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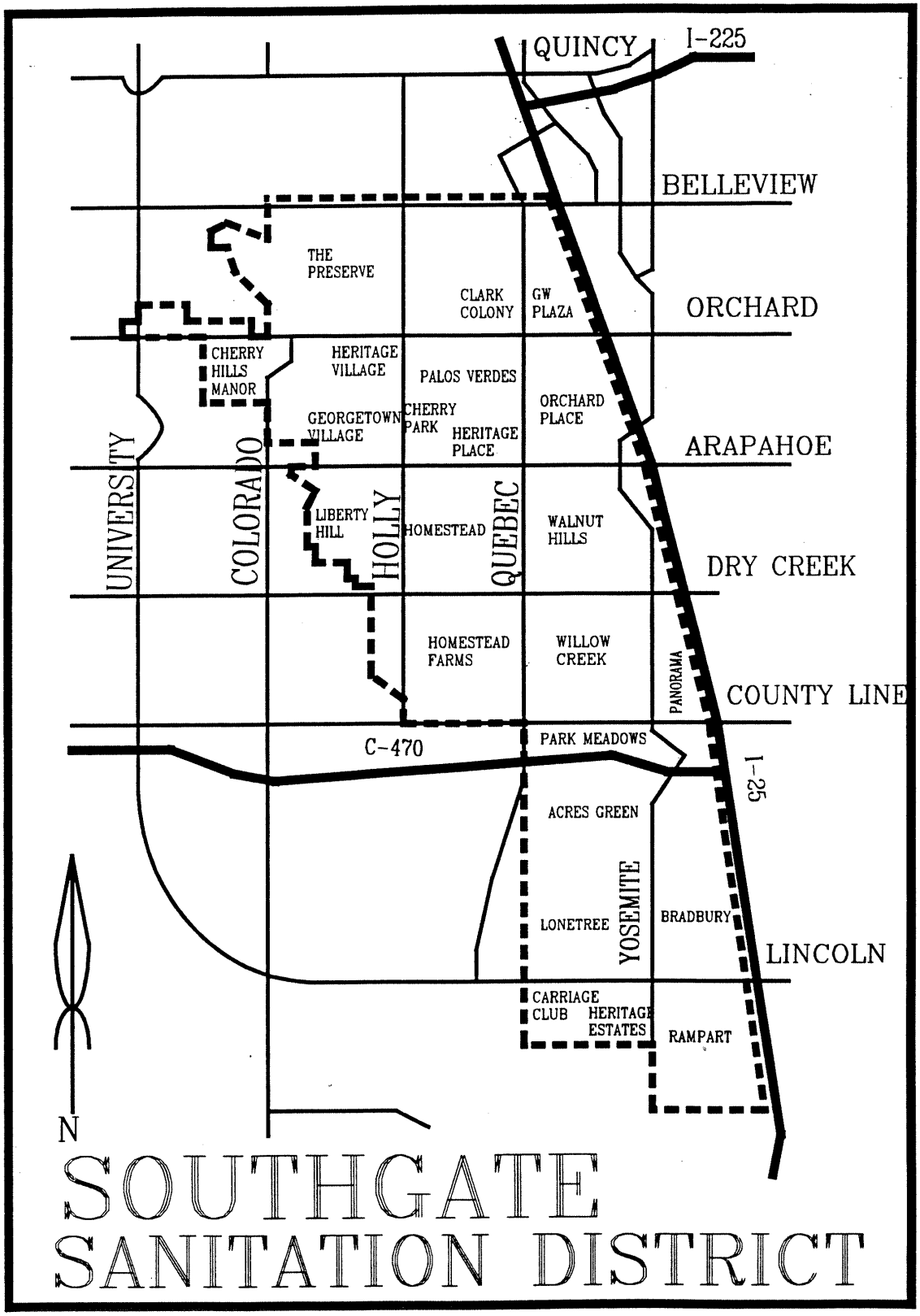
QUINCY
I-225
BELLEVIEW
ORCHARD
ARAPAHOE
DRY CREEK
COUNTY LINE
LINCOLN
THE PRESERVE
CLARK COLONY
GW PLAZA
CHERRY HILLS MANOR
HERITAGE VILLAGE
PALOS VERDES
GEORGETOWN VILLAGE
CHERRY PARK
HERITAGE PLACE
ORCHARD PLACE
UNIVERSITY
COLORADO
LIBERTY HILL
HOLLY
HOMESTEAD
QUEBEC
WALNUT HILLS
HOMESTEAD FARMS
WILLOW CREEK
PANORAMA
C-470
PARK MEADOWS
I-25
ACRES GREEN
YOSEMITE
LONETREE
BRADBURY
CARRIAGE CLUB
HERITAGE ESTATES
RAMPART
N
SOUTHGATE
SANITATION DISTRICT

SECTION 1 - GENERAL

1.1 PURPOSE

These specifications set forth District regulations, engineering, design, and materials specifications and construction procedures for all sewer facilities intended to become a part of the District System, and for privately owned sewer facilities connected thereto, to the extent regulated hereby. These Specifications may be purchased at the Southgate Sanitation District office, located at 3722 E. Orchard Road, Littleton, CO 80121, at cost.

1.2 DISTRICT SERVICE AREA

The Southgate Sanitation District Service Area consists of approximately 9,900 acres located in both Douglas and Arapahoe Counties, Colorado. Generally, the District is located south of Belleview Avenue and West of Interstate Highway I-25. The District's Service Area is more particularly shown on the District Service Area Map found on the preceding page.

1.3 AUTHORITY

These Specifications shall be administered by the District, and all matters involving the interpretation and enforcement hereof shall be finally determined by the District.

1.4 REVISIONS

These Specifications are effective as of June 13, 1995. Revisions to these Specifications may be made from time-to-time by the District and shall be in effect at the date of issuance by the District. Any person using these Specifications should contact the District for information relative to revisions.

1.5 DEFINITION OF TERMS

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

1.5.1 ACTUAL COSTS

All direct and indirect costs attributable to any project or undertaking. Actual costs to the District shall include its engineering, legal, labor, material, equipment, administrative, and overhead expenses, calculated in accordance with the rates set forth in Appendix 1 to Article 7 of the Rules and Regulations, and all direct payments to third parties, at cost.

1.5.2 BOARD OR BOARD OF DIRECTORS

The duly constituted Board of Directors of the District.

1.5.3 CONTRACTOR

Any person who performs any work, either for himself or another, on any sewer facilities, public or private, within the District, including all subcontractors, agents, employees, officers and other representatives of such person.

1.5.4 CONSTRUCTION PLANS

Plans and Specifications for the construction of a specific sanitary sewer system project which have been reviewed and signed by the District.

1.5.5 DISTRICT

Southgate Sanitation District, Arapahoe and Douglas Counties, Colorado, its employees, agents, officers, directors, insurers, and professional consultants.

1.5.6 DISTRICT ENGINEER

The District's Staff Engineer.

1.5.7 DISTRICT MANAGER

The Manager of the Southgate Sanitation District appointed by the Board of Directors, or any other person duly authorized to perform the duties of the District Manager.

1.5.8 DISTRICT SYSTEM

The Plant, facilities, systems, assets, and appurtenant property rights owned or directly controlled by the District, but excluding all privately-owned sanitary sewer facilities.

1.5.9 ENGLEWOOD

The City of Englewood, Colorado, for itself and as operator and co-owner of the Bi-City Treatment Plant.

1.5.10 FOREIGN MATERIALS

Objects or substances not appropriate for transmission by a sanitary sewage system, including without limitation paving or construction materials, debris, furniture, appliances, clothing, bicycles, rocks, dirt, trash, grease, oil, sand, and grass, bush or tree clippings.

1.5.11 MAIN OR SEWER MAIN

Those pipes and appurtenant facilities used for carrying wastewater along public streets or easements or rights of way deeded or licensed to the District.

1.5.12 MAIN EXTENSION

The construction of any facilities, or the facilities themselves, which are intended to become a part of the District System upon acceptance by the District in accordance with Article 6 of the Rules and Regulations.

1.5.13 PERMITTED PREMISES

The land area and improvements thereto to which sewer service is limited under any particular Tap Permit.

1.5.14 PERSON

Associations, corporations, firms, partnerships and bodies politic and corporate, as well as individuals.

1.5.15 PROPERTY OWNER/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 person only in connection with his ownership of any specific parcel of real property involved in any specific matter governed by these Specifications or Rules and Regulations. For purposes of clarity, the masculine singular pronoun is used in these Specifications to refer to Property Owner.

1.5.16 RECORD OR AS-BUILT DRAWINGS

A separate set of full-scale construction plans marked to indicate completely and accurately the field-installed condition of facility construction in progress, as required by Section 3.11 of these Specifications.

1.5.17 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.

1.5.18 SERVICE LINES

Any sewer lines or portions thereof located upstream from the upstream end of the wye or saddle fitting on the District's Main, and intended or used to convey wastewater from Permitted Premises to the District System.

1.5.19 SEWAGE

See Wastewater paragraph 1.5.24.

1.5.20 SWIMMING POOL DISCHARGE

Wastewater from any swimming pool carried by the District System, including swimming pool filter backwash effluent and water drained directly from the swimming pool itself.

1.5.21 TAP OR SERVICE CONNECTION

The physical connection to a District Main which, together with the Tap Permit for same, effects sewer service to any Permitted Premises.

1.5.22 TAP PERMIT

The written authority to make a Tap for sewer service to Permitted Premises from the District System.

1.5.23 USER

Any person who discharges or causes the discharge of wastewater to the District System.

1.5.24 WASTEWATER OR SEWAGE

The combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants and institutions, including polluted cooling water.

A. Sanitary Wastewater. The combination of liquid and water-carried wastes discharged from toilet and other sanitary plumbing facilities.

B. Industrial Wastewater. The combination of liquid and water-carried wastes discharged from any industrial establishment and resulting from any trade process carried on in that establishment, including the wastewater from pre-treatment facilities and polluted cooling water.

1.5.25 WASTEWATER UTILITY ORDINANCE

Chapter 2, Title 12 of the Englewood Municipal Code.

1.6 ABBREVIATIONS

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

AASHTO - American Association of State Highway and Transportation Officials
ACI - American Concrete Institute
AISC - American Institute of Steel Construction, Inc.
ANSI - American National Standards Institute, Inc.
ASA - American Standards Association
ASTM - American Society of Testing Materials
ASCE - American Society of Civil Engineers
AWWA - American Water Works Association
OSHA - Occupational Safety Health Administration
UL - Underwriter's Laboratories
UNI - Uni-Bell Association
UPC - Uniform Plumbing Code

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SECTION 2 - SANITARY SEWER DESIGN CRITERIA

2.1 GENERAL

All sanitary sewer lines, manholes, service connections, and related public facilities within the Southgate Sanitation District shall be designed in accordance with these Specifications. Any deviation from these Specifications 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.

2.2 PLAN REQUIREMENTS

Construction plans for sanitary sewer system shall meet the guidelines set forth in the Sanitary Sewer System Plan Requirements Check List and General Notes for Sanitary Sewer System Plans found in the Appendix. The check list and general notes are guidelines and as such, some items may not be applicable to all projects as determined by the District.

2.3 FLOW DEVELOPMENT CRITERIA

Sanitary sewer lines shall be designed to transport average and peak sewage flows in accordance with these Specifications. Average and peak flow development criteria presented in following Table 2.1 are minimum criteria, and the District reserves the right to modify flow criteria, at any time, for the design of specific projects. Flow development criteria for proposed uses not shown in Table 2.1 (i.e. car-wash, laundries, auto service stations, supermarkets, places of assembly, hospitals, etc.) shall be determined by the District on a case by case basis using generally accepted planning criteria.

Peak sanitary sewer flows shall be calculated as follows:

Peak Flow = (Avg. Flow x Peak Factor) + Infiltration/Inflow

Infiltration and inflow is estimated to be ten percent (10%) of the Average Flow.

Peak factor for developments with population larger than 3,000 shall be determined using "Curve A" presented in Figure 4 of the ASCE-Manuals and Reports on Engineering Practice No. 37, "Design and Construction of Sanitary and Storm Sewers."

The formula or "Curve A" is as follows:

$$\text{Peak Factor} = 10^{(\log(5) + 0.6051 - 0.2017 \log(\text{population}))}$$

TABLE 2.1 FLOW DEVELOPMENT CRITERIA

USE	OCCUPANCY	AVERAGE DAILY SEWAGE FLOW	PEAK FACTOR
Single-Family	3.5 Persons	100 GPCD	4.0
Townhome	2.5 Persons	100 GPCD	4.0

Multi-Family	2.1 Persons	100 GPCD	4.0
Retail/Commercial	N/A	0.3 GPD/SF	2.5
Office	N/A	0.1 GPD/SF	2.5
Elementary School	700 Students/Staff	10 GPCD	4.0
Middle School	1070 Students/Staff	10 GPCD	4.0
High School	2470 Students/Staff	10 GPCD	4.0
Restaurants	N/A	1.5 GPD/SF	4.0

ABBREVIATIONS

GPCD	Gallons Per Capita Per Day
GPD/SF	Gallons Per Day Per Square Feet Developed Floor Space
N/A	Not Applicable
SF	Square Feet Developed Floor Area
Single-Family	Detached Single-Family Residential Dwelling (Owned)
Multi-Family	Attached Single-Family Residential Dwelling (Rented)
Townhome	Attached Single-Family Residential Dwelling (Owned)

2.4 SANITARY SEWER SYSTEM HYDRAULIC DESIGN CRITERIA

2.4.1 GENERAL

The sanitary sewer system shall be designed to transport average and peak sewage flows in accordance with these Specifications, and shall prevent deposition of suspended materials within the system.

2.4.2 SANITARY SEWER LINES

No public sanitary sewer line shall be smaller than eight (8) inches in diameter. Sanitary sewer lines shall be designed to provide peak flow velocities between two (2) feet per second (fps) minimum and ten (10) feet per second (fps) maximum using Manning's Formula as follows:

$$V = 1.49/n \; R^{2/3} \; S^{1/2}$$

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 = 0.013

The maximum design flow depth at peak flow shall not exceed 83% of the internal pipe diameter (i.e. d/D = 0.83, ratio flow depth to internal pipe diameter).

Hydraulic characteristics shall be calculated for each reach of the sanitary sewer system to show conformance with these Specifications. Table 2.2 outlines minimum and generally acceptable maximum slopes for sanitary sewer lines as follows.

TABLE 2.2

Nominal Pipe Diameter (Inches)		Minimum Slope (Ft/100 Ft)	Maximum Slope At d/D = 0.83 (Ft/100 Ft)
4	(Service)	2.0	20.0
6	(Service)	1.0	12.0
8		0.50	10.0
10		0.35	6.0
12		0.25	4.0
15		0.20	3.0
18		0.20	2.2

It should be noted that the maximum slopes are based on d/D = 0.83. As flow depth decreases, the allowable maximum slope may also increase, as long as velocities do not exceed 10 fps. The minimum slopes indicated are absolute minimums.

All dead end sanitary sewer lines (i.e. cul-de-sacs) shall have a minimum slope of one percent (1%).

Construction plans shall develop and show average flows, peak flows, and other information at all points of connection to the existing sanitary sewer system as follows:

QPEAK	-	Peak Sanitary Sewer Flow
QAVG	-	Average Sanitary Sewer Flow
VPEAK	-	Peak Flow Velocity
VAVG	-	Average Flow Velocity
dPEAK	-	Peak Flow Depth in Line at Point of Connection
dAVG	-	Average Flow Depth in Line at Point of Connection
d/DPEAK	-	Ratio of Peak Flow Depth to Inside Pipe Diameter
S	-	Slope of sanitary sewer line
n	-	Manning's "n" = 0.013
PF	-	Peak Factor Per Table 2.1
Development	-	Number and type of total ultimate planned units tributary to the point of connection.

Sanitary sewer system layout shall provide a system of lines which generally increase in diameter from higher to lower areas within the basin. Once a line size is increased at any point in the system, it shall not be reduced in size at any downstream location, regardless of available line slope.

2.4.3 MANHOLES

Manholes shall be designed to promote smooth, continuous flow between adjacent reaches of sanitary sewer lines. The minimum drop from any pipe invert upstream and the pipe invert "out" shall be 0.2 feet. Where manholes are designed to collect flows from two or more incoming lines, the design "in" inverts shall be set to keep the largest incoming line (i.e. line contributing the largest flow) lower in the manhole than the other incoming lines. The other, generally smaller incoming line(s) shall enter the manhole a minimum of 0.1 Ft. higher than the invert of the largest

line. Maximum inside drop from upstream invert to downstream invert shall be twelve inches (12").

Where new lines are proposed to connect to the District's outfall lines, (i.e. lines 15-inches in diameter or greater), the crown of the incoming line shall match the crown of the outfall line.

Manholes shall have a minimum inside diameter of four (4) feet. Manhole sizing for various line sizes and multiple inlet configurations is presented on the "Standard Manhole" construction detail, found in Section 5 of these Specifications.

Sanitary sewer lines shall be designed so the angle between any upstream line and the downstream line is 90o, minimum.

2.5 SANITARY SEWER SYSTEM LOCATION AND ALIGNMENT

2.5.1 GENERAL LOCATION IN STREETS

Where sanitary sewers are located in the street right-of-way, they shall be designed to the following guidelines.

In streets running generally north and south, the sewer line shall be placed ten feet (10') west of the street centerline.

In streets running generally east and west, the sewer line shall be placed ten feet (10') south of the street centerline.

In streets which "meander" in each direction, the sewer line will conform to the above Specifications as near as is practical, but shall not "zig-zag" across the street centerline. A location shall be selected and shall be followed within the street. The final location shall be as determined by the District during plan review.

Curvilinear sewer mains are not allowed. Designs shall attempt to minimize the numbers of manholes. In no case shall the sewer line be designed closer than five (5) feet to the lip of a cross pan, or gutter, or ten (10) feet to any right-of-way line, or easement boundary.

The District will not permit construction of a project until all plats and rights-of-way to be dedicated that are related to the project are fully signed and recorded by the County.

2.5.2 GENERAL LOCATION IN EASEMENTS

Where sanitary sewer lines are proposed in easements, they shall be designed within the easement boundary to the following minimum requirements. Sanitary sewer easements shall be a minimum of thirty feet (30') wide and shall have legal descriptions and drawings prepared in accordance with these Specifications. Easement widths are subject to review by the District. Easements shall provide easy access to manholes by a tandem wheeled maintenance (jet) truck. Where easements straddle property lines, the sanitary sewer alignment shall be a minimum of ten feet (10') from one edge of the easement and a minimum of ten feet (10') from the property line. When selecting the location of utility lines within an easement, consideration shall be given to excavation, maintenance, and repair requirements. In no case shall the sewer line be designed closer than 10 feet to any easement boundary. Sewer lines in unpaved easements shall be AWWA C 900 Class

150 PVC, polyvinyl chloride pipe. Polyethylene Lined Ductile Iron Pipe (minimum Class 50) may also be used where permitted by the District.

A copy of the Grading Plan and Landscaping Plan showing the proposed conditions at the easements shall be submitted for review by the District. The maximum cross slope within easement boundaries shall be 4%. Landscaping, such as trees, bushes, rock gardens, etc., will not be allowed. Landscaping shall be either sod or gravel surface. Gravel surface is preferred. Fences parallel to the sanitary sewer alignment within the easement is not permitted. Fences perpendicular to the easement need to have a 12-foot removal section or gate for access by District.

2.5.3 EASEMENT LEGAL DESCRIPTIONS AND DRAWINGS

Easement legal descriptions and drawings shall be prepared under the direct supervision of a Professional Land Surveyor, Registered in the State of Colorado.

Legal descriptions and drawings shall be prepared on legal sized (8-1/2" X 14") paper, and shall be referenced to the nearest Section corner. 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. Easement traverse shall close within 1/10,000.

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

Easement legals shall bear a professional land surveyor (State of Colorado) seal and signature. The easement legal and drawing shall be included with the District's Standard Easement Deed. A sample copy of the Standard Deed is included in the Appendix. The District reserves the right to modify the conditions of the Easement Deed, at any time, for specific projects.

Legal descriptions and drawings should be submitted to the District for review along with a Title Insurance Commitment covering the subject right-of-way. A copy of each document listed in the Title Commitment must be included. Title Commitment must be prepared within the last 30 days of date of submittal to District. All expenses incurred in obtaining Title Insurance shall be paid by the Applicant.

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

2.5.4 RELATION TO OTHER UTILITIES

Sanitary sewer lines in streets and easements shall be designed to provide a minimum separation of ten (10) horizontal feet measured between the centerline of any water line or appurtenance and the sanitary sewer. Horizontal edge-to-edge separation with utilities other than water lines shall be five (5) horizontal feet minimum, and shall in all cases allow for future excavation of the sewer line without causing damage to the adjacent utility.

Where sanitary sewer lines are proposed to cross water lines or other utility lines, they shall be designed to cross at an angle close to ninety degrees (90o). Minimum vertical clearance between

the edge of sanitary sewer line and edge of the water line or other utility, shall be eighteen inches (18"), minimum. See Section 2.14.3 for additional requirements related to water line crossings.

2.5.5 DEPTH

Minimum depth of sanitary sewer lines shall be six feet (6') measured from the top of pipe to final street grade. Lines proposed to be constructed with less than six (6) feet minimum cover shall require written special permission by the District Manager. 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 improvements, structure, or foundation.

2.6 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. 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 drainage 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 erosion protection requirements. Review by the County and Urban Drainage and Flood Control District may be required.

2.7 MANHOLES

2.7.1 GENERAL

Manholes shall be provided at all changes in grade, changes in alignment, dead-end lines, and at junctions with other sanitary sewer lines. Manholes shall be installed on straight sections of line at distances not greater than 400 feet for sanitary sewers 15-inches in diameter or less, and 500 feet for sanitary sewers 18-inches in diameter or greater.

2.7.2 MANHOLE SIZE

All manholes shall have a minimum inside diameter of four feet (4'), or two feet (2') greater than the outside diameter of the largest pipe entering or leaving the manhole. The following Table 2.3 should be used as a guideline.

TABLE 2.3 MANHOLE SIZING

Two Way Manholes

Maximum Nominal Pipe Sizes	Minimum Manhole Inside Diameter
18" or Smaller	4'-0"
21" to 36"	5'-0"
42" and up	Sizing by District

Three and Four Way Manholes

Maximum Nominal	Minimum Manhole

Pipe Sizes	Inside Diameter
3-Way 8"	4'-0"
4-Way 8"	4'-0"
3-Way 12"	4'-0"
4-Way 12"	5'-0"
3-Way 18"	5'-0"
4-Way 18"	6'-0"

Three and Four way manholes/vaults having a pipe larger than 18" will require a special design by the Design Engineer. Such design will need to be reviewed by the District.

2.7.3 MANHOLE HYDRAULIC DESIGN

(See Section 2.4.3)

2.7.4 MANHOLE DEPTH

Minimum manhole depth shall be as required to provide six feet (6') of cover over the top of the upstream pipe. Maximum depth shall be reviewed and determined by the District on a case-by-case basis. Where the depth of a manhole is twenty feet (20'), or more from cover to invert, an intermediate platform may be required by the District to be located at the midpoint of the manhole in accordance with the "Intermediate Platform" construction detail found in Section 5 of these Specifications. The use of intermediate platforms will be at the District's discretion and will be reviewed on a case-by-case basis.

2.7.5 GRADE ADJUSTMENT

Manholes shall be constructed to permit grade adjustments by use of precast concrete adjusting collars or brick courses not to exceed a total height of twelve (12) inches. In open space areas, manhole rims shall be set four (4) inches above grade to prevent infiltration from surface runoff.

2.7.6 DROP MANHOLES

Drop manholes shall not be constructed where the sanitary sewer line design can be modified to provide the maximum inside drop of twelve inches (12"). Where this is not possible, and by special request of the District, drop manholes may be designed and constructed.

The design of drop manholes shall be in accordance with the "Drop Manhole" construction details found in Section 5. Maximum permitted outside drop shall be reviewed and determined by the District on a case-by-case basis.

2.7.7 SERVICE CONNECTIONS TO MANHOLES

Service connections directly to manholes are not permitted. Services which follow an alignment "behind" a dead-end manhole shall be connected to the system by means of a 5-foot stub of 8-inch main which is extended beyond the manhole and has a wye fitting for the service line. One (1) service connection is permitted at a dead-end manhole. The design and installation of a service connection at a dead-end manhole shall conform to the "Service Connection to Dead-End Manhole" construction detail found in Section 5.

2.8 SANITARY SEWER SERVICE CONNECTIONS

Sanitary sewer services shall be designed to transport the peak sewage flow from any residential or non-residential use to the sanitary sewer system. Services shall be sized by the Owner's Architect or Mechanical Engineer using the Uniform Plumbing Code (UPC) method, and shall be a minimum of four inches (4") in diameter. Service sizing calculations shall be submitted to the District for review whenever a new service line is proposed and whenever an existing service changes ownership or intended use. The District is not responsible for the sizing or adequacy of the service line to perform its intended use and assumes no responsibility for the service lines maintenance or operation.

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 sewer main at wyes and plugs shall be shown in tabular form on the plans. Sanitary sewer services shall be located a minimum of ten (10) feet from water services, typically on the downhill side of the water service.

Sanitary sewer service connections shall only be made to District mains in public streets. Service connections to District mains in easements shall be reviewed and approved by the District on a case-by-case basis.

2.9 CLEANOUTS

Cleanouts are not permitted on Southgate Sanitation District lines (i.e. lines 8-inches in diameter or greater). Cleanouts should be installed on 4-inch and 6-inch private service lines at the following locations: any change in direction requiring horizontal or vertical bends, every 100 feet of installed service line, and at other locations as required to clean the entire service line by rodding.

2.10 OIL, SAND AND GREASE INTERCEPTORS

2.10.1 GENERAL

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 the Owner's Engineer 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 around grease interceptors.

Facilities which discharge any quantities of sand, oil or other inert debris into the sanitary sewer service shall have a 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, at a minimum, based on the criteria outlined below. All calculations shall be submitted to the District for review. Construction, ownership and maintenance of the sand and oil interceptor shall be the Owner's responsibility. Bypasses are not permitted around sand and oil interceptors.

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. Construction details for sand, oil and grease interceptors may be found in Section 5 of these Specifications.

2.10.2 Engineering Review

Two (2) sets of plans and specifications, including complete mechanical and plumbing sections with interceptor detail and calculation shall be submitted to the District for review prior to construction. This submittal will be accompanied by a narrative explanation of the operation or process from which the interceptor will be receiving drainage. Interceptor designs must meet the criteria set forth in the following paragraphs and in accordance with the appropriate sections in the District's Rules and Regulations.

Drawings shall be submitted to the District indicating, but not limited to the following:

1) Building use and size, site layout, proposed service locations, size, alignment, grades and tie-in locations.
2) Service sizing calculations.
3) Proposed interceptor location with respect to the building, street improvements and landscaping.
4) Interceptor sizing and by-product rate of generation calculations.
5) Interceptor shop drawings.
6) Process description of system generating sand, oil or grease.
7) 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 installation uses a two (2) stage precast vault located outside the building, in accordance with the Oil & Sand Interceptor and Commercial Grease Interceptor details found in Section 5 of these Specifications.

2.10.3 Criteria

It is the Owner's and/or Owner's Engineer's responsibility to determine the adequate size of the interceptor. When determining the minimum size of interceptor required, the following criteria shall be observed.

(a)Common Provisions:

Grease interceptors shall conform to the "Commercial Grease Interceptor Detail," Drawing No. 26. The interceptor selection shall be based on the required capacity of the interceptor. If the interceptor must be installed within the building due to space limitations, prior written authorization must be obtained from the District. The basic formula for sizing grease interceptors is: (turnover rate) x (categorical use factor) x 2.5

(gallons of water) x (seating capacity). The categories and formulas for each type of establishment are as follows:

(b)Specific Category Criteria:

Category A - Restaurant/Cafaterias Full or limited service with the capability to serve or prepare 100 or more meals per day. Plumbing Fixtures: one pot sink, one 2- or 3-compartment sink, one hand sink, one mop sink, one floor sink, one dishwasher, one garbage disposal -- NOT CONNECTED TO THE GREASE INTERCEPTOR.

Equipment: one grill, one fryer, one to three ovens.

FORMULA:

2.0 x 1.0 x 2.5 x seating

Category A-1 - Same criteria as the previous category with the additions listed:

Plumbing Fixtures: The same as previously listed; however, the garbage grinder will be directed to the interceptor.

Equipment: The same as previously listed.

FORMULA:

2.0 x 1.25 x 2.5 x seating

Category A-2 - Same criteria as A-1 with the following additions and differences listed:

Plumbing Fixtures: For each additional garbage grinder and dishwasher that is to be directed to the grease interceptor, there will be a factor of .25 added to the Categorical Use Factor (C.U.F.).

Equipment: For each additional "Wok" stove, deep fryer and grill, there will be a factor of .50 added to the categorical factor.

Category B - This category is for hospitals, schools, institutions, and care facilities.

FORMULA:

Hospitals/Schools: 2.0 x .75 x 2.5 x bed usage or seating
Institutions/Care Facilities: 2.0 x 1.0 x 2.5 x seating or bed usage

These formulas will be adjusted by the following when necessary:

A value of .25 will be added to the Categorical Use Factor for each dishwasher or garbage disposal directed to the grease interceptor above the number of one each.

A value of .50 will be added to the C.U.F. for each additional deep fryer or grill above the number of one each.

Category C - This category encompasses deli stores with meat cutting facilities, supermarkets with meat cutting capabilities, and/or bakeries retail and wholesale bakery facilities and butcher shops.

FORMULA:

(hours of operation) x 4.0 x 10

For each of the following conditions, a factor of .50 is to be added to the C.U.F. value of 4.0 when dealing with meat cutting:

- More than one floor drain
- Complete cooking of meats

When dealing with retail type bakeries or supermarkets that have bakery facilities in addition to a deli and/or meat cutting, the bakery shall be sized separately using the same formula as above with the deletion of the .50 adjustment for the cooking of meats. There is an adjustment of an addition of 1.5 to the C.U.F. when dealing with bakeries that are wholesale only or are of the industrial classification.

Category D - This category is for food courts or "common" traps. Each case shall be sized by separating each of the potential contributors into its own category, then combining the operations for a total trap size.

Example: Mile High Food Court Tenants List: McDonalds, Taco Bell, Wong Le's Mongolian, Mrs. Fields Cookies, Little Caesars Pizza. McDonalds, Taco Bell, and Wong Le's would be sized using the formula applicable for Category A-2; Little Caesars could be sized by using Category A-1; and Mrs. Fields would use the formula for Category C.

Category E - Commissaries, commercial kitchens, and caterers must be sized on an individual case-by-case basis. However, it should be noted that the minimum acceptable size for a commercial kitchen shall be 1,500 gallons.

Category F - This category shall include all food manufacturing types. Each case is evaluated separately. Whenever a manufacturing operation is evaluated, it must be noted that a control manhole will be required in most cases in addition to a minimum of a 1,500 gallon grease interceptor.

Note: Seating capacity can be approximated, using 10 sq. ft. of dining area per person.

(c)Commercial oil and sand trap interceptors shall conform to the "Oil and Sand Trap Interceptor Detail," Drawing No. 25, unless the District has accepted an alternative.

(d)Oil and Sand Interceptor Sizing - The formula is: volume = (flow rate from building x 2.0 hours of retention time) x 2. The minimum size shall be 300 gallons.

2.10.4 CONNECTIONS

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

(b)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.

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

2.10.5 MINTENANCE

The responsibility of cleaning and maintaining the interceptor in efficient operating condition shall be the Owner's and/or lessee's responsibility. Grease interceptor shall be accessible and shall be inspected on a periodic basis by representatives of the District.

All sand, oil and grease interceptors must be pumped out at a maximum interval of every quarter year. Cost of pump out shall be at Owner's expense.

No testing will be performed by the District. The District does retain the right as allowed by Colorado State Statute, to review all interceptors during regular business hours, on an unscheduled basis, to determine if the unit is operating and being maintained on a regular basis.

2.11 INDUSTRIAL PRETREATMENT

Any development which generates industrial wastewater will be required to install a pretreatment process prior to the sewage effluent entering the public sanitary sewer system. It is the industrial Property Owner's responsibility to be in compliance with the City of Englewood's "Wastewater Utility Ordinance." The Owner is required to contact the City of Englewood/City of Littleton Bi-City Sewage Treatment Plant (phone no. 762-2600) to determine the type and degree of pre-treatment required.

2.12 UNDERDRAINS

For the purposes of this section 2.12, Under drains are defined as facilities and systems designed to collect and convey groundwater which may accumulate around building foundations.

Under drains shall not be installed within any sanitary sewer trench, public or private, without the express written consent of the District, and then only upon the terms and conditions stated herein.

Under drain systems are not part of the District system. The regulations, specifications and other requirements stated herein are solely to define the terms and conditions upon which Under drain systems may be allowed in public or private sanitary sewer trenches in the District, and any District plan review, plan acceptance, or construction observation relating to Under drains shall be for the sole purpose of ensuring the compliance of such Under drains with the conditions of any authorization for the same to be installed in sanitary sewer trenches.

Any Property Owner seeking District authorization to install an Under drain in a sanitary sewer trench in the District shall submit a written request therefore accompanied by an executed form of Under drain Agreement found in the Appendix. The District shall have sole, exclusive and unfettered discretion to deny or permit any proposed Under drain system to be constructed

beneath sanitary sewer facilities. Allowing any such Under drain is an accommodation to the Property Owner.

The Under drain shall be designed by the Owner's consulting engineer and shall observe the following guidelines to protect sanitary sewer facilities from adverse impacts from the Under drain.

•The under drain system shall be designed and constructed as a groundwater conveying system that is independent of the sanitary sewer foundation and bedding material.

•Sanitary sewer bedding shall not be used in the underdrain systems. An 8 mil polyethylene barrier shall be placed beneath of the sanitary sewer system and above the proposed underdrain systems. No allowance shall be taken for the porosity of the sewer system bedding material in calculating the underdrain capacity.

•All pipes proposed to be installed beneath the sanitary sewer system shall have a pipe class equal to or greater than the sanitary sewer pipe.

•Underdrain systems shall have adequate daylight points as underdrain systems are not permitted below the District's outfall sanitary sewer lines. Clay cut-off walls shall be installed with solid wall pipe downstream of the cut-off wall where the underdrain system alignment daylights away from the sanitary sewer system.

•Underdrain systems shall not pass beneath any manhole or structure, but shall be routed around the manhole or structure using solid wall pipe.

•Underdrain cleanouts shall not be permitted to be installed in sanitary sewer manholes.

•Construction details for construction around manholes and cut-off walls shall be submitted to the District for review.

•The locations of the underdrain system and daylight points shall be referenced on the Construction Plans.

•Roof drains and other surface water collection systems shall not discharge into an underdrain system.

The following note must be placed on all sanitary sewer system construction plans for developments with underdrain systems:

> "Underdrain systems composed of gravel, solid pipe and/or perforated pipe are not a part of the District's sanitary sewer system and are not designed, owned, or maintained by the District."

2.13 PROTECTION OF WATER SUPPLIES

2.13.1 Water Supply Inter-Connections

There shall be no physical connection between a public or private potable water supply system and a sanitary sewer, or appurtenance thereto which would permit the passage of any sanitary sewage or non-potable water into the potable water supply.

2.13.2 Relationship to Water Supply Sources

While no general statement can be made to cover all conditions, it is generally recognized that sanitary sewers must be kept remote from public water supply wells or other water supply sources and structures in accordance with the applicable Colorado State and/or County Health Department Standards.

2.13.3 Relationship to Water Lines

Sewers shall be located a minimum of 10 feet horizontally from existing or proposed water lines (centerline distance). Where sewer lines cross water mains, the sewer pipe shall be a minimum of 18" clear distance vertical separation from the water line. If this clear distance is not feasible, the crossing must be designated and constructed so as to protect the water line. Minimum protection shall consist of the installation of an impervious and structural sewer. For example:

Example 1 - Where 18" clear distance is provided between the bottom of sewer and top of water line, one length of Polyethylene Lined Ductile Iron Pipe or AWWA C-900 PVC pipe, at least 18 feet long shall be centered over the water line. Joints of the sanitary sewer pipe shall be encased in a concrete collar at least 6" thick and extending at least 6" either side of the joint.

Example 2 - Where 18" clear distance is not provided, AWWA C-900 PVC sewer pipe with reinforced concrete encasement shall be used. Encasement shall be in accordance with the "Concrete Encasement Detail", found in Section 5 and shall extend a minimum distance of 10 feet from either side of the water main.

In all cases, suitable backfill or other structural protection shall be provided to preclude settling and/or failure of any pipe.

2.14 ENCASEMENTS AND CASINGS

2.14.1 Concrete Encasements

Concrete encasements shall be required by the District, under the following conditions:

Where sewer lines are at a depth too shallow to sustain traffic loads or any other load to which they are, or will be subjected.

At locations where horizontal or vertical movement or loading of the sewer line may be experienced.

At any other location designated by the District.

Concrete encasements shall provide concrete and reinforcement in accordance with the "Concrete Encasement" Detail, found in Section 5 of these Specifications, and shall be of a length to completely span the condition encountered. The concrete encasement detail is generally acceptable for most conditions but the District may require a special, site specific concrete encasement on a case by case basis.

2.14.2 Pipe Casings

Pipe casing shall be used where bores or protective installations are required by the District. All pipe casings shall be constructed to conform with the "Pipe Casing and Sled" Detail, found in Section 5, of these Specifications.

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SECTION 3 - CONTRACTORS' CONSTRUCTION REQUIREMENTS

3.1 GENERAL CONSTRUCTION STANDARDS

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. Whenever any provision of these Specifications or the Rules and Regulations imposes a duty addressed in this Section 3 upon a Contractor, the term "Contractor" in such context shall be deemed to apply also to the Property Owner.

3.1.1 Compliance

Contractor shall comply with all District, City of Englewood, State and Federal Rules, Regulations, Standards and Specifications.

3.1.2 Permits

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 orders of, or permits issued by such entities or agencies.

3.1.3 Subsurface Structures

The District will make available to the Contractor record drawings showing the location of its facilities and such information as it has about other subsurface structures in the vicinity of the work, but the Contractor shall be finally and solely responsible for notifying all owners or operators thereof of his intent to excavate in the area, and determining the existence and location of all subsurface structures in such area.

If a Contractor damages any District facilities during construction, he shall immediately notify the District. The Contractor shall provide bypass pumping, at his own cost, until the District reviews the damage and proposes remedial measures. All costs to repair the District facilities shall be borne by the Contractor. Repairs shall be performed in accordance with the "Sanitary Sewer Line Repair" detail found in Section 5 of these Specifications and/or the District site specific recommendations.

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 damages to any such structures.

3.1.4 Warranty

All materials and workmanship furnished by the Contractor shall conform to these System Specifications and to all plans and designs accepted by the District, and shall be free from all defects due to faulty or non-conforming materials or workmanship.

3.1.5 Independent Investigation

Contractor shall thoroughly examine the work site to ascertain for himself all soil, geological, groundwater and other conditions to be encountered which might affect the work being undertaken. The Contractor shall enter into such work relying on his own investigation and information, and not on any statements or representations, if any, that have been made by the District.

3.1.6 Indemnification

By undertaking any work subject to this section, Contractor agrees to indemnify and hold harmless the District from any and all liability, claims, and demands, on account of injury, loss, or damage, including without limitation claims arising from bodily injury, personal injury, sickness, disease, death, property loss or damage, or any other loss of any kind whatsoever, which arise out of or are in any manner connected with any work subject to this section if such injury, loss, or damage is caused in whole or in part by, or is claimed to be caused in whole or in part by, the act, omission, error, professional error, mistake, negligence, or other fault of Contractor, or which arise out of any Workmen's Compensation claim of any employee of the Contractor. Contractor agrees to investigate, handle, respond to, and to provide defense for and defend against such liability, claims or demands at the sole expense of Contractor. The Contractor also agrees to bear all other costs and expenses related thereto, including court costs and attorney fees, whether or not any such liability, claims, or demands alleged are groundless, false, or fraudulent. Nothing in this subsection shall be deemed to impose upon Contractor any obligation to defend or hold the District harmless against claims for damages legally caused by any unlawful act or omission of the District.

3.2 REQUIRED SUBMITTALS

No Contractor shall begin work on any Main Extension, Tap, or other District facilities until he has obtained the prior authorization of the District therefore, and has submitted, in addition to any other materials required elsewhere herein, the following, accepted as to form by the District:

3.2.1 Written Agreement

If required by the District, a writing duly signed by Contractor (1) acknowledging his consent to be bound by the provisions of Section 3.1; (2) warranting that the work will conform to such provisions and will be free from defects due to faulty or non-conforming materials and workmanship; (3) agreeing to indemnify the District as provided in 3.1.6, and (4) agreeing to pay any and all applicable fees and charges provided by these Specifications and the Rules and Regulations in connection with the work.

3.2.2 Fees

The full amount of all fees payable in advance, or any required costs deposits, or both.

3.3 STOP WORK ORDERS

3.3.1 Order

The District may revoke any authorization for work and issue a Stop Work Order upon a determination that the Contractor has violated or is about to violate any condition of any plan acceptance, any provision of these Specifications or Rules and Regulations, or any other standard,

specification, or rule imposed by the District. A Stop Work Order shall take effect immediately upon the entry thereof by the District and notice to the Contractor, and shall remain in full force and effect until rescinded in writing by the District.

3.3.2 Effect

It is unlawful for any person to do any work in violation of the terms of any Stop Work Order issued pursuant to this section except such as may be permitted by the District in order to render the construction site safe and secure.

3.4 CURE OF DEFECTS

3.4.1 Order to Cure

If the District determines that any part of the work was not performed in conformity with these Specifications, Rules or Regulations or accepted plans, or is defective, of poor or unworkmanlike quality, or is otherwise not in conformity with any applicable warranty, it may give written notice thereof to the Contractor. Such notice shall specify the non-conformity, direct the Contractor at his cost to perform specified remedial work, and specify the period of time determined by the District reasonably necessary for completion of the remedial work.

3.4.2 District Cure

If the Contractor fails within the time stated following such notice to cure the non-conformity specified therein, the District, in addition to and without waiving any of its other remedies, may perform the work and charge the Contractor for its actual costs incurred in connection therewith, calculated in accordance with the rates set forth in Appendix 1 to Article 7 of the Rules and Regulations. The provisions of Article 7 of the Rules and Regulations applicable to invoicing and collection of fees and charges shall apply to any charges assessed to Contractor under this section.

3.5 PRE-CONSTRUCTION MEETING

A Pre-construction Meeting shall be arranged by the District Engineer and held prior to the start of any work. The District Engineer, Contractor, Soils Engineer, and Developer, or Developer's Engineer, must be represented at this meeting, which shall generally be held at the District Office (3722 East Orchard Road, Littleton, Colorado 80121). After the Pre-construction meeting is held, the Contractor shall, at least 48 hours prior to the start of construction, notify the District of its construction schedule and start date.

3.6 CONSTRUCTION PLANS

Construction Plans shall be reviewed and signed by the District and the District's Consulting Engineer. The signed plans and a copy of these Specifications shall be kept on the project site by the Contractor at all times.

3.7 DEFECTIVE MATERIALS

All materials not conforming to the requirements of these Specifications shall be considered defective. Whether in place or not, such material shall be removed immediately from the site of the work, unless otherwise permitted by the District. Rejected material, the defects of which have been subsequently corrected, shall not be used until the District has reviewed them and found

them acceptable. The District will not consider conveyance and acceptance of a project if the Contractor fails to comply promptly with any order of the District made under the provisions of this Section.

3.8 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 Owner's engineer and the District to discuss an alternative design. The Contractor's construction shall not deviate from the signed plans without the review and approval of the District, or Owner's engineer.

3.9 CONSTRUCTION WATER

The Contractor shall be responsible for obtaining any water required for various phases of construction. Arrangement and coordination of permits shall be made through the appropriate Water District or other agency.

3.10 TEMPORARY HANDLING OF SEWAGE

Certain work in connection with tying into the existing sanitary sewer facilities may require the temporary handling of sewage either by pumping, bulk heading at low flows, or other means acceptable to the District. Sewage so diverted shall be handled in a manner so as not to create a public nuisance or health hazard. Any temporary ditching shall be backfilled and compacted, and the ground elevations restored to original conditions.

Handling of sewage shall conform, and be acceptable to current Colorado Department of Health requirements and/or applicable City/County Health Department requirements.

3.11 RECORD DRAWINGS

The Contractor shall maintain on the job site, a separate set of full-scale Construction Plans marked up to fully indicate field installed conditions. These drawings shall be maintained in a current condition at all times until completion of the work and shall be available for review by the District at all times. All reviewed variations from the reviewed and signed Construction Plans, for whatever reason, including those occasioned by optional materials, and those required by coordination between trades, shall be indicated. These variations shall be shown in the same general detail utilized in the original design. Upon completion of the work, the marked up set of drawings shall be furnished to the District for review. After the District has reviewed the marked up drawings, the drawings shall be returned to the Owner's Engineer. The Owner's Engineer shall use the marked up plans to prepare half sized (12" x 18") mylars. The mylars shall be a reverse read, wash-off (moist erasable) photographic 4 mil mylar reproduction. A half-sized (12" x 18") CADD plot on mylar is acceptable.

The following construction information shall be added to the mylars at a letter and pen size that will be legible after reduction is completed.

Date Installed:
Contractor:
Field Administrator:
Soils Engineer:

Surveyor:

All service lines must be shown on the plans.

The finalized half-size drawings and a computer disk containing the drawings in the latest version of AutoCAD must be presented to the District prior to probationary acceptance of the project.

3.12 REPLACEMENT OF EXISTING STREET IMPROVEMENTS

In areas where existing pavement, concrete improvements, storm or drainage improvements are removed during construction, they shall be replaced in kind to the limits disturbed by the sewer line construction. All replacement shall be in accordance with the appropriate City, County, or State Highway Department Standards.

3.13 SAFETY; TRAFFIC CONTROL

The Contractor shall determine, initiate, maintain and supervise all measures necessary to protect the public during construction.

Traffic shall be controlled at those locations throughout the project area in order to maintain an efficient and orderly vehicular and pedestrian traffic flow. All traffic control, construction signing, and residential access, etc., shall be handled in conformance with the Uniform Traffic Control Manual and the appropriate City, County, or State Highway Department Standards.

The Contractor shall furnish, construct, maintain, and finally remove detours, road closures, lights, signs, fences, barricades, flares, miscellaneous traffic devices, flagmen, drainage facilities, reconstruct paving and such other items and services as are necessary to adequately safeguard the public, both traveling and otherwise, from hazard and inconvenience. He shall erect and maintain such warnings and directional signs as may be required by the City, County, or State Highway Department.

Should the progress of construction require closure of residential access, the Contractor shall notify the residents which may be affected at least 24 hours in advance of such closure, and provide temporary access. Prior to the start of construction, the Contractor shall notify affected residents as well as the appropriate police and fire departments, giving the approximate starting date expected, completion date, and the name and telephone number of a responsible person representing the contractor who may be contacted at any hour.

3.14 CONSTRUCTION OBSERVATION

The District shall decide any and all questions that may arise during construction as to the quality and acceptability of the materials furnished, the work performed, or the manner of performance of the work.

No observation or testing will be performed by the District on weekends or holidays without the express agreement of the District secured in advance. Whenever any observation or testing is required by any specific provision of these Specifications or the Rules and Regulations, or by the terms of any permit or plan acceptance, the Contractor shall give the District such notice as is required and shall not cover or otherwise obscure the work until the observation or testing has

been made. The Contractor shall at his cost uncover or otherwise make such work accessible for observation or testing when ordered to do so by the District if he violates this requirement.

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 reason of any observations, testing, or reviews required or authorized by these Specifications or the Rules and Regulations, or by reason of the issuance of any acceptance or permit for any work subject to this section.

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

Observations of work in progress and on-site visits are not to be construed as a guarantee by the District of the Contractors' performance.

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.

The District exercises no control of the safety or adequacy of any equipment, building components, scaffolding, forms, or any other work aids used in or about the project, or in the superintending of the same.

3.15 GEOTECHNICAL OBSERVATION

Geotechnical observation and backfill density tests will be performed by the Contractor's Soils Engineer to provide acceptable fill control, bedding compaction, and foundation suitability. All supervision necessary to control fill and compaction tests will be at the expense of the Contractor. If the first compaction test does not meet with the Specifications, the sub-standard areas shall be reworked and additional compaction tests will be performed until the Specification is met. Any deviation from the plans, Specifications, or soils report, must be corrected by the Contractor to the satisfaction of the District. Copies of all compaction tests shall be provided to the District on the working day following the test. The location and frequency of compaction testing shall be per the City, County, or District Specifications, whichever is more stringent. The minimum testing interval is as follows:

	Horizontal Interval	Vertical Interval
Sanitary sewer main	250 feet	every 1 foot
Sanitary sewer structure	every structure	every 1 foot
Service line	every 3rd service	every 1 foot

3.16 FEES

Contractor will pay the District all fees imposed and assessed by the District for reviews, observation, tests, acceptance, and any other undertakings performed by the District or its professional consultants in connection with the administration and enforcement of these Specifications and the Rules and Regulations, as provided by Article 7 of the Rules and Regulations.

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SECTION 4 - MATERIALS, TESTING AND INSTALLATION

4.1 GENERAL

All sanitary sewer system materials, construction and testing shall be in accordance with these Specifications. 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. PVC pipe material (as defined in Section 4.2) shall be used for sanitary sewer system construction.

4.2 POLYVINYL CHLORIDE (PVC) PIPE

4.2.1 Material

All non-pressurized plastic pipe and fittings shall be polyvinyl chloride (PVC) and shall meet the requirements of ASTM D 1784 "Rigid Poly (Vinyl Chloride) and Chlorinated Poly (Vinyl Chloride) Compounds" and ASTM D 3034 SDR 35, (sizes 8-inches through 15-inches) or ASTM F 679 SDR 35 (18" through 27"), "Type PSM Polyvinyl Chloride (PVC) sewer pipe and fittings" latest revision. Pipe and fitting markings shall include the appropriate ASTM And Cell Classification Numbers (12454-B or 12454-C or other ASTM approved classifications). Unmarked pipe and fittings will be rejected.

4.2.2 Straightness

Maximum allowable curvature as measured from the concave side of the pipe shall not exceed 1/16" per foot of length.

4.2.3 Joint Type

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.

4.2.4 Thickness Class

All PVC pipe shall have an SDR ratio of 35 unless otherwise specified by the District.

4.2.5 Laying Lengths

PVC pipe shall have normal laying length of either 18 or 20 feet.

4.2.6. Installation and Testing

See Sections 4.12 and 4.13 of these Specifications.

4.3 AWWA C 900 POLYVINYL CHLORIDE PIPE (PVC)

4.3.1 General

All AWWA C 900 polyvinyl chloride pipe (PVC) furnished under these Specifications, shall be manufactured in strict accordance with AWWA Standard Specifications C 900, latest revision, with the following additional requirements:

4.3.2 Size of Pipe

This Specification includes PVC pressure class pipe eight inches (8") through twelve inches (12").

4.3.3 Thickness Class

Pipe furnished under this Specification shall be a minimum of Class 150, SDR 18 with a minimum sustained pressure requirement of 500 psi and a burst pressure requirement of 755 psi at 73.4o F.

4.3.4Laying Lengths

Pipe shall have a normal laying length of twenty feet (20'), or ten feet (10') where designated for curves. Random lengths shall not be acceptable.

4.3.5Joint Type

Pipe joints 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.

4.3.6 Installation and Testing

See Sections 4.12 and 4.13 of these Specifications.

4.4 SANITARY SEWER PIPE FITTINGS

4.4.1 Fittings and Branches

Branches of the size and type shown on the reviewed and signed Construction Plans shall be furnished for service connections. In line "wyes" are the only fittings acceptable for service connections to new construction. "Wye" branches shall have their axis approximately 45o (unless otherwise specified on the plans) to the longitudinal axis of the pipe. All branches shall be of sufficient length to permit making a proper joint when the connecting pipe is inserted in the branch socket.

Service 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.

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.

4.4.2 Plugs

Pipe plugs shall be 3/4" in thickness and shall have a factory-made plasticized polyvinyl chloride compound joint material cast and bonded to the pipe. The material shall be molded and cured to a uniform hardness and compressibility, and form a tight compression coupling when assembled. The material used for the compression joint shall conform with the type of pipe material specified.

Neoprene (synthetic rubber) plugs shall be equal to those manufactured by Gladding McBean and Company or equal. The joint formed by the plug and pipe shall be a tight compression coupling when assembled.

4.4.3 Installation and Testing

Fitting installation shall be in accordance with the manufacturer's recommendations and Sections 4.7, 4.12.6 and 4.13 of these Specifications.

4.5 MANHOLES

4.5.1 General

This Section outlines the material and installation requirements for manholes. Excavation, foundations and backfill requirements are described in Section 4.12. All manhole structures shall be designed for H-20 traffic loading in accordance with AASHTO Specifications.

4.5.2 Cast-In-Place Concrete Bases

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.

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 it a slump test of two-inches (2"). Air entrained in the mix when placed, shall be between 3% and 5%. Base reinforcing steel or wire mesh shall be in accordance with the "Standard Manhole" detail found in Section 5 of these Specifications.

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.

All base deflectors shall be smooth and of the proper radius to provide a smooth flow transition in accordance with the "Base and Deflector" detail, found in Section 5 of these Specifications. The concrete base shall be shaped with concrete hand tools and shall receive a hard steel trowel finish before the concrete sets.

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.

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

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.

4.5.3 Pre-Cast Concrete Bases

Contractors shall obtain written permission from the District prior to installing pre-cast manhole bases. Generally, pre-cast bases are only allowed where construction of a cast-in-place base is impractical. An example of where pre-cast 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.

Material Specifications for pre-cast bases are as follows:

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

All base and barrel sections shall be poured monolithi¬cally. Reinforcement shall include #4 bars on 12-inch centers.

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

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

Pipe boots or gaskets are to be placed in the cored openings and shall be manufactured by Forsheda F-910 meeting all ASTM 923 requirements.

Manhole steps shall be manufactured by MA Industries, Inc., Model No. PS2-PF 6 polymer polypropylene plastic with grade 60 reinforcement or aluminum step, meeting Federal Specifications QQ-A-200/8.

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

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 benzyl resin Conseal CS102 or CS202 concrete sealant or equal between the pipe and the core hole.

The void area between the pre-cast invert, benches, and pipe shall be filled with concrete.

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

4.5.4 Pre-Cast Barrel Sections

Pre-cast concrete barrel sections are to be used for all sanitary sewer construction.

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

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.

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 90o. 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.

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.

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. The eccentric cone and steps shall be centered between the inlet and outlet pipes. All interior joints shall be grouted. All exterior and interior joints shall be grouted where groundwater conditions exist.

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 65o F and 85o F until the grout has set.

4.5.5 Steps

Manhole steps shall be plastic steps manufactured by MA Industries, Inc., Model No. PS2-PF 6 made from polymer polypropylene plastic with grade 60 reinforcement or aluminum steps, meeting Federal Specifications QQ-A-200/8. Manhole steps shall not be used to lift manhole sections.

4.5.6 Intermediate Platforms

At the District's discretion, manhole platforms shall be installed in manholes having a depth, ring to invert of 20-feet or more, and in drop manholes or other manholes designated by the District. The use of intermediate platforms will be reviewed by the District on a case-by-case basis. Material requirements and installation shall be in conformance with the "Intermediate Platform" construction detail found in Section 5 of these Specifications.

4.5.7 Ring and Covers

Cast iron rings and covers shall conform to the drawings found in Section 5 of these Specifications. The castings shall weigh not less than 400 pounds, and shall conform to ASTM Designation A-27. 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.

Manhole rings and covers shall be set to the final grades shown on the plans. Manhole rings shall be securely attached to the manhole riser section with a grout bed and plastic joint sealing compound (Ram-Neck) in pavement, or with a concrete collar in unpaved areas. After the rings are securely set in place, covers shall be installed and the assembly shall be cleaned and scraped of foreign materials.

Manhole covers in unpaved drainage ways shall be aluminum with Cam locks.

4.5.8 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.

4.5.9 Final Grade Adjustments

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.

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 appropriate sized barrel section added, followed by cone and grade ring replacement.

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

4.5.10 Interior Lining

All outfall manholes, drop manholes, or other manholes as determined by the District, shall have an interior corrosion resistant lining. Acceptable material is Sikagard 62 High-Build Protection Coating or equal.

Surface preparation shall be accomplished by mechanical means approved by the manufacturer (i.e. sandblasting, grinding, power washing, etc.) to remove all laitance (form oils) and other loosely bound material from the surface of the manhole walls. All surfaces shall be clean and dry prior to coating.

Prior to coating, all "Honeycomb" areas, "Bugholes" greater than 1/4" in size, or other areas of a size which the coating cannot span, shall be filled with Sikatop 121 Plus or equal. Areas requiring Sikatop 121 Plus shall receive the same surface preparation required for the Sikgard 62, and application shall be per manufacturer's recommendations.

Once surface preparation is complete, Sikagard 62 High-Build Protection Coating shall be applied in three coats, 5-7 dry film mils per coat, for a total thickness of 20 mils. Either coating shall be applied using the manufacturer's recommendation.

Prior to applying the first coat and subsequent to applying the last coat, the Contractor shall notify Sika Corporation to schedule a review of the surface preparation and final coat application by the material supplier. Service costs, if any, are the responsibility of the Contractor.

Color shall be selected by the District.

4.5.11 Exterior Coating (In Groundwater)

Where groundwater conditions exist, the exterior joints of the precast sections shall be grouted. 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"). The Contractor shall submit material specifications for the exterior coating to the District for review prior to construction. The exterior coating shall be applied per manufacturer's recommendations.

4.5.12 Manhole Testing

The Contractor shall submit the concrete mix design to the District for review at least 48 hours prior to any concrete base pour. The District may require that concrete cylinders be sampled from base pours and tested at 28 days to show conformance with the required 28-day compressive strength requirement of 3000 psi. Slump and air entrainment may also be tested during concrete base pour, at the District's discretion.

No other specific testing procedures are established for manholes. Manhole construction will be observed by the District and shall conform to the requirements of this Section.

4.6 SANITARY SEWER SERVICE CONNECTIONS

4.6.1 General

The purpose of this sanitary sewer service connection specification is to address the actual connection between the public sanitary sewer system and the private service line. The District is responsible for the sanitary sewer main line, manholes, and the wye fitting on the main line for the sanitary sewer service, only.

All sanitary sewer services are private and includes the 45□ service fitting and service line. Section 4.5 of these Specifications describes the material requirements for fittings, branches and plugs.

4.6.2 Service Connections to New Construction

New main line construction shall use PVC in-line "wye" fittings for 4" and 6" service connections, or manholes for 8" service connections. Construction shall be in conformance with this Section and the "Service Connections to New Construction" construction detail found in Section 5 of these Specifications.

All in-line PVC wye fittings shall be of equal pipe class to the PVC materials used in public main line construction. Fitting material shop drawings shall be submitted to the District for review prior to construction.

In-line wye fittings shall be installed at the locations indicated on the reviewed and signed plans. The "wye" shall be rotated to provide entrance into the main line at the "ten" or "two" o'clock position. The Contractor shall record the connection invert elevation and distance from the nearest downstream manhole immediately upon installation. This information shall be shown on the record drawings.

4.6.3 Service Connections to Existing Construction

Service connections to existing sanitary sewer lines shall be made using either a "tee" or "wye" saddle depending on the existing main line material. Construction shall be in conformance with this Section and the "Service Connections to Existing Construction" construction detail found in Section 5 of these Specifications.

Connection to existing PVC material shall be made using a "wye" saddle with double stainless steel straps. The existing PVC sewer line shall be scored to the shape of the wye using a template approved by the saddle manufacturer. The hole shall be cut with a hole cutter or keyhole saw and cleanly machined by hand to remove all burrs, rough edges, and debris. The exterior of the main shall be wiped clean and prepared with an approved solvent prior to the installation of the saddle. The saddle shall be solvent welded to the pipe and drawn tight against the pipe using double stainless steel straps.

Upon completion of the tap, the main line, tapping saddle and service line within the sanitary sewer line trench shall be bedded per Section 4.12.5 and hand tamped prior to backfilling.

Connection to existing concrete or clay sewer lines shall be made using a PVC tee saddle and gasket with double stainless steel straps. When connecting to an existing concrete or clay main, a long-body style PVC tee saddle shall be used. The sewer main shall be "core drilled" with a circular bit. Necessary precautions shall be taken so that the removed circular segment is not lost in the sanitary sewer main. Percussion taps 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.

The circular hole shall be cleaned by hand to remove all rough edges and debris. The exterior of the main shall be wiped clean and prepared with an approved solvent prior to the installation of the gasket tee saddle. The saddle shall be drawn tight against the gasket and existing line by means of double stainless steel straps.

Upon completion of the tap; the tapping saddle shall be reinforced with a concrete collar. The main and tapping saddle shall be bedded with materials per Section 4.12.5 and hand tamped prior to backfilling.

4.6.4 Service Connections to Dead-End Manholes

One service line may be connected to a dead-end manhole when it is not possible to make the connection to the main line. The service line shall connect behind the manhole in conformance with the Service Connection to Dead-End Manhole detail found in Section 5 of these Specifications.

4.6.5 Testing of Service Line Connections

No specific testing is required for the in-line fittings, or saddle type connections by the District. However, 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.

All service lines shall be plugged at the end of the service with a watertight plug manufactured for use with the service line material. End plugs must be able to withstand the internal pressure of leakage testing in accordance with Section 4.13 of these Specifications.

4.7 CLEANOUTS

Cleanouts are not permitted on Southgate Sanitation District lines. Cleanouts should be installed on private services at: any change in direction requiring horizontal or vertical bends, every 100 feet of service line, and at other locations as required to clean the entire service by rodding.

Construction details showing material requirements and installation procedures for cleanouts are found in Section 5 of these Specifications.

4.8 ENCASEMENTS

4.8.1 General

Reinforced concrete encasement shall be constructed to the limits shown on the Construction Plans. However, should field conditions differ from the information shown on the reviewed and signed plans, (e.g., ground elevations, creek locations), the encasement limits shall be reviewed in the field by the District, prior to any encasement construction.

4.8.2 Materials

Encasements shall be constructed of concrete made from well-graded aggregate and Type II cement, having a minimum twenty-eight (28) day compressive strength of 3000 psi, slump of 2"-4", and air entrainment of 3% to 5%.

Reinforcement steel used in encasements shall be ASTM A36 steel.

4.8.3 Installation

Reinforced concrete encasement shall be installed in accordance with the "Concrete Encasement" construction detail, found in Section 5 of these Specifications. Minimum clear distance between steel reinforcement and the edge of the concrete encasement shall be three inches. The encasement shall be formed using undisturbed soils or concrete formwork. Concrete shall be vibrated around steel reinforcement using vibration equipment or manual poling and shall not be placed on a frozen or unstable foundation. Suitable concrete protection shall be provided to reduce rapid moisture loss and to protect the concrete from freezing.

4.8.4 Testing

The Contractor shall submit the concrete mix design to the District for review at least 48 hours prior to encasement construction. The District may require that concrete cylinders be sampled on-site and tested at twenty-eight (28) days to show conformance with the required twenty-eight (28) day compressive strength requirement of 3000 psi. Slump and air entrainment may also be tested at the time of concrete pour, at the District's discretion.

4.9 MARKER POSTS

Marker posts are required adjacent to manholes or other appurtenances installed outside of paved rights-of-way in order to provide a physical reference for field location.

Marker posts shall be four-inch (4") 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. A 4-inch by 4-inch (4" X 4"), or 6-inch by 6-inch (6" X 6"), redwood marker post may also be used, at the Owner's discretion, with the necessary location information routed into the post.

Marker posts shall be installed at the locations indicated on the reviewed and signed plans and at other locations requested by the District during construction. Marker post installation shall be performed in accordance with the details, found in Section 5 of these Specifications.

4.10 SANITARY SEWER SYSTEM INSTALLATION

4.10.1 Excavation

General

Excavation for sanitary sewer lines, manholes, fittings and other appurtenances shall be an open trench excavation to the depth required by the reviewed and signed Construction Plans.

All excavations shall be properly supported in the manner as required by OSHA Code of Federal Regulations, Volume 37, No. 243, Sub-part P, Section 1926.652, and the related sections, or as required by State laws and municipal ordinances, and as may be necessary to protect life, property and the work.

Limits of Excavation

Length - Except by expressed written permission of the District, the maximum length of open trench shall be 600 feet or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller. The distance is the collective length at any location, including open excavation, pipe laying, appurtenances, construction, and backfill. The trench shall not be left open when the Contractor has left the project site and is not engaged in construction operations, unless temporary fences or barricades are provided. Traffic barriers shall be placed by the Contractor as required by the representative City, County, or State, or as stipulated by local conditions, to ensure construction safety at all times.

Width - Trench width at the ground surface may vary with and depend upon the depth, type of soils, and position of surface structures. In general, the minimum clear width of the trench, sheeted or unsheeted, measured at the top of the pipe should be one foot (1') greater than the outside diameter of the pipe. The maximum clear width of the trench at the top of the pipe should not exceed a width equal to the outside pipe diameter plus two feet (2'). If the above defined trench widths must be exceeded, or if the pipe is installed in a compacted

embankment, the pipe embankment shall be compacted to 95 percent Standard Proctor Density, to a point at least 2.5 (two and one-half) pipe diameters from both sides of the pipe or to the undisturbed trench walls, whichever is less.

Trenching By Hand or Machine

Hand methods for excavation shall be employed in locations directed by the District. The Contractor shall use whatever equipment or hand methods necessary to protect all existing utilities.

Bracing Excavations

All excavations shall be properly supported in the manner as required by OSHA Code of Federal Registrations Vol. 37, No. 243, Sub-part P, Section 1926.652 and other related sections or as required by state laws and municipal ordinances, and as may be necessary to protect life, property and the work. Excavations shall be so braced, sheeted and supported that they will be safe, and the ground alongside the excavation will not slide or settle. Excavations shall be so braced or sheeted so as to provide conditions under which workmen may work safely and efficiently at all times. The sheeting, shoring and bracing shall be so arranged as to not place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

Care shall be exercised in the withdrawing or removing of sheeting, shoring, bracing and timbering to prevent the caving in or collapsing of the excavation faces which are being supported.

Rock Excavation

Solid rock, boulders, and large stones shall be removed to provide a minimum clearance of at least nine inches (9") below the pipe and fittings.

In general, blasting will be allowed in order to expedite the work if a permit by the local authority having jurisdiction is granted. All explosives and appurtenances shall be transported, handled, stored and used in accordance with the laws of the local, state and federal governments, as applicable.

All blasting shall be controlled so as not to injure any existing structure or facility. Owners or occupants of nearby structures or facilities must be notified at least 72 hours in advance of blasting, in writing, by the Contractor. The notice shall state the anticipated date and time of blasting, and entity responsible for performing the blasting.

Blasting shall be controlled so as not to make any excavation unduly large or irregular as to shatter the rock on the bottom or sides of any excavation or surface upon or against which concrete is to be placed. If, in the opinion of the District, blasting could cause damage to rock foundations, supports, or structures, blasting shall not be allowed, and excavation shall be continued by jack-hammering, barring, wedging or other methods.

4.10.2 Tunneling and Boring

Tunneling or boring may be required by the City, State or County Highway Department where construction crosses major roadways. Boring and casing materials and construction methods shall be reviewed by the District on a case-by-case basis but will generally conform to the requirements outlined on the "Pipe Casing and Sled" detail found in Section 5 of these specifications.

4.10.3 Grading and Stockpiling

The Contractor shall control stockpiling and grading in such a manner to prevent water from flowing into excavations. Obstruction of surface drainage shall be avoided and means shall be provided to allow storm water to flow uninterrupted into existing gutters, other surface drains or temporary drains. Excavated material shall not be placed or stockpiled closer than two feet (2') from the top edge of the trench.

4.10.4 Foundations and Subgrade

General

All manholes or vault foundations and pipe subgrade installation shall be in a stable condition. Any and all questions relative to foundation and subgrade stability shall be coordinated through the District and the owners' Geotechnical Engineer. The Geotechnical Engineer will be responsible for determining if the foundation and/or subgrade is stable prior to the utility installation.

Stable Foundations and Subgrade

The trench bottom shall be excavated six inches (6") below the invert of the pipe unless otherwise designated on the plans. Before the pipe is laid, the foundation shall be prepared by backfilling with bedding material conforming to these Specifications. The bedding shall be thoroughly tamped to achieve a relative density of 70% as determined by ASTM D-2049.

Dewatering

The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades at the bottoms of excavations. These methods may include well points, sump pumps, suitable rock or gravel drains placed below the bedding, temporary pipelines and other means, all of which shall be subject to the review of the District.

Dewatering of the sewer line trenches shall commence when groundwater is first encountered, and shall be continuous until such time that, in the opinion of the Owner's Geotechnical Engineer, it is safe to allow the water table to rise. Pipe trenches shall contain sufficient backfill to prevent pipe flotation.

The Contractor shall dispose of the water from the work site in a suitable manner without damage to adjacent property or endangering public health or safety. Water shall not be drained into the sanitary sewer system.

Foundations in Unstable Soil

When excessively wet, soft, spongy, unstable or similarly unsuitable materials is encountered at the surface upon which the bedding material or foundations are to be placed, dewatering shall be performed and unsuitable materials shall be removed to a depth as determined in the field by the Owner's Geotechnical Engineer and the District.

The degree of soil instability will determine the limits of over excavation. In general, over excavation will be required, and stabilization rock shall be installed as indicated on the "Special Bedding" construction detail until the foundation and/or subgrade is stable as determined by the Owner's Geotechnical Engineer and the District.

Overdepth Excavation

Where excavation is inadvertently or otherwise carried below subgrade and/or foundation elevations, suitable provision shall be made to adjust the deeper excavation beneath pipe or structures. Over-depth backfilling, with bedding material or on-site material, shall be compacted to provide a firm and unyielding foundation, as directed by the Owner's Geotechnical Engineer and the District.

Foundations in Rock

Where rock is encountered, it shall be removed below grade. The trench shall be backfilled with clean imported bedding material to provide a compacted foundation cushion. The minimum clearance between rock and the pipe shall be nine inches (9").

4.10.5 Bedding

General

All pipe bedding materials for stable and unstable installation conditions hall be reviewed by the owners' Geotechnical Engineer and the District, prior to delivery of the bedding to the construction site. The area indicated in the bedding details from the trench bottom to twelve inches (12") above the pipe shall be referred to as the "pipe zone". Bedding materials and installation shall meet or exceed the requirements of this section.

Bedding Material

The pipe bedding, using either clean imported 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:

Class A Bedding - Class A bedding shall be used for the bedding of ductile iron and PVC sanitary sewer lines at depths of cover less than 16 feet. Class A bedding shall consist of placing select bedding material (known as "squeegee") defined as follows, from six inches (6") under the pipe to a point twelve inches (12") above the top of pipe.

Class A bedding material shall conform to the following:

Sieve Size	Total Percent Passing by Weight
3/8"	100%
No. 8	65% - 100%
No. 50	10% - 30%
No. 100	0% - 10%
No. 200	0% - 5%

Class B Bedding - Class B bedding shall be used where designated by the District for stabilization for the 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 eight inches (8") under 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, as follows:

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%

Class B bedding and PVC AWWA C-900 pipe shall be used at depths of cover over 22 feet. Pipe strength calculations shall be submitted to the District for review and approval for all sewer lines with depths of cover over 22 feet.

Bedding Installation

The pipe shall be bedded as indicated in the "Standard Bedding" and "Special Bedding" details, found in Section 5 of these Specifications. The Contractor shall be responsible for accurately shaping the pipe subgrade to fit the bottom of the pipe. The intent is to relieve the bell of the pipe from all loading and provide continuous bearing of the pipe barrel on the bedding. Use of a drag template shaped to conform to the outer surface of the pipe will be required if other methods do not give satisfactory results.

The pipe shall be centered in the trench, adjusted to line and grade and bedding shall be simultaneously placed on both sides of the pipe as not to disturb alignment and grade.

The bedding material shall be sliced under the haunches of the pipe to fill all voids. The slicing shall be performed when the bedding material covers approximately one-third (1/3) of the pipe's diameter.

Bedding Compaction

All bedding material shall be compacted to a minimum Relative Density of 70 percent, as determined by ASTM D-2049. Each lift shall be solidly tamped with the proper tools so as not to injure, damage or disturb the pipe. Backfilling shall proceed simultaneously on each side of the pipe. Water settling for compaction is generally not permitted and must be reviewed by the District prior to its use.

Bedding Testing Requirements

All bedding shall meet the gradation set forth in this Section. Bedding material shall be tested by the Owner's Geotechnical Engineer for gradation requirements, and test reports shall be submitted to the District, prior to delivery of and bedding material to the project site.

Bedding compaction shall be tested using the "Sand Cone Method" in conformance with ASTM D1556 or other methods reviewed by the District. Compaction test results shall be submitted to the District on the working day following the test. If compaction tests do not meet these Specifications, the sub-standard area shall be reworked and retested until these Specifications are met. The location and frequency of bedding compaction testing will be determined by the District on a case by case basis.

4.10.6 Sanitary Sewer Line Installation

General

Pipe shall be laid without grade break from structure to structure, with the bell ends of the pipe upgrade. Pipe shall be laid to the lines and grades shown on the reviewed and signed construction plans and shall form a close concentric joint with the adjoining pipe. The interior of the sewer pipe shall be cleaned of all dirt and superfluous material of all descriptions, as the work progresses.

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. In no event shall sanitary sewers be used as drains for removing water which has infiltrated into the trench.

A water-tight plug (Pollard, or equal), shall be installed at the point of connection to the existing system at the start of construction, and shall not be removed without permission of the District.

Material Review Before Installation

All pipe, fittings, shall be carefully examined for cracks and other defects before installation. Spigot ends of pipe shall be examined with particular care as this area is the

most vulnerable to damage from handling. Defective materials shall be set aside for review by the District. Provisions of Section 3.4 of these Specifications also apply.

Laying of Sanitary Sewer Pipe

Placement of PVC sanitary sewer pipe in the trench shall conform to ASTM D2321 Specification for "Underground Installation of Flexible Thermoplastic Sewer Pipe", Uni Bell Standard UNI B-5, and these Specifications. Placement of ductile iron sanitary sewer pipe in the trench shall conform to ANSI/AWWA C600 and these Specifications. Under no circumstances shall PVC sewer pipe be dropped or dumped into the trench.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipelaying crew cannot put the pipe into the trench and place it without getting earth into it, the District may require that before lowering the pipe into the trench, a heavy tightly woven canvas bag of suitable size, or plastic caps, shall be placed over each end of the pipe and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed inside the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell or coupling and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with bedding material. Precautions shall be taken to prevent dirt from entering the joint space.

Alignment and Grade

The sewer line shall be laid and maintained to the required lines and grades as shown on the plans.

Where obstructions or field conditions are encountered during construction which interfere to such an extent that an alternation in the reviewed plans is required, the District shall have the authority to change the plans in accordance with Section 3.5 of these Specifications.

Laser beam equipment or the batter board system may be used to provide line and grade. The District prefers the use of the laser beam system.

When using the batter board system, batter boards shall be installed on each side or on the same side of the trench. Stakes supporting the batter boards shall be placed the same distance apart as the grade stakes set by the Owners' Surveyor. Three batter boards shall be in use at all times. The cross members or straight edges crossing the sewer ditch shall be set according to the grade showing on the grade stakes. A centerline grade string and plumb-bob shall be used to keep the sewer pipe in line. A grade rod shall be used to provide accurate grade on the invert of the sewer pipe. The quality of the batter boards and the grade rod shall be reviewed for acceptability by the District. If so instructed, the Contractor shall replace grade and line equipment to meet the requirements of the District.

Joint Installation

When manufacturer's prefabricated joints are used in the laying of sanitary sewer lines, such lines shall be jointed using lubricants, primers, adhesives, solvents, etc., recommended by the pipe manufacturer. All factory fabricated joints shall be placed, fitted, joined and adjusted in such a manner as to obtain the degree of water tightness required and be in compliance with recommended methods of manufacturer, and as accepted by the District.

Fittings and Branch Installations

Pipe "wyes," shall be furnished and installed along with the sanitary sewer line. Wyes of the size(s) specified on the reviewed plans shall be installed for all sanitary sewer service connections as shown on the reviewed and signed construction plans. The longitudinal barrel or branch fittings to be placed in line and grade with the sanitary sewer mains shall be of the same diameter, quality and type as the adjoining sewer line.

Installation, earthwork and bedding for branches shall conform to the applicable provisions set forth for the sewer line. Unless otherwise specified, the branch of "wye" fittings shall be inclined upward at an angle not greater than 45o from a horizontal line. No wye or tee for a sanitary sewer service connection branch may be placed closer than 5 feet, to the downstream edge of any structure, or 3 feet from the bell or spigot end of a pipe section, and shall be in conformance with the "Service Connection to New Construction" detail. The Contractor shall hand tamp the backfill under every "wye" branch after it is installed.

All joints for plugs shall be installed in order to withstand the internal pressure of the leakage and/or infiltration test; however, joints shall be made in such a manner that they may be removed without injury to the socket.

Pipe at Manholes or Structures

A pipe joint of the same inside diameter as the adjoining pipe shall be placed at the inlet(s) and/or outlet to each manhole or structure as shown on the reviewed and signed plans.

Pipe bells shall not be cast into manholes or structures. The bell shall be cut off so that the plain end of the pipe is flush with the inside wall of the manhole or structure, or as otherwise shown on the accepted Construction Plans.

Sanitary Sewer Line Testing and Acceptance

(See Section 4.11)

4.10.7 Backfilling

General

All trenches shall be backfilled after pipe, fittings and appurtenances have been installed and reviewed. When a compaction requirement value is specified herein, the optimum moisture content and density shall be determined in accordance with the appropriate ASTM specification.

Backfill Material

Backfilling shall be done with on-site material, sand or gravel. No oil cake, bituminous pavement, concrete, rock or other lumpy material shall be used in the backfill unless these materials are scattered and do not exceed 3" in any dimension. Material or perishable, organic, spongy, frozen debris, or otherwise unacceptable nature shall not be used in backfilling. No material greater than 3" in any dimension shall be placed within 1 foot of any pipe, manhole or structure. Backfill material shall be subject to the review of the District.

Within the street right-of-way, the road subgrade and final grade, including base course and asphalt placement, shall be replaced in strict accordance with the appropriate City, State or County Highway Department's Standards.

Backfill Installation

In street rights-of-way, the portion of the trench above the "pipe zone" to the finished roadway surface, shall be backfilled, compacted and/or consolidated by methods reviewed by the District Engineer to obtain a Standard Proctor Density of 95% (ninety-five percent) or equivalent relative density. In easements and other areas outside street rights-of-ways, the remaining portion of the trench above the "pipe zone" shall be backfilled, compacted and/or consolidated by methods reviewed by the District to obtain a Standard Proctor Density of 90% (ninety percent) or equivalent relative density.

Backfill to be compacted by heavy compaction equipment shall be placed in uniform horizontal lifts not exceeding 15" in depth or as specified by the District. Heavy compaction equipment shall not be used closer than three feet to walls at the top of any structure nor closer than three feet to the top of the pipe. Before each lift is compacted, the material therein shall be brought within 1% above or 3% below the optimum moisture content for the specified compaction.

Flooding, pooling, or jetting shall not be allowed unless reviewed and accepted by the District, prior to construction.

Any damage to the pipe as a result of the Contractor's backfill and compaction operation shall be repaired and/or replaced by the Contractor.

Backfill Compaction Tests

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

Copies of test results shall be provided to the District. In all cases where the tests indicate sub-standard compaction, additional compactive effort and tests will be required until these Specifications are met. Final acceptance of the lines by the District will be contingent upon satisfactory compaction results. Leakage and deflection testing of the sewer main shall not be performed until backfill compaction conforms to these Specifications.

4.10.8 Final Clean Up

Prior to probationary acceptance, the Contractor shall clean street right-of-ways and easements of all rubbish, excess materials, temporary structures and equipment and shall leave the same areas to plus or minus 1/10 of a foot from the elevations that existed prior to construction or the final grades as shown on the reviewed and signed plans.

4.11 SANITARY SEWER LINE TESTING AND ACCEPTANCE

4.11.1 Visual Review Prior to Installation

The following imperfections in any type of pipe or special fitting will be considered defects and cause rejection.

Any cracks, lumps, blisters, pits or flakes on any interior or exterior surface of a pipe or fittings.

When the pipe varies from a true circle more by than 3% of its internal diameter.

When a pipe or fitting, designated to be straight, deviates from a straight line more than 1/16" per linear foot. The deviation shall be measured using a straight edge at a point midway between the ends of the pipe.

When a piece is broken from either the socket or spigot end.

4.11.2 Flushing

Prior to any testing, the lines shall be hydraulically cleaned at a water pressure of not less than 1000 psi to remove debris, dirt or other foreign matter. The lowest manhole (or manholes) within the project shall be plugged with a water-tight plug (Pollard or equal) on the downstream outlet of the manhole and all water, silt and debris shall be pumped from this manhole and disposed of properly.

4.11.3 Alignment and Grade Testing

After the sewer line and all appurtenances have been installed and flushed, and satisfactory compaction test results have been submitted to the District, but prior to paving, the line shall be visually reviewed by the District for alignment and grade.

Alignment will be reviewed by lamping and/or surveying. Grades will be reviewed by surveying pipe inverts at manholes and by lamping. The full diameter of the pipe should be visible when viewed between consecutive manholes.

If requested by the District, the Contractor shall supply workers to assist in lamping. If, as a result of lamping, the District has questions pertaining to the alignment and/or grade, the District may request that a video tape review be conducted to permit a closer review of the line. Sags, high points or other alignment or grade problems shall be repaired by the Contractor to the District's satisfaction.

4.11.4 Low Pressure Air Testing

Each section of sanitary sewer line between manholes shall be low pressure air tested in accordance with UNI-BELL UNI-B-6, Latest Revision and as specified herein.

Plugs

All outlets from the pipe section being tested shall be plugged and braced to prevent plug blow-out during the pressure test. Either mechanical or pneumatic plugs may be used.

Pressurizing Equipment

All pressurizing equipment used in pressure testing shall include a regulator or relief valve set no higher than 9 psi to prevent over-pressurizing the line and to prevent plug displacement.

The above ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psi. The continuous monitor gauge shall be at least 4-inches (4") in diameter, with a minimum division of 0.10 psi and an accuracy of + 0.04 psi.

Two separate hoses shall be used. One to connect the control panel to the sealed line for introduction of low pressure air, and another separate hose connection for measurement of air pressure buildup in the line.

Line Pressurizing

Low pressure air shall be slowly introduced into the sealed line until the air pressure reaches a value of 4.0 psi.

If the line being tested is in a groundwater condition, the internal air pressure value of 4.0 psi shall be increased to include the addition of groundwater pressure on the pipe.

The additional pressure shall be calculated by adding 0.433 psi internal air pressure for each foot of water over the sealed pipes invert, but the maximum allowable internal air pressure in the pipe shall not exceed 9.0 psi. Therefore, the low pressure air test may be used in a groundwater condition as long as the average depth of water over the line does not exceed 11.5 feet. Should the average groundwater depth exceed 11.5 feet, the infiltration test shall be performed in accordance with Section 4.13.8 of these Specifications.

Pressure Stabilization

After a constant pressure of 4.0 psi, (or 4.0 psi greater than groundwater back pressure over the pipe) is reached, the air supply shall

be throttled to maintain the 4.0 psi air pressure for 2 minutes. This allows the temperature of the air to equalize with the temperature of the pipe.

Timed Pressure Loss

After pressure stabilization, the air hose from the air supply shall be disconnected or shut off. The continuously monitoring pressure gauge shall be observed while the pressure is decreased to 3.5 psi (or 3.5 psi greater than the back pressure of any groundwater over the pipe). At that time, timing shall commence using a stopwatch, and the time interval measured until the internal

pressure reaches 3.0 psi (or 3.0 psi greater than the back pressure of any groundwater over the pipe).

Passing Test Requirements

If the timed pressure loss is greater than the minimum time outlined in the following Table 4.1, the Section undergoing the test shall pass. If the minimum time in Table 4.1 is not met, the air loss is considered excessive and the test fails.

TABLE 4.1

SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED

Line Repair or Replacement - If the section being tested fails, the Contractor may be required to video tape the sewer line to determine the location of the defective area. The defective pipe shall be repaired or replaced and the low pressure air test performed until the test requirements are satisfied.

4.11.5 Pipe Deflection Testing

At least thirty (30) days after construction and after flushing, all sanitary sewer systems constructed of PVC pipe shall be tested for vertical ring deflection using a deflectometer, properly sized "Go, No-Go" Mandrel, or sewer ball. Maximum allowable vertical ring deflection is five percent (5%) of the pipe's inside diameter. The following Table 4.2 outlines the acceptable Mandrel diameter for different sizes of PVC pipe.

TABLE 4.2

5% DEFLECTION MANDREL DIMENSIONS

Nominal Size Inches	Base Inside Diameter Inches	5% Deflection Mandrel
8"	7.665	7.28
10"	9.563	9.08
12"	11.361	10.79
15"	13.898	13.20
18"	16.976	16.13
21"	20.004	19.00
24"	22.480	21.35
27"	25.327	24.06

4.11.6 Infiltration Testing

Where specified by the District, infiltration testing shall be performed instead of low pressure air testing. This generally would occur when a severe groundwater condition is present. The allowable infiltration for any portion of the sanitary sewer system shall not exceed 50 gallons per inch of inside pipe diameter per mile, per day, including manholes. The amount of infiltration shall be measured using a pipe weir, flume or other method proposed by the District. Groundwater pumping or dewatering shall not occur adjacent to lines being tested for a period of at least three days prior to the infiltration test.

The following Table 4.3 outlines the allowable units of infiltration for various sizes of pipe.

TABLE 4.3 - ALLOWABLE LIMITS OF INFILTRATION
50 Gal/Inch Dia/Mi/Day
or 0.04 Gal/Inch Dia/100'/Hr

Diameter of Sewer (Inches)	Infiltration Gal/Hr/100' (Gallons)
8	0.32
10	0.40
12	0.48
15	0.60
18	0.72
21	0.84
24	0.96
27	1.08
30	1.20
33	1.32
36	1.44

4.11.7 Conveyance and Acceptance

Conditional and final acceptance by the District of facilities intended to be owned and operated by the District shall be accomplished as provided in Article 6 of the Rules and Regulations.

4.11.8 Final Testing

At least eight (8) months after final backfill operations, and probationary acceptance, but no later than thirty (30) days prior to final acceptance of the project, pipelines constructed of flexible materials may be re-tested for vertical ring deflection by a Go-No-Go gauge, at the District's discretion.

Maximum ring deflection of the pipeline shall be limited to Five percent (5%) of the internal pipe diameter. Installed pipe exceeding this deflection limit shall be considered to have reached the limit of its serviceability and shall be replaced and retested prior to final acceptance.

The District shall determine the footage to be tested, but in no case shall the test section be less than 400 feet or the distance between successive manholes, whichever is less. The Go-No-Go gauge shall be reviewed for acceptability by the District prior to testing.

SECTION 5 - CONSTRUCTION DETAIL DRAWINGS

Drawing 1	Standard Bedding for Sanitary Sewer Lines
Drawing 2	Special Bedding for Sanitary Sewer Lines
Drawing 3	Standard Manhole
Drawing 4	Manhole Base and Deflector
Drawing 5	Standard 24" Ring and Cover
Drawing 6	(Not used)
Drawing 7	30" Ring and Cover
Drawing 8	36" x 24" Double Ring and Cover
Drawing 9	Aluminum Step
Drawing 10	Plastic Step
Drawing 11	Manhole Blockout
Drawing 12	Intermediate Platform (District Option)
Drawing 13	Outside Drop Manhole for Pipe 15" & Smaller
Drawing 14	Outside Drop Manhole for Pipe 18" & Larger
Drawing 15	Service Connections to New Construction (PVC Pipe)
Drawing 16	Service Connections to Existing Construction
Drawing 17	Service Connection to Dead-End Manhole
Drawing 18	Concrete Encasement Detail
Drawing 19	Pipe Casing and Sled
Drawing 20	Standard Steel Marker Post
Drawing 21	Redwood Marker Post
Drawing 22	Sanitary Sewer Line Repair
Drawing 23	Service Cleanout
Drawing 24	(Not used)
Drawing 25	Oil and Sand Interceptor
Drawing 26	Commercial Grease Interceptor
Drawing 27	Trench with Underdrain
Drawing 28	Sanitary Sewer Service Connections with Underdrain
Drawing 29	Sanitary Sewer Service Connections with Underdrain

APPENDIX ITEM 1

SANITARY SEWER SYSTEM
PLAN REQUIREMENTS CHECK LIST

GENERAL REQUIREMENTS

1. Correct sheet size (24" x 36").
2. Vicinity Map.
3. Location Map.
4. Index to drawings.
5. List of quantities.
6. List of agencies, including surveyor, soils engineer and all involved agencies for the project.
7. General notes. (Refer to Appendix Item 2.)
8. Professional Engineer, State of Colorado, seal and signature on every sheet.
9. North arrow on vicinity map, location map and each plan view.
10. Title block on each sheet.
11. Bench mark, including U.S.G.S. datum, location, elevation and monument type.
12. Street alignment, existing and proposed, shown on overall plan.
13. Street names.
14. Horizontal curve data for street centerline and all curbs shown on plan, or recorded plat included in plan set.
15. Street grades, existing and proposed shown on profile.
16. Typical street cross-section(s).
17. Street addresses for all lots and/or buildings indicated on plan, or address plat included in plan set.
18. Lot and block numbers.
19. Front lot dimensions.
20. Property, easement and tract lines shown on plan.
21. Private improvements identified.
22. Existing improvements identified.
23. Match lines and sheet references called out in plan and profile.
24. Street cross-pans shown.
25. Center line of drainage channel(s) shown.
26. 100-year flood plain limits shown.
27. Estimated construction cost and proposed development build-out schedule submitted.
28. Recorded plat and address plat submitted.
29. Project in conformance with overall sanitary sewer master plan.

SANITARY SEWER REQUIREMENTS

A. General

1. Sewer line horizontal alignment generally 10' south and west of street centerline; 5' min. from flow line; 10' min. from R.O.W. line.
2. All sewer lines shown in both plan and profile.
3. Manning formula hydraulic data including Q, V, D, d/D, S and n, indicated at connection(s) to existing system. Number and type of units and per unit average and peak flows.
4. Sewer easement drawings and legal descriptions submitted with Professional Land Surveyor, State of Colorado, seal and signature affixed.
5. Sanitary sewer system notes included (refer to attached).
6. Sanitary sewer system details included.
7. Service wye locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, right of left side connection looking upstream and the invert of the main at wyes and plugs shown in tabular form on the plans.
8. Note on plans: "No connections to existing system shall be made until the new lines have been tested and accepted by the District".

B. Sewer Plan View

1. Scale: 1" = 50'
2. Pipe size and material called out.
3. Bearings and linear footage between manholes called out along sewer reach.
4. Outside angles between sewer reaches called out at manholes. (deflection angle)
5. Sewer lines dimensioned from street centerline or property line, and from other utilities, curb and gutter and other obstructions.
6. Connection(s) to existing system shown on plan and tied to property corner or section corner.
7. Manholes properly numbered on plan.
8. Directional flow arrows shown.
9. Service line connections shown (service lines within easements not allowed).
10. At least a 10' workable easement margin on each side of the sewer line.
11. Manhole markers included for sewer line outside of paved R.O.W.
12. Match lines and sheet references.
13. All utility improvements, including water lines and storm sewer, shown on plans.

C. Sewer Profile View

1. Scales: 1" = 50' (horizontal)
   1" = 5' (vertical)
2. Manholes properly numbered and stationed.
3. Pipe size, linear footage and grade called out between manholes.
4. Sewer line grades checked.
5. 1% minimum slope on dead-end mains.
6. Invert elevations for all entering and exiting pipes, rim elevations, cuts and drop inverts called out at the manholes.
7. Sewer service table showing lot number, station from downstream manhole, invert of sewer main at service and left or right side service included.
8. Inside manhole drop between inverts of highest entering pipe and lowest existing pipe not to exceed 1-1/2".
9. Connections to existing system shown on profile.
10. Crossings with other utilities shown on profile (1-1/2' minimum edge-to-edge separation)
11. Match lines and sheet references.

APPENDIX ITEM 2

SOUTHGATE SANITATION DISTRICT
General Notes for Sanitary Sewer System Plans

1) All sanitary sewer system plans and construction shall conform with the current Southgate Sanitation District Specifications and the City of Englewood Standards, and shall be subject to construction observation by District personnel or representatives. Copies of the District's Specifications may be obtained from the District. The Owner, his Engineer or Contractor, shall schedule a pre-construction meeting with the District at least 48 hours prior to the start of construction. Construction plans, reviewed and signed by the District Manager and District Engineer, will be distributed at the pre-construction meeting. No construction will be permitted until all easements are signed and recorded and the pre-construction meeting has been held.

2) The pipe for sanitary sewer mains shall be in accordance with ASTM D-3034 SDR 35 PVC pipe in paved R-O-W's and easements, and AWWA C 900, Class 150 in unpaved easements.

3) Probationary acceptance of the new sanitary sewer mains will not be considered until all requirements for acceptance have been met, including

    1. Sanitary sewer trench compaction test results, and,
    2. Record drawings.

4) The sanitary sewer system will be tested in accordance with the District Specifications.

    1. Lamp 100% of the new system,
    2. Low pressure air test 100% of the new system
    3. Deflection test 100% of the new system.

5) Manhole rims shall be set at an elevation relative to the pavement, in accordance with the appropriate City, County or State Highway Department Standards. Whether or not the manhole is in a paved or unpaved area, a minimum of four-inches (4") of concrete riser rings shall be used to adjust rim elevations to final grade. The maximum acceptable vertical adjustment utilizing riser rings is twelve inches (12").

6) Existing pipe at the point of connection shall not be "broken out" and no service connections will be made until the new system is accepted.

7) The Contractor shall verify existing manhole inverts at proposed points of connection, prior to construction staking.

8) The Contractor shall take care to properly shape all manhole inverts and benches in accordance with District Specifications. Manhole inverts shall be constructed with a smooth trowel or stone finish, and benches finished with a light broom, non-skid finish.

9) The District and/or its representative is not a guarantor of the construction Contractors' obligations and performance of contract.

10) Observations of work in progress and on-site visits are not to be construed as a guarantee by the District or its representative of the Contractors' performance.

11) The District and/or its representative is not responsible for safety in, on, or about the Project site, nor for compliance by the appropriate party of any regulations relating thereto.

12) The District and/or its representative exercises no control of the safety or adequacy of any equipment, building components, scaffolding, forms, or any other work aids used in or about the project, or in the superintending of the same.

13) All new mains must be jetted prior to probation and may be required again prior to final conveyance and acceptance by the District. Costs of jetting will be the responsibility of the contractor. The contractor will be responsible for all pumping associated with the line jetting.

APPENDIX ITEM 3

CONVEYANCE AND ACCEPTANCE
OF
MAIN EXTENSION

1. As of the ____ day of _____, 19__, _____ "Grantor", whose address is _____, has requested and by these presents does request Southgate Sanitation District, Arapahoe & Douglas Counties, Colorado (the "District"), whose address is 3722 E. Orchard Road, Littleton, Colorado 80121, to make preliminary inspection of the lines and facilities more particularly described on Plans prepared by _____, dated _____, 19__, and titled _____, and Record Drawings pertaining to the same lines and facilities, which Plans and Record Drawings are incorporated herein by reference as if set forth herein verbatim, constructed by Grantor in, on, under and across the following described real property:

The said lines and facilities, together with all appurtenances, are hereinafter called the "Project," which term shall be synonymous with the term "Main Extension" as defined in the District's Rules & Regulations, and System Specifications.

2. For valuable consideration, the receipt of which is acknowledged, Grantor hereby transfers and conveys the above-described Project to the District, its successors and assigns, free and clear of all liens, claims and encumbrances of any kind. Grantor, for itself, its successors and assigns, warrants that it has full right and lawful authority to make the conveyance herein contained and agrees to defend the District against any defect in its title to the Project or its right to make the conveyance.

3. The conveyance made in Paragraph 2 above is subject to acceptance thereof by the District and shall not be effective either for purposes of Conditional Acceptance or Final Acceptance until such acceptance is subscribed hereon by the District in the space provided below, all as provided by the District's Rules & Regulations, and System Specifications, except that in no case shall the District's acceptance be deemed final until all street curb and gutter improvements located above Project components have been made.

4. The inspections, observations, testing and reviews performed by the District in connection with this Conveyance and Acceptance are for the sole and exclusive benefit of the District. No liability shall attach to the District by reason of any of the same, or by reason of the issuance of any approvals arising out of them. Further, such inspections, observations, testing and reviews are made for limited purposes only, and the District shall not be deemed to have waived any rights with respect to defects in materials or workmanship in the Project not reasonably susceptible of discovery by the particular inspections, observations, testing or reviews actually performed by the District.

5. This Conveyance and Acceptance is made pursuant and conformable to the District's Rules & Regulations, and System Specifications, as now or hereafter constituted, whose provisions are incorporated herein by reference as though set forth verbatim.

6. The Actual Cost of the Project is $ _____.

IN WITNESS WHEREOF, Grantor has executed this Conveyance and Acceptance the day and year first above written.

INDIVIDUAL OR PARTNERSHIP*

STATE OF COLORADO }
} ss.
COUNTY OF _____ }

The foregoing instrument was acknowledged before me this __day of _____, 199_, by _____.

Witness my hand and official seal.
My commission expires:

Notary Public

*If partnership, both signature and acknowledgement must state capacity of person signing and identify the partnership, by name.

---------- CORPORATION

By:
President

ATTEST:

Secretary

(SEAL)

STATE OF COLORADO }
} ss.
COUNTY OF _____ }

The foregoing instrument was acknowledged before me this __day of _____, 199_, by
president, and _____, secretary of _____, on behalf of the corporation.

Witness my hand and official seal.
My commission expires:

Notary Public

Conditional Acceptance

The Project has received Conditional Acceptance effective as of _____, 19__. Grantor may apply for Final Acceptance any time after _____.

SOUTHGATE SANITATION DISTRICT, Arapahoe and Douglas Counties, Colorado

By:
(Title) (Date)

By:
Meurer & Associates, Inc. Date
District Engineer

Final Acceptance

The Project has received Final Acceptance effective as of _____, 19__.

SOUTHGATE SANITATION DISTRICT, Arapahoe and Douglas Counties, Colorado

By:
(Title) (Date)

By:
Meurer & Associates, Inc. Date
District Engineer

APPENDIX ITEM 4

UNDERDRAIN AGREEMENT

THIS UNDERDRAIN AGREEMENT is entered into this_____ day of _____ , 20__ , by and between SOUTHGATE SANITATION DISTRICT, a quasi-municipal corporation of the State of Colorado (hereinafter referred to as "Southgate"), whose address is 3722 East Orchard Road, Littleton, Colorado 80121, and (hereinafter "Developer"), whose address is
.

WHEREAS, Developer is the owner of a tract of land commonly known as (hereinafter referred to as "Property"), located in County, Colorado, and more particularly described on Exhibit A attached hereto and made a part hereof; and

WHEREAS, for Developer's convenience and for Developer's better enjoyment of the Property, Developer has requested permission to install and construct a private underdrain system in the same trench with sanitary sewer facilities owned and operated by, or subject to the control of Southgate that will serve the Property; and

WHEREAS, Southgate has determined that granting the Developer's request will be of a benefit to the future inhabitants of Southgate.

NOW, THEREFORE, in consideration of the mutual promises and covenants hereinafter set forth, the parties hereto agree as follows:

1. Consent. Developer may, at Developer's sole expense and before or contemporaneously with installation of the sanitary sewer facilities intended to serve the Property, install Developer's underdrain (hereinafter "Underdrain") in the same trench with sanitary sewer lines that serve the Property. If such Underdrain is installed, Developer shall, at all times, have the obligation, enforceable at the demand of Southgate, to operate, maintain, repair, and replace said Underdrain as may be necessary or desirable from time to time to avoid or eliminate any adverse impact on sanitary sewer facilities, as determined by the District.

Before performing any maintenance on or repair or replacements of the Underdrain, Developer agrees to give Southgate at least five (5) days' written notice of the time and place where any such maintenance, repair, or replacement operations are to take place. All maintenance, repair or replacement operations shall be performed in a manner so as not to interfere with or endanger the physical condition or operation of sanitary sewer facilities.

In emergency situations, Developer need not give five (5) days' written notice before performing maintenance, repair, or replacement operations; however, Developer agrees to notify the District by telephone of emergency maintenance, repair, or replacement operations and to provide the District with written notice of the same as soon as practicable thereafter.

2. Ownership and Control. It is expressly understood and agreed that Southgate does not own and will not operate, manage, control, maintain, repair or replace the Underdrain contemplated herein; that Southgate shall have no obligation to operate, manage, control, maintain, repair, or replace the Underdrain; and that said Underdrain is and shall remain at all times private property, completely separate and apart from sanitary sewer facilities; and that Developer and its successor ,as provided below, shall own, operate, manage, control, maintain, repair and replace the Underdrain contemplated herein. Nothing contained herein and nothing hereafter done by Developer, its successors and assigns, shall constitute a dedication of the Underdrain to Southgate. Southgate shall under no circumstances whatsoever accept the Underdrain, or be deemed to have accepted the Underdrain, as property of Southgate.

2.1 Notwithstanding anything contained in this Agreement to the contrary, it is understood and agreed that if the physical condition or operation of sanitary sewer facilities is interfered with or endangered, or constitutes a risk to the health and safety of the public as a result of Developer's Underdrain, then in that event, Southgate shall have the right, but no obligation, at Developer's expense, to do whatever is reasonable and necessary under the circumstances to eliminate such condition.

3. Record Drawings. Developer agrees to furnish Southgate with a set of record drawings for the Underdrain the Developer installs.

4. Indemnification. Developer agrees to indemnify and save Southgate, its officers, Directors, agents, and employees harmless from and against every claim, demand, liability, cost, charge, suit, judgment, and expense of whatsoever kind or nature, including, but not limited to, interest, court costs, and attorneys' fees which Southgate, its officers, Directors, agents, or employees may pay or incur by reason of or which in any way arise out of: (1) this Agreement, (2) the enforcement of this Agreement, or (3) the Underdrain contemplated herein.

This indemnification shall extend to claims, demands, and liability for injury to persons and property and financial loss which occur off the job site as well as on, and for injury and damage to person and property and financial loss occurring after construction of the Underdrain contemplated herein, as well as for any such injury, damage, or loss occurring during the construction of the Underdrain.

5. No Reliance. Developer acknowledges that Developer has not relied upon Southgate to determine whether the Underdrain system and its various components will perform any certain function. Developer is relying solely upon Developer's professional engineer and contractor to: (1) prepare the design and plans for the Underdrain, (2) determine the material, specifications, and soil conditions with regard to the Underdrain, and (3) construct the Underdrain according to the Developer's plans and specifications.

6. Subdivision Documents. Developer agrees that the Property will be held, sold, and conveyed subject to recorded covenants, conditions and restrictions that, among other things, shall expressly:

a) Refer to this Underdrain Agreement and recite the book, page, and reception number at which said Agreement is recorded in the office of the Clerk and Recorder of the County in which the property is located;

b) Provide for an owners' association as part of the plan for the development of the Property, which association shall, among other things, assume and perform all of Developer's obligation hereunder, expressly including the indemnity stated in paragraph 4 above.

c) Permit the District to require the repair, reconstruction, replacement, or relocation of the Underdrain, or any portion thereof, if the District determines for any reason that sanitary sewer facilities are being damaged or endangered by the Underdrain;

d) Subordinate any easement granted to the owners' association for the operation and maintenance of the Underdrain to the rights granted to Southgate by recorded easement deed or agreement, plat dedication, or platted easement for the operation and maintenance of Southgate's facilities;

e) Require the owners' association to establish an adequate fund to cover the cost of predictable operation, maintenance, repair, replacement, and relocation costs, which fund shall be maintained by the assessment of sufficient fees against members of the association to satisfy said obligations;

f) Reaffirm that Southgate does not own, operate, manage, or control the Underdrain system, that the Underdrain system is private property and that Southgate shall not have any obligations for its operation, maintenance, repair, replacement, or relocation.

7. Continuance of Benefits and Obligations. This Underdrain Agreement shall inure to the benefit and shall be binding upon the successors and assigns of the parties hereto, including, but not limited to, the Grantees of the Developer. It is agreed that the conditions, covenants and restrictions, together with the owners' association referred to in paragraph 6 above, are vehicles for facilitating the performance of

Developer's obligations hereunder and shall in no way supersede this Underdrain Agreement or relieve Developer or the Grantees of Developer from any obligation hereunder.

8. Statement on Recorded Plat. Developer agrees that there shall be a statement on the recorded plat for the Property stating that the owners' association shall be responsible for the operation, maintenance, and repair of the Underdrain.

9. Authority to Execute. Each person or persons executing this Agreement on behalf of Developer personally warrants and covenants to Southgate that he or she has full and complete authority to bind the Developer in accordance with the terms of this Agreement.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first above written.

SOUTHGATE SANITATION DISTRICT

By: _____

Duane L. Tinsley, Manager

_____

(Name of Developer)

By: _____

(Name and Title)

_____

(Telephone Number)

STATE OF COLORADO)
) ss.
COUNTY OF _____)

The above and foregoing was acknowledged by Duane L. Tinsley, as manager of the Southgate Sanitation District, this_____day of _____, 20____ .

Witness my hand and official seal.

My commission expires:

_____
Notary Public

_____
Address

STATE OF COLORADO)
) ss.
COUNTY OF _____)

The above and foregoing was acknowledged by_____, as _____ of _____, this _____day of _____ , 20_____.

Witness my hand and official seal.

My commission expires:

_____
Notary Public

_____
Address