repair of damages may be performed by the District or a licensed District Contractor and the assessment of costs shall be passed on to the Contractor.

C. Any Contractor who damages District facilities shall indemnify and hold the District harmless against any and all claims for damage resulting there from and shall indemnify and hold the District harmless against any and all claims for damage to any such structures or facilities.

D. Utility locates for newly installed pipe during construction shall be performed by the Contractor or representative of the Owner until initial acceptance is issued.

E. The Contractor shall assume full responsibility and expense for the protection of all public and private property, roads, curb, gutter, sidewalk, pedestrian ramps, cross pans, curb cuts, driveway cuts, structures, water mains, sewers, utilities, utility appurtenances etc., both

above and below ground, at or near the site or sites of the work, being performed under the contract, or which are in any manner affected by the prosecution of the work or the transportation of work force and materials in connection therewith.

F. The location of existing utilities shown on the drawings is based on the best available information but is not to be construed as exact. During the design phase of the project the existing utilities were identified from existing plans and visible surface appurtenances. However, not all existing utilities were marked, and it will be the Contractor's responsibility to verify and protect all existing utilities during construction. If additional utilities are discovered during the construction that are not identified on the plans, this will not constitute a Change Order, and the Contractor shall include all cost for locations, crossing, and protecting all existing utilities for such work in the bid price.

2.4.14 Water Main Installation

A. Pipe shall be laid without a break in grade from fitting to fitting or to the lines and grades shown on the reviewed and signed construction plans. Pipe deflection is allowed at the locations indicated on the construction plans. Deflections at joints (DIP) or in the pipe (PVC) should not meet or exceed the manufacturer's maximum requirements. The interior of the water pipe shall be cleaned of all dirt and superfluous materials.

B. When pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon/lunch hour and breaks, as well as overnight and on holidays.

C. All pipe and fittings shall be carefully examined for cracks, sun damage and other defects before installation. Spigot ends shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective materials shall be marked and removed from site.

D. Placement of DIP in the trench shall conform to the ANSI/AWWA C600 and these Engineering Standards. Placement of PVC pipe in the trench shall conform to ASTM Standard D2331 or Uni-Bell Standard UN B5 and these Engineering Standards.

E. Pipe cutting shall be straight and true and done so in a workmanlike manner as to provide a smooth end, perpendicular to the flow axis of the pipe, without damaging the pipe or pipe lining. All burrs shall be removed from the ends of the pipe by lightly rasping or filing the pipe end.

F. Pipe bedding shall be Class A bedding material for water mains at normal depths of cover (4.5-feet to 10-feet). Class A bedding shall consist of placing select bedding material (squeegee) from the undisturbed pipe foundation to a point 12-inches above the top of pipe.

2.4.15 Water Shutdowns

If it is necessary to shut down any portions of the existing water system to make new connections the Contractor will be responsible for notifying all District customers in writing each day, they are

affected by the water outage and at least 48 hours prior to such outage. The duration of the water outage shall be minimized and if directed by the District, the Contractor shall provide temporary water supply to customers.

2.4.16 Connection to Existing Main and Main Tapping

It is the Contractor's responsibility to confirm the water main is restrained when making connection to existing water systems or when exposing existing water mains. Any damage, water loss, or impacts on construction schedule shall solely be the Contractor's responsibility.

Tapping requirements:
2 inch and smaller – Denver Water

4-inch wet tap and larger - Ed Pearce Inc and Core and Main
3-inch taps are typically done as a 4-inch wet tap or a 4-inch tee and reduced to 3-inch

All new water meters 1.0-inch diameter and smaller and 1.5-inch and larger shall be purchased from the District (District provides everything but the copper). The cost of meter shall be included in the system development fee.

2.4.17 Residential Access

The Contractor shall ensure that all residents have access from the street to their property each night. When access to a resident's property cannot be maintained during normal working hours (weekdays), the Contractor must personally notify the affected residents 24 hours in advance of the closure. Traffic plates and other H20 rated temporary access methods may be required to allow access.

2.4.18 Water Services

A. In applications beneficial to the customer, the water service line shall be replaced to the meter pit. The District will determine whether or not this requirement is applicable on a case-by-case basis.

B. The Contractor shall be responsible for flushing water through the outside faucet of the property once the water service connection is completed. All clogged or restricted pipes in the residence shall be the responsibility of the Contractor. Large service lines serving non-residential properties such as commercial, industrial, school or business, which have backflow preventer may need to have a meter pulled on an existing service, or have provisions made for high velocity flushing through the service line or corp on a new line, to eliminate all shavings or debris that may affect the customers' facilities. The Contractor is also responsible for damages to any and all other customers' facilities damaged by debris entering the service line from any service line repairs or reconnects.

2.4.19 Operation of Existing Valves

A. All existing water main valves shall be operated only by the District.

B. Any newly constructed valve that has been tested and in service shall be operated only by the District.

2.4.20 Installation of Fire Hydrants

Contractor shall protect fire hydrants from damages throughout the duration of working on site. When fire hydrants are required to be installed for fire protection, Contractor shall place temporary barricades near hydrants during construction to prevent incidental contact with hydrants.

2.4.21 Tracer Wire

Tracer will shall be installed for all pipe materials. Continuous wire runs are required, and splice locations must be approved by the engineer of record. Contractor is responsible for integrity of wire splices and performance testing, at no point is Engineer or District responsible for a tracer wire test failure prior to issuance of final acceptance.

Tracer wire shall be tested for performance with the District inspector present. Any continuity failures during trace wire test shall be remediated prior to the acceptance of water mains.

2.4.22 Repair Taps and Replacement of Service Lines

The property owner is responsible for contacting the District before repairing a damaged water service line or water main tap. Any leaks detected on the service line must be repaired at the expense of the property owner. Repairs must be performed by a District permitted contractor and shall be inspected by a District representative prior to backfill. Materials used shall be in accordance with the Section 2.3 Material Selection.

2.5 SYSTEM TESTING AND ACCEPTANCE

When testing water mains, the Contractor shall make every effort to eliminate the number of customers out of service. Testing against a plug or cap should be a last resort, this is to limit water loss and necessary times to drain water mains prior to bringing main into service. A thorough plan shall be reviewed by the District prior to commencing any system testing.

2.5.1 Chlorine Testing

A. Main extensions and private pipe extensions shall be chlorinated in accordance with AWWA C651, “Disinfecting Water Mains,” and the local health authority having jurisdiction, prior to acceptance by the District. The chlorinating agent and method of application shall be subject to the review of the District.

B. Chlorination of the finished pipelines shall be completed prior to the hydrostatic testing. Prior to filling the pipe with water, the pipe shall be clean and free of debris to the satisfaction of the District. All labor, equipment, and materials necessary to chlorinate and complete hydrostatic testing of water lines are the contractor’s responsibility.

C. Dispose of highly chlorinated water by dechlorination or other methods in a safe manner and in conformance with the District and National Discharge Elimination System Requirements. Submit proposed disposal and dechlorination plan to the District representative for review. Provide for adequate dechlorination and disposal of water without damage to adjacent property.

D. Disinfection by chlorine swabbing may be used for 16-inch and smaller mains that are less than 100-feet in length, in accordance with AWWA C651.

2.5.2 Hydrostatic Testing

A. Hydrostatic tests shall not be performed on any portion of the pipeline until all field placed concrete has had adequate time to develop design strength. Contractor may elect to obtain concrete cylinders to test contract strength if rapid hydrostatic testing is requested.

B. The District shall be notified a minimum of 24-hours in advance of testing. All testing shall be performed in the presence of the District.

C. The method of supplying water and the source of the water for hydrostatic testing shall be certified and approved by the District. The use of barrels or rented tanks, sanitary or otherwise, to supply water for hydrostatic testing is prohibited.

D. Pipe shall be field pressure tested to a minimum of 150 psi. All hydrostatic testing shall be done in accordance with AWWA C-600, "Hydrostatic Testing."

E. While the test pressure is maintained, the pipeline shall be examined for any leaks. Any pipe or fitting found to be faulty shall be removed and replaced. Cutting and replacing pavement, excavation, and backfilling may all be necessary to locate and repair leaks discovered by pressure testing of pipe. The Contractor shall be responsible for supplying the labor, equipment and materials necessary to accomplish the prescribed testing and repair work, if required.

F. If testing shows any leakage, the pipeline will not be accepted. The pipeline shall be repaired, re-chlorinated and tested until it meets test requirements.

2.5.3 Clearwater Testing

Samples of water will be collected for bacteriological examination and residual chlorine content testing before the pipe is put into service. The District will be responsible for the chlorine test and the Contractor will be responsible for the clear water test.

2.5.4 Backflow Prevention Device Inspection

All new backflow prevention devices shall be inspected by a qualified backflow device inspector prior to acceptance by the District. Final approval of backflow prevention device shall be evidenced

by a "Certificate of Approval" issued by an approved testing laboratory certifying full compliance with AWWA C510-78 and labeler specifications.

It is the responsibility and requirement of the inspection company testing the new system to submit all test reports to https://nwswsd.c3swift.com. For assistance with registration and test report submittal contact support@swiftcomply.com, or call SwiftComply at 619-304-6022.

2.5.5 Conditional Acceptance

The District will perform a walk through with Developer, Engineer or Owner to determine any items that are outside of these Engineering Standards and project specifications. The Contractor shall remediate all violations to meet the Standards and project specifications prior to receiving a conditional acceptance letter which begins the Warranty Period.

2.5.6 Warranty Period

All materials and workmanship furnished by the Contractor shall conform to these Engineering Standards, Rules and Regulations and to all plans and designs accepted by the District, and shall be free from all defects due to faulty or nonconforming materials or workmanship for a period of one year. Backfilling and compaction warranty period is two years. The one-year period will begin after the District provides written acceptance of the work.

2.6 GENERAL NOTES

1. All materials and workmanship shall be in conformance with the Denver Water Department (DWD) engineering standards, material specifications, and standard drawings; and the North Washington Street Water and Sanitation District (NWSWSD) requirements whichever is more stringent.
2. All water mains shall be ductile iron pipe, conforming to ANSI a21.51/AWWA c151, class 52 thickness. The interior of each length of pipe shall have a cement-mortar lining conforming to the requirements set forth in ANSI a21.4 of standard thickness. The exterior of the pipe shall be coated with standard bituminous coating approximately one mil thick. Polyvinyl chloride pipe (PVC) may be accepted as an alternative to DIP. PVC pipe shall be manufactured in accordance with AWWA standard C-900, 'polyvinyl chloride (PVC) pressure pipe, 6-inch through 12-inch, for water. Minimum pressure class shall be 305 psi, DR 14. All pipes shall have installed 12-gauge single strand tracer wire, taped to pipe with PVC tape. Tracer wire shall terminate at fire hydrants or as directed by the District. Six inch wide, aluminum foil plastic backed, detectable warning tape shall be installed 12 to 18-inches below surface grade. Tape shall indicate buried water line below and shall be blue in color and be manufactured by Thortec or equal. 16-inch pipe shall be fusible PVC or restrain joint pipe, DR 14 installed by pipe bursting technique. Refer to technical specifications for material and installation requirements.
3. All fittings shall be made from gray-iron or ductile iron and furnished with mechanical joint ends. All fittings shall have a pressure rating of 250 psi and shall be wrapped with an 8-mil minimum thickness polyethylene material per AWWA c105.
4. The ductile-iron pipeline and fittings shall be encased in polyethylene film in accordance with the requirements of ANSI a21.5/AWWA c105.
5. Fire hydrants shall be Mueller, model 423 factory painted red. All bolts, nuts and washers shall be 316 stainless steel.

6. All gate valves shall be iron bod resilient seat valves meeting the Denver Water Department standards. All head bolts, nuts and washers shall be 316 stainless steel. Gate valves shall open left when installed north of 78th Avenue and shall open right when installed in 78th Avenue or south of 78th Avenue. 16-inch diameter gate valves shall be American Flow Control or equal with bevel gear actuator.
7. A pre-construction meeting shall be scheduled by the contract 48 hours before beginning construction on the project. The pre-construction meeting shall be held at the NWSWSD offices and include at a minimum the District and their engineer, the contractor's superintendent on site, and representative of the Denver Water Department.
8. Residential project shall be assessed for individual water meter per individual address. Prior to District final approval of plans, developer shall submit tap and meter applications for each residential property with an address.
9. Project which includes relocation of meter pits or installation of new meter pits shall replace the service line from the main to the property line.
10. After the waterline has been backfilled and before placement of the finished surface, Contractor must test tracer wire for continuity and ability to locate with a District representative present. Should the test result in a non-continuous tracer wire, Contractor shall locate failure and correct. Any placement of finished surface material prior to tracer wire performance confirmation will be at the Contractors own risk.
11. Contractor shall take as-built survey shots on all fittings, valves, utility crossings, changes to alignment, and vertical changes.

3.0 SANITARY SEWER STANDARDS

3.1 GENERAL

This section covers the design requirements and consideration for all North Washington Street Water and Sanitation District sanitary sewer system components. All sanitary sewer lines, manholes, service connections, and related public facilities within North Washington Street Water and Sanitation District boundary shall be designed in accordance with these Engineering Standards, and any other applicable Federal, State, and Local regulations. Any deviation from these Standards shall require written permission from the District, prior to design or construction. Design of all sanitary sewer system construction plans shall be performed under the direct supervision of a Professional Engineer, registered in the State of Colorado. The intent is to provide a consistently designed, long-term, reliable system which can be easily located and maintained by the District.

Construction plans for sanitary sewer system shall meet the guidelines set forth. Some of the items below may not be applicable to all projects as determined by the District. Prior to beginning of any construction, the Sanitary Sewer plans shall be reviewed and approved by the District.

3.2 DESIGN REQUIREMENTS

3.2.1 Design Criteria

A. No public, District owned, sanitary sewer gravity line shall be smaller than eight inches in diameter.

B. Sanitary sewer lines shall be designed to transport average and peak hour wastewater flows in accordance with these Engineering Standards.

C. Average wastewater flows from a new development can be determined by City and County of Denver

D. In streets having unusually sharp turns and/or centerline alignment offsets the sanitary sewer alignment shall not “zigzag” across the street centerline. The final location shall be determined by the District during plan review.

E. For new developments, no parallel sanitary sewer lines to existing lines will be allowed. The Developer will upsize the existing line at their expense.

F. Curvilinear sanitary sewer lines are not allowed. Design shall attempt to minimize the number of manholes. In no case shall the sanitary sewer line be designed closer than three feet (3’) to the cross pan, or gutter; a minimum of five feet (5’) of clearance is desired.

G. All dead-end sanitary sewer lines shall have a minimum slope of one percent (1%), this promotes higher velocities to remove settled solids and other debris. Dead end sewer lines shall have manholes.

H. Minimum depth of sanitary sewer lines shall be six feet (6') measured from the top of pipe to finished grade. Lines proposed to be constructed with less than six feet (6') minimum cover shall require written special permission by the District.

I. Maximum depth of sanitary sewer lines shall be reviewed by the District on a case-by-case basis, but in all cases, the maximum depth shall not exceed the depth where future excavation of the installed sewer line cannot be accomplished due to the existing or future location of another utility, street improvement, structure, or foundation.

J. Minimum Flow Velocity – The design of 2.0 feet per second at peak flow

Manning's Equation

$V = 1.49/n * R^{(2/3)} * S^{(1/2)}$

Where V = Flow Velocity (ft/sec)
R – Hydraulic radius (ft), determined by dividing the flow area by the wetted perimeter
S - Slope (ft/ft) of the energy grade line, which is approximately equal to the sanitary sewer line design slope
n – Manning's Pipe Roughness Coefficient or "n" Factor

Maximum design flow depth at peak flow shall not exceed d/D of 0.5 for 12-inch and smaller and 0.75 for 15-inch and larger.

3.2.2 Manholes

A. Maximum spacing of 400 feet between manholes.

B. Buoyancy of manholes must be considered a floatation.

C. Must be prevented with appropriate consideration where high groundwater conditions are anticipated.

D. Manholes with pipe penetrations larger than 24-inches in diameter shall be 5' manholes.

E. Manholes shall be designed to promote smooth, continuous flow between adjacent reaches of sanitary sewer lines. The minimum drop from any pipe invert upstream to pipe invert "out" shall be 0.2 feet, unless grade and elevation constraints are apparent.

F. Where manholes are designed to collect flows from two or more incoming lines, the design 'In" invert shall be set to keep the largest incoming line (line contributing the most flow) lower in the manhole than the other incoming lines. The other incoming lines shall enter the manhole a minimum of 0.1 feet higher than the invert of the largest line.

G. Maximum inside drop from upstream invert to downstream invert shall be twelve inches.

H. Where new lines are proposed to connect to the District's outfall lines, the crown of the incoming line shall match the crown of the outfall line.

I. Manholes shall have a minimum inside diameter of four feet (4') .

J. Sanitary sewer lines shall be designed such that the angle between any upstream line and downstream line is 90 degrees (90 °), minimum.

K. Where design requires the use of a drop manhole, design shall use a minimum 5-foot diameter manhole and an inside drop. Outside drops are not prohibited and will only be approved on a case-by-case basis. As approved by the district.

L. Minimum manhole depth shall be as required by these Standards. Maximum depth shall be reviewed and determined by the District on a case-by-case basis. Where the depth of the manhole is 20 feet (20') or more from cover to invert, special considerations shall be made (platform, structural design, safety, access), and designed by structural engineer.

M. Manholes shall be constructed to permit grade adjustments by use of precast concrete adjusting collars, or HDPE plastic adjustment rings, not to exceed a total height of 12 inches (12").

N. In open space or landscaped areas, manhole rims shall be set four inches (4") above grade (or as requested by District) to prevent infiltration from surface runoff.

O. Manholes in areas of unpaved interim conditions will require adjustment to final grade/paving by the Owner/Developer.

3.2.3 Service Connection to Manholes

Service connection to manholes are not allowed without written permission from the District.

3.2.4 Profile and Alignment

A. Sewer lines are not allowed to be curved. Changes to horizontal alignment shall be accomplished with manholes.

B. All sanitary sewer main extensions shall be shown on the construction document in plan view and profile view. The only exception to the profile view requirement is for use of Cure-in-place-pipe.

C. Sanitary sewer mains shall have a minimum of five foot (5') edge to edge horizontal clearance with utilities other than water lines. Horizontal clearance requirements allow for future excavation of the sewer line without causing damage to the adjacent utility.

D. Sanitary sewer mains shall be at minimum 10-feet horizontal and 1.5-feet vertical clearance from potable water, reclaim and irrigation water. Only in special conditions will a pipe casing be allowed in lieu of achieving the minimum clearance requirements.

3.2.5 Sanitary Sewer Services

A. Sanitary sewer lines shall be PVC SDR 35 ASTM d3034

B. The sanitary sewer service lines that are one hundred feet or longer will be required to install a two-way cleanout 5-foot from building and at every 100 feet after.

C. Where new sanitary sewer mains are required, the service connections shall be installed new to the edge of Right of Way or District easement. This requirement is to be evaluated on a case by case basis. Generally, new main in primary roads will require new service lines to be installed, to reduce the need for disrupting primary road traffic and surface pavement.

3.2.6 Easement and Right of Way

A. All preliminary and final plats will show NWSWSD existing and proposed easements.

B. All sanitary sewer lines shall either be within public Right of Way or exclusive North Washington Street Water and Sanitation District easements.

C. Sanitary sewer lines proposed outside of Right of Way shall be designed within an easement with the following minimum requirements.

1. Sanitary Sewer easements shall be a minimum of 30 feet (30') wide and shall have legal descriptions and drawings prepared by a licensed surveyor, in the state of Colorado, and in accordance with these Standards.

2. Greater than 30 foot (30') easements will be required for sewers installed with other utilities, where sewer depth exceeds 12', or other reasons deemed necessary by the District. All easement widths are subject to review and approval by the District.

3. Manholes shall be provided at each end of any easement.

4. Easements shall provide easy access to manholes by tandem wheeled maintenance truck. If easement is in undeveloped area, a ten foot (10') maintenance path will be required and designed to meet H-20 loading requirements. Ditch, creek and river crossing will require special consideration for access on a case-by-case basis, to be determined by the District during design review.

5. If the sanitary sewer line is the only utility proposed to be constructed within the easement, the alignment shall be the easement centerline. Where sanitary sewer line shares easement with other utilities, the sanitary sewer shall be at minimum 10 feet (10') away from edge of easement.

6. Where easements straddle property line, the sanitary sewer easement shall be a minimum of 10 feet (10') from the one edge of the easement and a minimum of 10 feet (10') from the property line. Designers and developers shall only use straddled easements as a last resort.

7. When selecting the location of utility lines within an easement, consideration shall be given to excavation, maintenance, and repair requirements.

8. Sanitary sewer lines in unpaved easements shall be AWWA C900 DR18 PVC

9. Easements divided by a property line of two separate owners, or lots are not acceptable.

10. Grading Plan and Landscaping Plan shall consider the easement conditions. Grading Plan and Landscaping plan shall be submitted for review by the District.

11. Legal descriptions and drawings shall be prepared on letter sized (8 ½“ x 11”) paper and shall be referenced to the nearest section corner. Legal descriptions may also be tied to a recorded plat. The legal description shall be a “metes and bounds” description, accurately describing to a hundredth of a foot, the point of beginning, each easement line bearing and distance, and the total area contained in acres.

12. Easement drawings shall be presented at a scale sufficient to clearly show all easement boundaries. The drawings shall show the north arrow, referenced section corner, all bearing and distances, total acres, adjacent property identification, street names and date of preparation.

13. Easement legal description shall bear a professional land surveyor, state of Colorado, seal and signature.

14. Legal descriptions and drawings should be submitted to the District for review along with closure calculations and Title Insurance Commitment covering the subject right of way. A copy of each document listed in the Title Commitment must be included. All expenses incurred in obtaining Title Insurance shall be paid by the Grantor.

15. The District will not permit construction of a project until all easements related to the project are fully signed and recorded on the County Records.

3.2.7 Sanitary Sewer Study

A. A sanitary sewer study shall be submitted for all developments tributary to the District’s sewage collection system unless this requirement is waived by the District.

B. The study will be prepared by a Professional Engineer, licensed in the State of Colorado, whose seal and signature shall be affixed to it.

C. The flow calculations shall include:
   a. The quantity (average, peak and infiltration) of sewage flow expected to be generated by the project.
   b. The nature of wastes if not ordinary domestic sewage.

c. The quantity and type of discharge of an unusual nature (i.e. swimming pools, cooling water, commercial discharges, floor drains from auto repair garages, steam cleaning, chemical, dairy, food processing or service, car washes, metal treating or plating operations, etc.)
d. In addition to the quantity of flow generated within a project, the impact of the project's expected peak flow on the sewer system downstream, from the point of connection to the first significant outfall, shall be investigated to ensure that adequate capacity is available not only for the proposed project, but for all present users of the existing public sanitary sewer system. Unless otherwise determined by the District, a significant outfall shall be considered to be any sewer or series of sewers which is continuously 15-inches in diameter or greater, from point in question to the sewage treatment plant.
e. The study should address the selection and evaluation of alternates, as well as phasing, and make recommendations as to the best plan to be selected for implementation.

D. Additional requirements may be added by the District on a case-by-case basis.

E. Any changes to the project which result in a revision of the information presented in the sanitary study shall be addressed in an amendment to the study.

F. The sewer's hydraulic capacity shall be such that the sewer is flowing at no more than 80% of full depth for 12-inch and smaller pipe and 50% of the full depth for 15-inch and large pipe at the calculated future peak flow rate.

3.2.8 Sanitary Sewer System Layout at Creek Crossings

Where sanitary sewer lines are proposed to cross creeks or drainage-ways, they shall be designed to cross perpendicular to the creek or drainage way centerline. Manholes shall be provided on each side of the crossing which can easily be accessed by a tandem wheeled maintenance truck. A specific geotechnical investigation shall be performed by the owner for each proposed crossing to evaluate potential 100 Year Flood scour depths of the creek or drawing way at ultimate development of the drainage basin. After the investigation has been reviewed by the District, minimum depth of the sanitary sewer lines will be established, as well as any encasement and/or erosion protection requirements. Review by the County, Mile High Flood District, Corps of Engineers and other agencies may be required.

3.2.9 Cleanouts

Not accepted at the end of mainlines

3.2.10 Oil, Sand and Grease Interceptors

a) All restaurants, cafeterias, supermarkets, bakeries, food processing, or other food preparation facilities shall have a grease interceptor installed on the sewer service line. The grease interceptor sizing and location shall be determined by a professional engineer, state of Colorado, based on the criteria outlined below. All calculations shall be submitted to the

District for review. Construction, ownership, and maintenance of the grease interceptor shall be the Owner's responsibility. Bypasses are not permitted.

1. Grease Interceptor Criteria

Method 1: 2006 UPC Formula

Step 1 – Meals per Peak Hour = Seating Capacity X Meal Factor
Meal Factors
Fast Food (45 min)……1.33
Restaurant (60 min)……1.00
Leisure Dining (90 min)……0.67
Dinner Club (120 min)……0.50

Step 2 – Waste Flow Rate:
With Dishwasher……6 gallon flow
Without Dishwasher……5 gallon flow
Single Service Kitchen……2 gallon flow
Food Waste Disposer……1 gallon flow

Step 3 – Retention Time
Commercial kitchen waste/dishwasher……2.5 hours
Single service kitchen……1.5 hours

Step 4 – Storage Factor
Commercial kitchen – 8 hour operation……1
Commercial kitchen – 16 hour operation……2
Commercial kitchen – 24 hour operation……3
Single service kitchen……1.5

Step 5 – Capacity
Multiply values from Steps 1-4. The result is the minimum approximate grease interceptor size for this application.

Meals per Peak Hour		Waste Flow Rate		Retention Time		Storage Factor		Capacity (gal)	Interceptor Size (gal)
	X		X		X		=		

Method 2: Drainage Fixture Unit Calculation

Where food is prepared, but as a general rule not consumed on the premises, or where seating capacity or number or meals served cannot adequately be determined, the following rule shall apply:

The following table establishes the drainage fixture unit values for various pieces of kitchen equipment, which may require connection to a grease interceptor. One drainage fixture unit shall equal 7.5 GPM. The total number of drainage fixture units shall be multiplied by 7.5 GPM to determine maximum rate of flow (GPM) possible into the grease interceptor. The volumetric capacity of the unit shall be five times the maximum rate of flow.

Fixture Unit Values

Type of Fixture	Fixture Unit Value
Clothes Washer	3
Combination Sink and Tray with Food Waste Grinder	4
Combination Sink and Tray with one 1 ½ Inch Trap	2
Combination Sink and Tray with Separate 1 ½ Inch Traps	3
Pot or Scullery Sink	4
Prep Sink	2
Service Sink (Standard Trap)	3
Service Sink (P Trap)	2

All Other Fixtures:.

1 ¼ Inch or less Trap Size	1
1 ½ Inch Trap Size	2
2 Inch Trap Size	3
2 ½ Inch Trap Size	4
3 Inch Trap Size	5
4 Inch Trap Size	6

Example: A total of 21 fixture units are to be discharged to a grease interceptor. 21 F.U. x 7.5GPM x 5 minute retention = 787.5 gallons.

Method 3: for Schools (Public and Private)

The sizing of grease interceptors for school kitchens shall be as follows:

Number of students x .6 (average daily participation) x 2.5 gallons per meal served equals volumetric capacity of grease interceptor. Example: 650 students x .6 ADP = 390 meals. 390 meals x 2.5 gallons/meal = 975 gallons.

b) Facilities which discharge any quantities of sand, oil or other inert debris into the sanitary sewer service shall have sand and oil interceptor installed on the sewer service line. Examples of such facilities include, but are not limited to: automobile service stations, mechanical repair shops, car washes, garden nurseries, warehouses, and parking garages with floor drains. The sizing and location of the sand and oil interceptor shall be determined by a professional engineer, state of Colorado, based on the criteria provided below. All calculations shall be submitted to the District for review. Construction, ownership, and

maintenance of the grease interceptor shall be the Owner's responsibility. Bypasses are not permitted.

2. Sand Oil Interceptor Criteria

a. Materials and Structures

All sand and oil interceptors shall be two compartment, precast concrete tanks. The smallest compartment shall have 1/3 the capacity of the entire interceptor.

b. Location

All sand and oil interceptors shall be located outside, on private property, within 30 feet (30') and not less than five feet (5') from the facility served, unless otherwise approved by the District, and shall be accessible at all times for maintenance and inspection.

c. Sizing

No combination sand and oil interceptor smaller than 750-gallon capacity shall be installed at a single bay facility.

The sizing shall be reviewed by the District and shall be as follows:

Three inch (3") diameter flow drains are rated at six (6) drainage fixture units (DFU)

Four inch (4") diameter flow drains are rated at eight (8) DFU
Sizing formula shall be as follows:

DFU connected X 7.5 GPM X 5 minutes = Interceptor Size.

i. Trough Drains

Where trough drains are used, each bay, or compartment, or area equaling the square foot surface of a standard service station bay which is served by a trough drain shall be rated at six (6) DFU per bay.

ii. Vehicle Wash Drains

Vehicle wash drains will be rated at eight (8) DFU each regardless of size.

d. Connections to Interceptors

i. All drains from the kitchen, food preparation, and dishwashing areas shall be connected to the grease interceptor.

ii. Garbage grinders not connected to the grease interceptor shall not be used for disposal of grease.

However, the District, at its discretion, may require any garbage grinder to go through the grease interceptor.

iii. All drains from automotive servicing areas, etc., will be connected to oil and sand interceptors.

c) In all cases, sand, oil and grease interceptors shall be located on the service line outside the building served, upstream of the location where human waste enters the service and so installed and connected as to be easily accessible for inspection and cleaning. The District will determine whether a sand, oil and grease interceptor is required whenever a new service line is proposed, and whenever an existing service line changes ownership or intended use. If the District determines that an existing facility needs to have a sand, oil, and/or grease interceptor installed, the Owner shall be required to provide the interceptor at his own cost, even if the interceptor was not originally required on the service line.

e. Design Review
Drawings shall be submitted to the District indicating, but not limited to the following:
i. Building use and size, site layout, proposed service locations, size, alignment, grades and tie-in locations.

ii. Service sizing calculations.

iii. Proposed interceptor location with respect to the building, street improvements and landscaping.

iv. Interceptor sizing and by-product rate of generation calculations.

v. Interceptor shop drawings.

vi. Process description of system generating sand, oil or grease.
vii. The proposed maintenance schedule. The District will review the above information in order to verify that an interceptor will be installed that is generally in conformance with accepted practices. The District is not responsible for the sizing or adequacy of the interceptor to perform its intended use, and assumes no responsibility regarding the interceptors' maintenance or operation.

The District requires precast vaults located outside the building for grease traps within the District.

3.2.11 Industrial Pretreatment

Any user discharging non-domestic wastewater into the North Washington Street Water and Sanitation District's municipal wastewater collection and treatment system is required to comply with the Pre-Treatment/Industrial Waste Control Regulations set forth in Metro Wastewater Reclamation District Rules And Regulations, Section 6 hereof. When the Provisions of Metro Wastewater Reclamation District Rules And Regulations, Section 6 are applicable, the Pre-treatment/Industrial Waste Control Regulations contained in Metro Wastewater Reclamation District Rules And Regulations, Section 6 shall supersede the engineering standards and requirements for non-domestic wastewater contained in Sections Three (3).

3.2.12 Underdrains

In no case shall underdrains connect to a sanitary sewer main or sanitary sewer service lines. Groundwater is prohibited from entering the sanitary sewer system.

3.3 ENGINEERING DESIGN CRITERIA AND STANDARDS/ REFERENCES

All sanitary sewer design and construction shall adhere to these Engineering Standards. Should a condition not be covered by these standards, the design and construction shall follow the latest versions of:

City and County of Denver Department of Public Work:

- Sanitary Design and Technical Criteria Manual
- Storm Drainage and Sanitary sewer Construction Details and Technical Specifications
- Wastewater Standard Detail Drawings

Metro Water Recovery District's Rules and Regulations

Construction activities that occur within the public Right of Way shall adhere to the authority having jurisdiction.

- Adam County Development Standards
- CDOT's M & S Standards

3.4 MATERIALS SELECTION

A. All items not included in the lists below are to follow the material specifications provided by the City and County of Denver Department of Public Work – Sanitary Design and Technical Criteria Manual.

B. All sanitary sewer system materials shall be in accordance with these Engineering Standards. Any material proposed as "an equal" must be reviewed and found acceptable by the District prior to design or construction unless specified otherwise by the District.

C. All materials furnished shall be new and undamaged. Everything necessary to complete installation shall be furnished and installed whether shown on approved drawings, included in these Engineering Standards or not and installations shall be complete as fully operable.

3.4.1 Pipe Selection

A. Gravity sanitary sewer mains constructed of the following materials are permitted:

- PVC Pipe ASTM 3034 SDR 35
- PVC Pipe ASTM 3034 SDR 26

PVC joints shall be made using an integral bell and spigot type rubber gasketed joint. Each integral bell joint shall consist of a formed bell and a single rubber gasket. Gaskets shall conform to ASTM F-477.

B. Pressurized sanitary sewer force main constructed of the following materials are permitted:

- C-900 DR-18

PVC joint shall be made using an integral bell and spigot type elastomeric gasketed push-on type joint. Solvent cement joints are strictly prohibited. Gaskets shall conform to ASTM F-477.

Design Engineer may select a pipe material of higher quality than shown above should there be reasonable cause for making the different material selection. Material shall be consistent from manhole to manhole. Unmarked pipe will be rejected.

3.4.2 Service Connections

A. In-line "wyes" are the only fittings acceptable for service connection to new construction. The "wye" branches shall have their axis approximately 45° to the longitudinal axis of the pipe, unless otherwise specified.

B. Connections to existing PVC pipe requires the use of a long body style "wye" saddle and rubber gasket secured to the pipe using a solvent weld and double stainless-steel straps.

C. Secure connections to existing concrete or vitrified clay pipe requires the use of a PVC “tee” saddle and rubber gasket secured to the pipe with double stainless-steel straps. The service connection shall be encased in concrete.

D. Tracer wire shall be installed for all service laterals with wire box located near edge of right of way.

3.4.3 Manholes

All manholes shall be designed for H-20 traffic loading in accordance with AASHTO Specifications.

3.4.3.1 Cast-In-Place Concrete Bases

A. Cast-in-Place manhole bases shall extend a minimum of eight-inch (8") below the pipe invert and the overall outside base dimensions shall be one foot (1') greater than the outside diameter of the manhole barrel sections. The base shall be constructed of premixed concrete having a 28-day compressive strength of 3,000 psi, minimum. The concrete shall be composed of well-graded, well-washed, aggregate, ranging from sand to gravel one and one-half inches (1-1/2") in maximum diameter.

B. The mix shall contain five (5) sacks of Type II cement to the cubic yard and only enough water shall be used in the mix to give a slump test result of two-inches (2”). Air entrained in the mix when placed, shall be between 3% and 5%. Base reinforcing steel shall be in accordance with the "Standard Manhole" detail found in Section 5 of these Specifications.

C. Sewer lines and manhole block-outs shall be set before any concrete is placed and shall be rechecked for alignment and grade after the concrete pour, but before the concrete has set. Inlets and outlets to the manhole shall be located as indicated on the reviewed and signed Construction Plans.

D. All base deflectors shall be smooth and of the proper radius to provide a smooth flow transition. The concrete base shall be shaped with concrete hand tools and shall receive a hard steel trowel finish before the concrete sets.

E. The accumulation of water on the surface of the concrete due to water gain, segregation, or other causes during placement and compacting, shall be prevented as much as possible. Provisions shall be made for the removal of such accumulated water. Under no circumstances shall new concrete be placed in standing water.

F. When concrete placement is performed during cold weather, the temperature of the concrete mix shall not be lower than 50° F. When concrete is placed during hot weather, the temperature of the concrete mix shall not be higher than 90° F.

G. When concrete is placed on grade without the use of forms, the ground shall be moistened, or other provisions made to prevent the ground from drawing water from the concrete mix.

3.4.3.2 Precast Concrete Bases

A. Contractors shall obtain written permission from the District prior to installing precast manhole bases. Generally, precast bases are only allowed where construction of a cast-in-place base is impractical. An example of where precast bases may be used is where a new sanitary sewer line is proposed to tie-in to an existing line in a busy street intersection.

B. Material Specifications for precast bases are as follows:

1. Minimum 4000 psi concrete compressive strength within 48 hours of manufacturing using Type II cement.

2. All base and barrel sections shall be poured monolithically. Reinforcement shall include #4 bars on 12-inch centers.

3. All areas of seam tears, cracks and honeycombs shall be patched and resurfaced prior to final curing.

4. Prior to coring the pipe openings and installing the pipe connection boot, all exposed reinforcing shall be coated with coal tar or epoxy paint.

5. Pipe boots or gaskets are to be placed in the cored openings - and shall be Trelleborg Forsheda 910 Connector seal meeting all ASTM 923 requirements.

6. Inverts and benches shall be extended completely across the base with a 0.20' minimum drop across the manhole invert.

C. The Contractor shall place a minimum of six inches (6") of one and one-half inches (1-1/2") crushed rock under the structure for leveling and structural stability. Once the base is installed, the Contractor shall make the required pipe connections and place pipe bedding. Subsequent to placing the pipe through the Forsheda boot/gasket, the Contractor shall place a one-inch (1") thick bead of butyl rubber sealant Conseal CS-102 or CS-202 concrete sealant or equal between the pipe and the core hole.

D. The void area between the precast invert, benches, and pipe shall be filled with concrete/grout.

E. All key lock lifting holes shall be filled with grout prior to backfilling.

F. Manhole joints shall be wrapped with a ConSeal wrap, CS-212, or approved equal. Wrap shall be a minimum of 6-inches and applied with manufacturer's recommended adhesive.

3.4.3.3 Precast Barrel Sections

A. Precast concrete barrel sections are to be used for all sanitary sewer construction.

B. Minimum wall thickness shall be as follows:

4' I.D. Barrel = 5" Wall Thickness
5' I.D. Barrel = 6" Wall Thickness
6' I.D. Barrel = 7" Wall Thickness

C. Reinforcement shall be Grade 60 and for circumferential placement shall consist of one line of steel in compliance with ASTM C-478 latest revision and shall not be less than 0.12 square inches per linear foot in 4' I.D. manholes, and not less than 0.17 square inch per linear foot in manholes 5' I.D. and greater. Spacing of circumferential steel shall not exceed 6." All splices shall be welded or lapped not less than 40 diameters of wire.

D. Slabs shall be reinforced with two layers of steel with a minimum area of 0.12 square inch per linear foot in both directions in each layer. Openings in flat slabs shall be additionally reinforced with a minimum of the equivalent of 0.20 square inches of steel at 90°. Straight rods used to reinforce openings shall have a minimum length equal to the diameter of the opening plus 2." Covers shall be reinforced with two layers of steel with a minimum area of 0.12 square inches per linear foot in both directions in each layer.

E. Concrete curing for precast material shall take place in a steam curing chamber or other moisture-controlled environment for such time and at such temperature as may be needed to enable concrete to meet the minimum 3000 psi compressive strength requirement. Type II cement shall be used for all components.

F. Each manhole section shall be placed in accordance with the manufacturer's recommendations in a plumb position. A flexible plastic joint sealing compound (Ram-neck) shall be used between each manhole section and shall be continuous around the entire manhole section circumference. Ram-nek should be installed on the top and bottom joint at each joint. The eccentric cone and steps shall be located over the largest bench area. All exterior and interior joints shall be grouted.

G. Grout shall be applied to all joint surfaces in accordance with the manufacturer's mixing and application recommendations. All surfaces receiving grout shall be moistened before grout is placed. Grout shall have a troweled finish and shall be protected from a rapid moisture loss using a covering of wet rags or polyethylene sheets. The temperature of the grout and the surfaces receiving the grout shall maintain a temperature between 65° F and 85° F until the grout has set.

3.4.3.4 Pipe to Manhole Connection

All pipe to manhole connections shall be watertight flexible connections made with gasketed NPC Kor-N-Seal boots, manufactured by Trelleborg Pipe Seals Milford, Inc. With express permission of the District, cast-in-place A-Lok X-cel connection manufactured by A-Lox Products, Inc. can be used. For the connections to remain flexible, grouting shall be in compliance with manufacturer's recommendations. Non-shrink grout should be used to fill voids inside manhole at pipe connections.

3.4.3.5 Manhole Steps

Manhole steps shall be plastic steps manufactured by MA Industries, Inc., Model No. PS2-PF-DF (Double Face) made from copolymer polypropylene plastic with grade 60 steel reinforcement. Aluminum manhole steps are not allowed. Manhole steps shall not be used to lift manhole sections. No manhole step shall be greater than 18-inch from the ring and cover.

3.4.3.6 Ring and Covers

A. The castings should not weigh less than 400 pounds and should conform to ASTM A-48. Ring and covers shall be Denver Light Pattern Cast Iron in areas of no vehicular traffic and Denver Heavy Pattern Cast Iron in streets and highways.

B. Locking covers may be required in select locations designated by the District.

3.4.3.7 Flat Top Cover

Flat top covers shall only be used with written permission of the District. Flat covers shall be a minimum of 8" thick and designed to withstand a minimum H-20 traffic loading.

3.4.3.8 Interior Lining

All outfall manholes, drop manholes, or other manholes as determined by the District, shall have an interior lining. Coating material specifications and installation methods shall be submitted to the District for approval. Lining manufacturers shall be Quadex Geokrete with Epoxy liner, Sprayroq SprayWall or Spectrum, LLC SpectraShield.

3.4.3.9 Exterior Coating

Exterior joints of manhole structures shall be coated with a waterproof bituminous membrane, or equal. The membrane shall be applied after the joints are grouted and shall lap the joint a minimum of six inches (6"). In lieu of bituminous membrane, a contractor can use 6” Conseal Wrap or equal. The Contractor shall submit material specifications for the exterior coating to the District for review prior to construction.

3.4.4 Concrete Encasement

Encasements shall be constructed of concrete made from well-graded aggregate and Type II cement, having a minimum 28 day compressive strength of 3000 psi, slump of 2" to 4", and air entrainment of 3% to 5%. Reinforcement steel used in encasements shall be ASTM A36 steel.

3.4.5 Marker Post

Marker posts shall be three inch (3”) diameter steel posts, painted yellow, and filled with concrete. The appurtenance description, size, type, and distance from the post shall be stenciled directly on the marker post

3.4.6 Bedding Material

The pipe bedding, using either clean well-graded sand, squeegee or 3/4-inch gravel conforming to these Specifications shall be placed in the pipe zone and compacted to the requirements set forth in this Section. The following classes of bedding material are permitted:

1. Class A Bedding

Class A (Squeegee) bedding shall be used for the bedding of PVC sanitary sewer lines at depths of cover less than 16 feet. Class A (Squeegee) bedding shall be placed six inches (6") below the bottom of the pipe to a point twelve inches (12") above the top of pipe.

Class A (Squeegee) bedding material shall conform to the following limits:

Class A Bedding (Squeegee):

Sieve Size	Total Percent Passing by Weight
3/8”	100%
No. 200	0-3%

2. Class B Bedding

Class B bedding shall be reviewed for use by the District for bedding of PVC sanitary sewer main at depths of cover between 16 feet and 22 feet. Class B bedding shall consist of placing crushed aggregate, as defined below, from nine inches (9") below the bottom of the pipe to a point twelve inches (12") above the top of the pipe.

Class B bedding shall be clean crushed aggregate conforming to ASTM D 448 No. 67, as follows:

Class B Bedding:

Sieve Size	Total Percent Passing by Weight
1”	100%
3/4”	90%-100%
3/8”	20%-55%
No. 4	0%-10%
No. 8	0%-5%

3.5 CONSTRUCTION REQUIREMENTS

All excavations affecting or involving any part of the District System, and all work on Main Extensions, Taps, or other District facilities shall be performed in conformity with and are subject to the requirements and conditions set forth herein. Additional requirements and conditions may be found in “3.3 Engineering Design Criteria, Standards and References”. Contractor shall bring to the District’s attention should conflicting requirements be present.

3.5.1 Compliance

Contractor shall comply with all District, County, State and Federal Rules, Regulations and Technical Specifications.

3.5.2 Preconstruction Meeting

A. A pre-construction meeting must be arranged by the Contractor and held prior to the start of any work. The District, District's Engineer, Contractor, Developer, METRO and Adams County (if applicable) must be represented at this meeting, which will be held at the District office.

B. All Contractors must notify the District at least 48 hours prior to start of construction.

i. Schedule

The Contractor shall submit a Sanitary Sewer Line Schedule of Construction Phases to sequence construction, line abandonment, testing, sanitary sewer service reconnections, and temporary (if applicable) and permanent paving. This shall be submitted to the District's Engineer for review and approval prior to construction and reviewed during the pre-construction meeting. Schedules shall be updated on a weekly basis and distributed to District personnel.

3.5.3 Working Hours

The District working hours are from 7:30 am to 4:00 pm Monday through Friday. Any construction work that requires District personnel or a District Representative to be on site on weekends, holidays or before 7:30 am or after 4:00 pm Monday through Friday will be considered overtime work.

3.5.4 Permitting

The Contractor shall be solely responsible for determining and obtaining any and all permits required for the work from other governmental entities or agencies having jurisdiction and shall perform the work in accordance with any and all applicable ordinances, regulations, laws and order of, or permits issued by such entities or agencies.

3.5.5 Inspection

A. No work shall be backfilled, including bedding material above spring line of the pipe, until the construction has been inspected and approved for backfill by the District's authorized inspector, unless prior authorization has been obtained.

B. No observation or testing will be performed by the District on weekends or holidays without the express agreement of the District secured in advance.

C. The observations, testing and reviews performed by the District are for the sole and exclusive benefit of the District. No liability shall attach to the District by reasons of any observations, testing, or reviews required or authorized by these Specifications or Rules and Regulations, or by reason of the issuance of any approval or permit for any work subject to this section.

D. The District is not a guarantor of the construction Contractors' obligations and performance of contract.

E. The District is not responsible for safety in, on, or about the Project site, nor for compliance by the appropriate party of any regulations relating thereto.

F. The Contractor shall notify the District 24 hours prior to making any service connections so the District may be on-site to observe the connection. In the event the tap and service line are covered prior to District observation, it shall be re-excavated by the Contractor, and cleared allowing for visual inspection of the tap and main.

3.5.6 Design Revisions During Construction

A. Should the Contractor encounter field conditions that prevent construction to occur in conformance with the reviewed and signed plans, a meeting shall be scheduled by the Contractor with the District and the District's Engineer to discuss an alternative design. The Contractor's construction shall not deviate from the signed plans without the prior review of the District and the District's Engineer.

B. Changes agreed upon in the field without written approval from the District will be considered a no cost change. If changes are made in the field without District approval, those items will be removed at the expense of the Contractor.

3.5.7 Staging and Storage

A. All piping material and appurtenances shall be stored off the ground and protected from dirt and weather. No pipe shall be installed with dirt or debris in the line.

B. All materials shall be stored, at minimum, per the manufacturers' recommendations.

3.5.8 Construction Water

The Contractor shall make his own provisions to apply all water necessary for backfill compaction, line flushing and video, and any other purpose during construction. Water can be obtained from the District at no charge for District projects. The Contractor will provide a deposit for a hydrant meter. The deposit will be returned when the hydrant meter is returned to the District in satisfactory working condition. The Contractor will pay North Washington Street Water and Sanitation District a $2,000 DEPOSIT for a construction water permit.

3.5.9 Groundwater

When draining an existing water main, the sump and pumps will be adequate to keep the water level of the sump below the water mains so that it does not contaminate the water system. The sump should be a minimum of two feet below the bottom of the pipe. Rock should be installed to one foot below the bottom of the pipe. The District will make every effort to provide a complete shutdown of the existing system for tie ins. However, it should be expected that existing valves do not seal and

provisions should be made by the Contractor for leaking control valves at no additional expense to the District.

3.5.10 Contractor Responsibilities

The contractor shall assume full responsibility and expense for the protection of all public and private property, roads, curb, gutter, sidewalk, pedestrian ramps, cross pans. Curb cuts, driveway cuts, structures, water mains, sewers, utilities, utility appurtenances, etc. both above and below ground, at or near the site or sites of work, being performed under the contract, or which are in a manner in connection therewith.

3.5.11 Utility Coordination and Locates

A. The District will make available to the Contractor record drawings showing the location of its facilities in the vicinity of the work, but the Contractor shall be finally and solely responsible for determining the existence and location of all subsurface structures in such areas.

B. If a Contractor damages any District facilities during construction, they shall immediately notify the District and take such measures as may be reasonably necessary or appropriate to minimize damage to the District system, prevent the escape of water from the District System, and prevent and mitigate damage from the escaped water. The repair of damages may be performed by the District or a licensed District Contractor and the assessment of costs shall be passed on to the Contractor.

C. Any Contractor who damages District facilities shall indemnify and hold the District harmless against any and all claims for damage resulting there from, and shall indemnify and hold the District harmless against any and all claims for damage to any such structures or facilities.

D. Utility locates for newly installed pipe during construction shall be performed by the Contractor or representative of the Owner until initial acceptance is issued.

E. The Contractor shall assume full responsibility and expense for the protection of all public and private property, roads, curb, gutter, sidewalk, pedestrian ramps, cross pans, curb cuts, driveway cuts, structures, water mains, sewers, utilities, utility appurtenances etc., both above and below ground, at or near the site or sites of work being performed under the contract, or which are in any manner affected by the prosecution of the work or the transportation of work force and materials in connection therewith.

F. The location of existing utilities shown on the drawings is based on the best available information but is not to be construed as exact. During the design phase of the project the existing utilities were identified from existing plans and visible surface appurtenances. However, not all existing utilities were marked, and it will be the Contractor's responsibility to verify and protect all existing utilities during construction. If additional utilities are discovered during the construction that are not identified on the plans, this will not constitute a Change Order, and the Contractor shall include all cost for locations, crossing, and protecting all existing utilities for such work in the bid price.

3.5.12 Access to Properties

A. The Contractor shall insure that all residents have access from the Street to their property each night. When access to a resident's property cannot be maintained during normal working hours (weekdays), the Contractor must personally notify the affected residents 24 hours in advance of the closure.

B. The Contractor shall coordinate with any commercial and industrial properties. All properties must be accessible during working hours (weekdays) and the Contractor must personally notify the affected business 24 hours in advance of the closure.

C. Traffic plates and other H20 rated temporary access methods may be required to allow access.

D. Emergency access shall not be blocked at any time for any reason

3.5.13 Excavation

A. Excavation for pipelines, manholes and appurtenances shall be an open trench excavation to the depth required by the reviewed and signed Construction Plans. Alternative trenchless technologies are acceptable upon review during design or formal change to design review meeting.

B. All excavations shall be properly supported as required by OSHA or as required by State laws and municipal ordinances, and as may be necessary to protect life, property and the work.

3.5.14 Backfill and Compaction

A. The Contractor must give special emphasis to the backfill and compaction at manholes, pipe, appurtenances, sewer services and structures. The backfill shall be placed in horizontal layers not exceeding two feet in depth and shall be adequately moistened and thoroughly tamped with air or vibrator plate or jumping jack compactor. At a minimum, two density tests will be taken at every foot for manholes and one test taken at every foot for valves. All compaction will be initially observed by the District.

B. The contractor will be responsible for repairing or complete replacement of any deterioration or settlement of the pipe trenches and associated street surfaces. Notification of the required repair will be issued by the District. All costs of repairs and all liability, as a result of surface deterioration or settlement, shall be the responsibility of the Contractor. The Warranty Period shall be extended for the full period for the entire project to cover future settlement deterioration until the Project as a whole shows no signs of settlement deterioration.

C. All excavations at the end of the day shall be backfilled and compacted. The subgrade shall be protected per the County Standards.

D. Compaction tests shall be performed by a qualified testing laboratory at locations designated by the District. All expenses involved in these tests shall be borne by the Contractor or the Developer

E. Project Owner and contractor shall carry a two year warrant for compaction and backfill.

3.5.15 Bypass Pumping

A. The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for reconstruction. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. Complete backup bypass pump and lines shall be provided. Bypassing includes all mainlines and service line bypassing required.

B. Wastewater shall not be allowed to spill into storm drains, street gutters, or open excavations. Any spill that occurs must be taken care of properly and immediately. Contractor shall bear all cost associated with any spills

3.5.16 Sanitary Services and Replacement of Service Lines

A. The property owner is responsible for contacting the District before repairing a damaged sanitary sewer service line or sanitary sewer tap. Property owners are responsible for the repair from the tap at the sanitary sewer main to the building.

B. Repairs must be performed by a District permitted contractor and shall be inspected by a District representative prior to backfill. Materials used shall be in accordance with the "Section 3.4 Material Selection".

C. Spot repairs shall use two Shielded Ferncos at each connection. Tap repairs shall use a saddle tap with a water-resistant sealant between saddle and main. Tap shall be secured with stainless steel straps and concrete around tap repair.

D. Percussion shall not be allowed. A percussion tap is defined as breaking the existing pipe material out in a circular fashion using a hammer and chisel or similar method.

3.5.17 Final Grade Adjustments

A. Final grade adjustments shall be made using a minimum of four inches (4") of concrete grade rings. Concrete grade rings shall make up the riser section providing the riser section does not exceed twelve inches (12") vertically.

B. Brick courses and steel grade rings are not allowed for vertical adjustment. If the riser section exceeds the vertical limitation, the riser and eccentric cone section shall be removed and the appropriately sized barrel section added, followed by cone and grade ring replacement.

C. Slanted final grade adjustments, to account for street cross slopes, shall be made using brick chips and cement mortar.

3.6 SYSTEM TESTING AND ACCEPTANCE

3.6.1 Low Pressure Air Test

A. Low pressure air tests in accordance with the latest version of UNI-BELL, UNI B-6 Specification, shall be used for testing of sewer lines. Tests shall be performed with suitable equipment specifically designed for air testing sewers.

B. Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. Plug the line at each manhole and all service connections with suitable test plugs. As a safety precaution, pressurizing equipment may include a regulator or relief valve set at 10 psi maximum to avoid over pressurizing and damaging an otherwise acceptable line.

C. Add air slowly until the internal air pressure of the sewer line is raised to four (4) psi gauge. At least two (2) minutes shall be allowed for the air temperature to stabilize before readings are taken and the timing is started.

D. When the pressure has stabilized between 4.0 psig and 3.5 psig, commence the test to determine the amount of time for pressure to drop by 0.5 psig. The test shall pass if the pipe pressure does not drop by more than 0.5 psig from the initial pressure reading within the time requirement indicated in UNI-B-6-98.

E. Refer to Uni Bell, UNI B-6 Specifications for testing when groundwater is present.

F. Water testing can be conducted as an alternative. A water column can be used to simulate a 4.0 psi pressure at the highest point of the sanitary sewer main.

3.6.2 Vacuum Testing Manholes

A. The District reserves the right to require a vacuum test on all new manholes installed, particularly in areas where the groundwater level is high or where there are questions regarding the integrity of the new barrel sections. All manholes shall be vacuum tested in accordance with ASTM C1244. All lift holes and any pipes entering the manhole shall be plugged prior to a vacuum being drawn and the drop over a specified time determined. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations. A vacuum of 10 inches (10") of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to nine inches (9") of mercury. The manhole shall pass if the time for the vacuum reading to drop from 10 inches (10") of mercury to nine inches (9") of mercury meets or exceed the values indicated below

3.6.3 Video Inspection

A. Upon completion of the sanitary sewer work and prior to any testing, the lines shall be thoroughly flushed and jetted to remove any debris, dirt, or other foreign matter. The lowest manhole (or manholes) within the project shall be plugged with a watertight plug on the

downstream outlet of the manhole and all water, silt and debris shall be pumped from within this manhole and disposed of properly.

B. After cleaning the new sanitary sewer, the Contractor shall perform and supply the District with a copy of the PACP TV inspection. TV inspections shall be performed by a PACP certified inspector and use an approved PACP scoring version. During the inspection, the contractor will dump water down the sanitary main, maintaining a small stream of water. The maximum dip or sag shall not exceed three-eighths of an inch (3/8") or an increase in water level of ten percent (10%). The Contractor will pump water out of the downstream manhole and dispose of the water at a District approved manhole.

C. Following TV inspections, Contractor will make any necessary repairs that have been identified. The sanitary sewer main will then be re-cleaned and a new TV inspection performed. If the TV inspections are determined to be acceptable by the District, the work will be eligible for initial acceptance.

D. Any infiltration in the sanitary sewer main or manhole must be repaired by the Contractor.

3.6.4 Lamp Test

Each section between manholes will be lamped by a District representative. Contractor shall furnish suitable assistance. A minimum of 75 percent (75%) of a true circle will be required in the lamp test to indicate a properly constructed sewer line. Any section not passing the lamp test must be repaired.

3.6.5 Pipe Deflection Test

a) No sooner than 30 days after placement and compaction of backfill, but prior to placement of permanent surface materials, clean and mandrel each line to detect obstructions (deflections, joint offsets, lateral pipe intrusions, etc.)

b) Use a rigid mandrel with diameter of at least 95 percent (95%) of the pipes specified average inside diameter and a length of the mandrel circular portion at least equal to the nominal pipe diameter

c) Maximum allowable deflection is 5 percent (5%) of the base internal diameter. Mandrel outside diameters in inches are as follows:

Pipe Size	Base I.D.	Mandrel O.D.
6	5.792	5.50
8	7.764	7.38
10	9.711	9.23
12	11.558	10.98

d) Pull the mandrel through the pipe by hand.

e) Relay or replace all pipe exceeding the 5 percent (5%) deflection at no additional cost to the Owner.

f) Retest repaired sections.

g) Maximum allowable deflection at end of one-year correction period, 7-1/2 percent of the base internal diameter tested.

3.7 GENERAL NOTES

1. All materials and workmanship to be in conformance with the standards and materials specifications of the North Washington Street Water and Sanitation District (NWSWSD).
2. All lines shall be laid under full time construction observation of the NWSWSD. The Contractor shall notify the NWSWSD at (303) 288-6664 at least 48 hours prior to the start of construction. The Contractor shall also schedule a pre-construction conference with the District, to be held at least 48 hours prior to the start of construction.
3. Sewer pipe and fittings shall be polyvinyl chloride pipe (PVC), meeting the requirements of ASTM D3034, and thickness requirements of SDR-26. As noted on the drawings. Provisions must be made for contraction and expansion at each joint with a rubber ring and integral thickened bell as part of each joint.
4. Concrete for manhole bases shall have a 28-day compressive strength that is no less than 3,000 psi. All reinforcement required shall be standard deformed reinforcement conforming to the requirements set forth in ASTM, Grade 60.
5. Sewer service line shall connect to the sewer main at either a wye.
6. A gasket joint shall be provided with 12 inches (12”) of the manhole wall, where the pipe enters/exits the manhole.
7. All pipe shall be bedded with no. 67 coarse aggregate (AASHTO m 43). The bedding zone shall extend from 6 inches (6”) below the pipe invert to 12 inches (12”) above the pipe crown.
8. Contractor shall obtain a permit from Adams County for work in the County Right of Way. It shall be the Contractor’s responsibility to pay all fees and abide by the requirements of the County.
9. Any existing service outages are required to be scheduled with customers 48 hours in advance and shall not exceed 4 hours in duration.
10. Except for the above scheduled outages, the Contractor shall provide bypass pumping pipe isolation plugs and required piping to maintain existing sanitary sewer service at all times.
11. Contractor shall include compaction testing in his pipe prices.
12. Manholes shall be lined/coated with corrosion protection polyurethane material. North Washington Street Water and Sanitation District indicates either SpyayRoc or Spectra Shield. Existing manholes with proposed connection shall be lined with a structural integrity polyurethane liner.
13. All sewer pipelines shall be flushed and televised before final acceptance. Video tape shall be given to the district for review prior to issuing substantial completion. Debris shall be captured in downstream manhole. It is prohibited for debris from flushing to enter the districts sanitary sewer system.

4.0 BILL OF SALE AND WARRANTY PERIOD

BILL OF SALE

KNOWN ALL MEN BY THESE PRESENTS that _____, a _____ ("Grantor"), for and in consideration of Ten and No/100 Dollars ($10.00) and other good and valuable consideration, the receipt of which is hereby acknowledged, paid by the North Washington Street Water and Sanitation District, a quasi-municipal corporation and political subdivision of the State of Colorado, whose address is 3172 E. 78th Avenue, Denver, Colorado 80229 (the "District"), does hereby bargain and sell, and by these presents, does grant and convey unto the District, its successors and assigns, all of its right, title and interest in the improvements and related appurtenances thereto described on the "As-Built" construction plans signed under seal of _____, Civil Engineer, on _____, attached hereto and incorporated herein by this reference as **Exhibit A** (the "Improvements").

TO HAVE AND TO HOLD the same unto the District, its successors and assigns forever; Grantor, its successors and assigns, shall warrant and defend the sale of said Improvements made unto the District, its successors or assigns, against all and every person or persons whomsoever, and warrants that the conveyance of the Improvements to the District, its successors or assigns, is made free from any claim or demand whatsoever;

FURTHER, Grantor warrants that the Improvements were designed and constructed in a workmanlike and good manner in accordance with the approved plans and specifications and in compliance with all applicable laws, rules and regulations relating to the Improvements; that the Improvements are free from defects in design, construction and material; and that the Improvements are on stable footing and there is no known danger of harmful subsidence or shifting.

FURTHER, Grantor hereby certifies the following:

1. That the Improvements have been constructed in proper easements or public rights-of-way, if applicable;

2. That Grantor has thoroughly reviewed all plans, notes, and specifications, examined the project site where the Improvements are located and ascertained all soil, geological, ground water, and other conditions to be encountered which may affect the construction and future maintenance of the Improvements;

3. Engineer certificates as to appropriate construction have been provided to the District;

4. No liens were filed for non-payment to contractors or other service providers;

5. The District has complied with all requirements pursuant to Section 24-91-103 and Section 38-26-107, C.R.S., regarding final settlement and payment to Grantor;

6. All warranties associated with the Improvements are hereby assigned to the District.

FURTHER, Grantor hereby acknowledges and agrees that Grantor will be responsible for a period of twelve (12) months from the date of initial acceptance of the Improvements by the District to repair or replace any defects or failures resulting from the work of Grantor, its contractors, or agents existing in the Improvements and any related facilities and appurtenances that are proposed to be conveyed in conjunction

with this Bill of Sale regardless of any warranty by third parties. Grantor shall provide District herewith a warranty bond for the 12 months following the initial acceptance in form acceptable to the District.

FURTHER, Grantor hereby waives any and all rights to file mechanics' or materialmans' liens against the Improvements or any portion thereof.

FURTHER, Grantor, on its behalf and on behalf of its successors, assigns, agents, guests and invitees shall release, indemnify, defend and hold harmless the District from any and all liability associated with Grantor's, or any other person's or entity's, loss, injury or damage to property and any claim arising therefrom, present or future, known or unknown, in connection with the District's accepting, holding or otherwise using the Improvements, or in connection with the design, construction, installation, or makeup of the Improvements including, but not limited to failure of the Improvements, or soil subsidence and/or loss of lateral or subjacent support to landscaping, pavement, retaining walls and/or building foundations affected by the location, design or construction of the Improvements as caused by or attributable to Grantor's action or inaction related thereto.

IN WITNESS WHEREOF, Grantor, by and through its authorized representatives, hereby executes this Bill of Sale as of this ____ day of _____, 20___.

_____,
a _____

By: _____

Name: _____

Its: _____

STATE OF _____)
) ss.
COUNTY OF _____)

The foregoing instrument was acknowledged before me this _____ day of _____, 20___, by _____, as _____ of _____, a _____.

WITNESS my hand and official seal.

_____
Notary Public

My commission expires: _____

Date of conditional acceptance and start of twelve (12) month warranty period:

_____

_____

District Engineer

NORTH WASHINGTON STREET WATER AND SANITATION DISTRICT

_____

District Manager

Date of Final Acceptance:

_____

_____

District Engineer

NORTH WASHINGTON STREET WATER AND SANITATION DISTRICT

_____

President

ATTEST:

_____

Secretary

EXHIBIT A

5.0 DISTRICT PLAN REQUIREMENT CHECK LIST

5.1 GENERAL REQUIREMENTS:

h) Drawings shall be at full scale 22” x 34” and half scale at 11” x 17”

i) Vicinity Map

j) Location Map

k) Index to Drawings

l) List of Quantities

m) List of agencies, including surveyor, soils engineer, and all involved agencies for the project

n) General Notes

o) Professional Engineer, State of Colorado, seal and signature on every sheet

p) North arrow on vicinity map, location map and each plan view

q) Title block on each sheet

r) Benchmark, including USGS datum, location, elevation, and monument type

s) Street alignment, existing and proposed, shown on overall plan

t) Street Names

u) Horizontal curve data for street centerline and all curbs shown on plans, or recorded plat included in plan set

v) Street grades, existing and proposed shown on profile

w) Typical street cross-section

x) Street addresses for all lots and/or buildings indicated on plan, or address plat included in plan set

y) Lot and block numbers

z) Property, easement, and tract lines shown on plan

aa) Private improvements identified

bb) Existing improvements identified

cc) Match lines and sheet references called out in plan and profile

dd) Street cross-pans shown

ee) Centerline of drainage channels shown

ff) 100-year flood plain limits shown

gg) Recorded plat and address plat submitted

hh) Project in conformance with overall sanitary sewer master plan

ii) Submit final plans in electronic format as .pdf or ACAD with finals plans for acceptance/signature.

jj) Upon approval of plans construction must begin within six months of signed approval. Projects exceeding six months may be granted conditional extensions for an additional six months. Any project which does not begin construction within a year of signed approval shall resubmit plans to District for review.

5.2 SANITARY SEWER REQUIREMENTS:

5.2.1 General

a) All sewer lines shown in both plan and profile

b) Manning formula hydraulic data including Q, V, D, d/D, S and n, indicated at connections to existing system. Number and type of units and per unit average and peak flows.

c) Sewer easement drawings and legal descriptions submitted with Professional Land Surveyor, State of Colorado, seal and signature affixed.

d) Sanitary sewer system notes included

e) Sanitary sewer system details included

f) Service wye locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, right or left side connection looking upstream and the invert of the main at wyes and plugs shown in tabular form on the plans.

5.2.2 Sewer Plan View

a) Scale 1” = 50’ minimum

b) Pipe size and material called out

c) Bearings and linear footage between manholes called out along sewer reach

d) Outside angles between sewer reaches called out at manholes

e) Sewer lines dimensioned from street centerline or property line, and form other utilities, curb and gutter, and other obstructions

f) Connections to existing system shown on plan and tied to property corner or section corner

g) Manholes properly numbered on plan

h) Directional flow arrows shown

i) Service line connections shown

j) Easements must be an “out lot” or contained on one property

k) At least a 10’ workable easement margin on each side of the sewer line

l) Manhole markers included for sewer line outside of paved ROW

m) Match lines and sheet references

n) All utility improvements, including water lines and storm sewer, shown on plans

5.2.3 Sewer Profile View

a) Scales: 1" = 50' min (Horizontal)

b) 1" = 5' vertical

c) Manholes properly numbered and stationed

d) Pipe size, linear footage and grade called out between manholes

e) Sewer line grades checked

f) 1% minimum slope on dead-end mains

g) Invert elevations for all entering and existing pipes, rim elevations, cuts and drop inverts called out at the manholes

h) Sewer service table or other notations showing lot number, station from downstream manhole, invert of sewer main oat service and left or right-side service included

i) Inside manhole drop between inverts of highest entering pipe and lowest existing pipe not to exceed 18"

j) Connections to existing system shown on profile

k) Crossings with other utilities shown on profiled (18" minimum edge to edge separation)

l) Match lines and sheet references

m) Dead end manholes should have a full invert through the manhole. Either note the requirement or call for an "Invert In" to note this.

5.3 WATER LINE REQUIREMENTS

5.3.1 General

a) All water lines shown in both plan and profile.

b) Water easement drawing and legal descriptions submitted with Professional Land Surveyor, state of Colorado, seal and signature affixed. Easement and legal descriptions shall meet Denver Water's requirements.

c) Water system notes included

d) All notated Denver Water details must be included in the plan set

e) Signature of Fire Marshall on cover sheet with required fire flow

f) Service tap locations, including size, building served, shown on as-builts

5.3.2 Water Plan View

a) Scale: 1" = 50' minimum

b) Pipe size and material called out

c) All valves, fittings, fire hydrants wet taps, thrust blocks, length of restraint, blow-offs and other appurtenances called out

d) Water line linear footage between valves, fittings and appurtenances called out

e) Radius of deflected water line called out.

f) Water lines dimensioned from street centerline or property line, and from other utilities, curb and gutter and other appurtenances

g) Connections to existing system shown on plan and tied to property corner or section corner

h) At least a 10' workable easement margin on each side of the water line.

i) Valves located at property line extensions. Valves required to isolate all fire hydrants, both ends of a water line through an easement or creek crossing and spaced to minimize the number of units put out of service during water line maintenance and repair work

j) Valves and fittings markers included for waterline

k) Fire lines called out

l) PRV size and inlet and outlet pressures shown

m) Match lines and sheet references

n) All utility improvements including sanitary sewer and storm sewer, shown on plans.

5.3.3 Water Profile View

a) Scales: 1" = 50' min (Horizontal)

b) 1" = 5' vertical

c) Water line stationed

d) Pipe size, linear footage and grade called out between grade breaks

e) Water line grade checked.

f) Top of pipe elevations called out at all grade breaks, fire hydrants, blow offs, air and vacuum valves, plugs, connections to existing water system and match lines.

g) 4.5' minimum cover from finished grade to top of pipe

h) 6.5 minimum cover for air and vacuum valve vaults

i) Restrained pipe length shown on profile

j) Connections to existing system shown on profile

k) Crossing with other utilities shown on profile (18" minimum separation from outside of pipe to outside of pipe)

l) Match lines and sheet references.