

\$3.00

STANDARD OPERATING PROCEDURES  
SEWERS

The following information is provided for Side Sewers, Testing, Type Pipe, Bedding, and Safety within the jurisdiction of the City of Fife, Public Works. Primarily the sewer division, to insure uniformity within the system.

The enclosed procedures are a guide and may be negotiated with the Maintenance Supervisor or City Engineer. Please respond in writing so any changes can be made in this procedure.

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CITY OF FIFE  
Standard Operating Procedure  
Sewers  
Side sewer, Testing, Type Pipe, Bedding, Safety

Minimum Size

No sewer shall be less than 8 inches in diameter except that, in special case, 6-inch diameter sewer lines may be approved by the department if they meet the following criteria:

- a. The probable maximum number of services will not exceed 30 persons. (For this purpose, compute on the basis of not less than three persons per residence.)
- b. Lengths of 6-inch pipe runs in excess of 150 feet will be allowed only at the discretion of the department.
- c. A manhole shall be provided where the 6-inch connects to 8-inch or larger line. Manholes shall be provided at a maximum of 300 foot intervals and at changes in direction or grade. Cleanouts are not acceptable as a substitute for manholes. This does not include a 6-inch side sewer to serve one or two single family dwellings.
- d. A manhole or cleanout shall be provided at the end of the 6-inch line. If a cleanout is provided, the first manhole will be placed within 150 feet of the end of the line.
- e. No extension of the 6-inch line will be possible at a later date.
- f. The minimum slope allowable for 6-inch lines will be 1.0 feet per 100 feet.
- g. Six-inch pipe used in collection systems shall be PVC conforming to ASTM D 3034, SDR 35, or Ductile Iron Class 50 conforming to ASTM A 21.51.
- h. The design is subject to all other design requirements as noted in this chapter.

Depth

Generally, sewer should not be less than three feet deep, but should be sufficiently deep to prevent freezing and physical damage and should receive sewage from existing dwellings by gravity.

Toughness Coefficient

An "n" value of 0.013 shall be used in Manning's formula for the design of all sewer facilities (regardless of pipe material) except inverted siphons, where an "n" value of up to 0.015 can be used.

## Slope

All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second. The following minimum slopes should be provided; however, slopes greater than these are desirable:

<u>Sewer Size</u> <u>(inches)</u>	<u>Minimum Slope</u> <u>(feet per 100 feet)</u>
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06
36	0.05

Under special conditions, slopes slightly less than those required for the 2.0-feet-per-second velocity when flowing full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for design average flow. Whenever such decreased slopes are proposed, the design engineer shall furnish with his report his computations of the depths of flow in such pipes at minimum, average, and daily hourly rates of flow. The maintaining sewage agency must recognize and accept in writing the problems of additional maintenance caused by decreased slopes.

Sewers shall be laid with uniform slope between manholes.

Sewers on 20 percent slope or greater shall be anchored securely with concrete anchors or equal. Suggested minimum anchorage spacing is as follows:

1. Not over 36 feet center to center on grades 20 percent and up to 35 percent.
2. Not over 24 feet center to center on grades 35 percent and up to 50 percent.
3. Not over 16 feet center to center on grades 50 percent and over.

## Alignment

Generally, gravity sewers shall be designed with straight alignment between manholes. However, curved sewers may be approved where circumstances warrant.

## Height-Velocity Protection

Where velocities greater than 15 feet per second are expected, special provision shall be made to protect against internal erosion or displacement by shock.

## Material

Any generally accepted material for sewers will be given consideration, but the material selected should be adapted to local conditions, such as characteristics of industrial wastes, possibility of septicity, soil characteristics, exceptionally heavy external loadings, abrasion, and similar problems.

Material and installation specifications shall contain appropriate requirements that have been established by the industry in its technical publications, such as ASTM, AWWA, WPCF, and APWA standards. Requirements shall be set forth in the specifications for the pipe and methods of bedding and backfilling so as not to damage the pipe or its joints, impede cleaning operations and future tapping, nor create excessive side fill pressure or ovalation of the pipe, nor seriously impair flow capacity.

All sewers shall be designed to prevent damage from superimposed loads. Proper allowance for loads on the sewer because to the width and depth of trench should be made. When standard-strength sewer pipe is not sufficient, the additional strength needed may be obtained by using extra-strength pipe or by special construction, such as improving bedding conditions or encasing the pipe in concrete.

## Joints

The method of making joints and the materials used shall be included in the specifications. Joint specifications shall meet the requirement that have been established by appropriate technical organizations such as ASTM, AWWA, WPCF, and APWA.

## Low Pressure Systems

### Application

Low-pressure systems should be considered for situations such as rock or high ground water table in which gravity sewers are impractical.

### Grinder Pumps/Septic Tank Effluent Pumps

All raw wastewater should be collected from individual building/dwellings and transported to the pressure system by appropriately sized grinder pumps.

Grinder pumps are not required for septic tank effluent, however, and adequate septic tank pumpout and disposal program shall be provided.

All pumps shall be positive-displacement-type or have operating curves that do not allow backflow under maximum head conditions.

Sumps shall be watertight and located above the seasonal ground water table where possible. A minimum 24-hour reserve capacity shall be provided.

#### Provision for Maintenance

Approval of a low-pressure sewer system shall be contingent on the following minimum provisions being made for operation and maintenance:

- a. At least a 5 percent reserve stock of replacement pumping units shall be maintained.
- b. There shall be qualified grinder pump maintenance personnel on the municipality staff as long as the system exists.
- c. There shall be a written service agreement with the manufacturer assuring the availability of factory-trained maintenance personnel, the continued availability of standby equipment and replacement parts, other provisions assuring the department that breakdowns will be repaired within 24 hours, and a written preventative maintenance plan.
- d. Grinder pumps shall be owned by the municipality and shall be maintained by the municipality or its assignee but, in any case, under supervision of the municipality.
- e. The owner of each building served by a grinder pump and low-pressure sewer system will give an easement and/or right-of-way to the municipality for maintenance and inspection services. All persons exercising rights under this document shall be suitably bonded against theft and/or damages to the building and its contents. Notification of entry shall be a matter between owner/occupant/user and the municipality.
- f. Replacement parts should be available for the entire life of the pumping unit. If parts become unavailable, provision should take into account life expectancy of the pumping unit and regular maintenance cost.

#### Minimum Velocity

The minimum velocity in the pressure system shall be 2 feet per second.

## Flushing

There shall be a means of cleaning the system, particularly to clear any settleable solids or grease accumulation. Require 15' maintenance easement on all minor trunk lines.

## Pressure Testing

There shall be means for isolating and pressurizing sections of the system to detect and locate leaks.

## Alarms

There should be a dual warning system both inside the building and out, indicating malfunction or non-function of the pumping. The high-level (in storage tank) warning system should also be a dual system. The warning system should be an audio-visual one.

## Cleanouts

Cleanouts should be provided at maximum of 400-foot intervals.

## Ventilation

Ventilation of the pump station should be provided via house vents where allowable or through a separate system.

## Standby Power

A plug shall be provided to allow for the connection of a portable generator or; the piping system shall contain valving and couplings such that a portable pump can be used in extended power outages.

## Vacuum Systems

Vacuum sewers are considered Developmental Technology.

Vacuum sewer systems may be considered as an alternative to gravity sewers to solve unusual problems in an existing development.

## Manholes

### Location

Manholes shall be installed at the end of each line of 8-inch diameter or greater unless the 8-inch line is not expected to be extended in the foreseeable future in which case, a cleanout can be installed at the end of the line; at all changes in grade, size, or alignment. Manholes shall be installed at all intersections, and at distances no greater than 400 feet.

## Connection

No outside drops permitted. Inside drop connections can be used. Where the difference in elevation between the incoming sewer and the manhole invert is less than 24 inches, the invert should be filleted to prevent solids deposition.

## Diameter

The minimum diameter of manholes should be 48 inches. The minimum clear opening in the manhole frame should be 23 inches.

Manholes connecting significant industries to the system should be larger, to provide space for monitoring and sampling equipment.

## Flushing

## Flow Channels

Flow channels in manholes shall be of such shape and slope to provide smooth transition between inlet and outlet sewers and to minimize turbulence. Channeling height shall be to the crown of the sewers. Benches shall be sloped from the manhole wall toward the channel to prevent accumulation of solids.

## Watertightness

Watertight manhole covers shall be used wherever the manhole tops may be flooded. Manholes of brick or segmented block shall not be used in areas where the ground water table is at or above the manhole.

## Connections

Line connections directly to the manholes or to short stubs integral with the manholes shall be made with AC or PVC adapters..

## Frames, Covers, and Steps

Frames, covers, and steps shall be of suitable material and designed to accommodate prevailing site conditions and to provide for a safe installation.

All covers located in an easement or constructed of aluminum material should be the locking type.

Materials used for manhole steps should be highly corrosion-resistant. Galvanized steel shall be used. First step will be no more than 12" from top of frame in cone, and must go to bottom of manhole, 28" maximum from frame to first step in cone.

## Special Details

### 2.41 Required Separation Between Water Lines and Sanitary Sewers

The basic separation requirements apply to sewers of 24-inch diameter or less; larger sewers may create special hazards because of flow volumes and joint types. The special construction requirements given are for the normal conditions found with sewage and water systems. More stringent requirements given are for the normal conditions found with sewage and water systems. More stringent requirements may be necessary in areas of high ground water, unstable soil conditions, etc.

#### Horizontal Separation (Parallel)

A minimum horizontal separation of ten (10) feet between gravity sanitary sewers and any existing potable water lines shall be maintained, whenever possible. The distance shall be measured edge to edge.

#### Unusual Conditions (Parallel)

When local conditions prevent a horizontal separation as described in 2.41, a gravity sewer may be laid closer than 10 feet to a water line provided.

- a. It is laid in a separate trench; or, it is laid in the same trench with the water line that is located at one side on a bench of undisturbed earth; and
- b. In either case, the elevation of the crown of the gravity sewer must be at least 18 inches below the invert of the water line. When this vertical separation cannot be obtained, the gravity sewer shall be constructed of materials and joints that are equivalent to water main standards of construction and shall be pressure tested to assure water tightness prior to backfilling.

#### Vertical Separation (Perpendicular)

Sewer line crossing water lines shall be laid below the water lines to provide a separation of at least 18 inches between the invert of the water pipe and the crown of the sewer, whenever possible.

Unusual conditions prevent a vertical separation as described in 2.41, the following construction shall be used:

- a. Gravity sewers passing over or under water lines shall be:

1. Constructed of material described in Table 1. The one segment of the maximum standard length of pipe, (but no less than 18 feet long) shall be used with the pipes centered to maximize joint separation.
  2. Standard gravity sewer material encased in concrete or in  $\frac{1}{2}$ " thick continuous steel casing with all voids pressure-grouted with sand-cement grout.
  3. The length of sewer pipe shall be entered at the point of crossing so that the joints will be equi-distant and as far as possible from the water line. The sewer pipe shall be the longest standard length available from the manufacturer.
- b. Water lines passing under gravity sewers, in addition, shall be protected by providing:
1. A vertical separation of at least 18 inches between the invert of the sewer and the crown of the water line;
  2. Adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking of the water lines; and
  3. The length of sewer pipe shall be centered at the point of crossing so that the joints will be equi-distant and as possible ????????? from the water line. The sewer pipe shall be the longest standard length available from the manufacturer.
- c. Pressure sewers shall only be constructed under water lines with ductile iron pipe or standard sewer pipe in a steel casing for a distance of at least ten (10) feet on each side of the crossing.

#### General

Sewers and appurtenances, where required in the plans shall be cleaned and tested after backfilling by either the exfiltration or low pressure air method at the option of the infiltration test.

All work involved in cleaning and testing sewer lines between manholes or rodding inlets as required herein shall be completed within fifteen working days after backfilling of sewer lines and structures. Any further delay will require the written consent of the Engineer. The Contractor shall furnish all labor, materials, tools, and equipment necessary to make the test, clean the lines, and perform all work incidental thereto. The contractor shall perform the tests under the direction and in the presence of the Engineer. Precautions shall be taken to prevent joints from

drawing during tests, and any damage resulting from these test shall be repaired by the Contractor at no expense to the City. The manner and time of testing shall be subject to approval by the Engineer.

All wyes, tees, and stubs shall be plugged with flexible jointed caps, or acceptable alternate, securely fastened to withstand the internal test pressure. Such plugs or caps shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

If the Contractor elects to test large diameter pipe one joint at a time, leakage allowances shall be readily removable, and their removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.

If the contractor elects to test large diameter pipe one joint at a time, leakage allowances shall be converted from GPM per 100 feet to GPM per joint by dividing by the number of joints occurring in 100 feet. If leakage exceeds the allowable amount, corrective measures shall be taken and the line then retested to the satisfaction of the Engineer.

Testing side sanitary sewers shall be for their entire length from the public sewer in the street to the connection with the building's plumbing. Their testing shall be as required by the local sanitary agency but in no case shall it be less thorough than that of filling the pipe with water before backfilling and visually inspecting the exterior for leakage. The decision of the Engineer as to acceptance of the side sanitary sewer shall be final.

If any sewer installation fails to meet the requirements of the test method used, the Contractor shall determine, at no expense to the City, the source or sources of leakage and shall repair or replace all defective materials or workmanship at no expense to the State. The complete pipe installation shall meet the requirements of the test method used before being considered acceptable.

#### Exfiltration Test

Prior to making exfiltration leakage test, the Contractor may fill the pipe with clear water to permit normal absorption into the pipe walls provided, however, that after so filling the pipe he shall complete the leakage test within twenty-four hours after filling. When under test, the allowable leakage shall be limited according to the provisions that follow. Specified allowances assume pre-wetted pipe.

Leakage shall be no more than 0.28 gph per inch diameter per 100 feet of sewer, with a hydrostatic head of 6 feet above the crown at the upper end of the test section, or above the natural groundwater table at the time of test, whichever is higher. The length of pipe tested shall be limited so that the pressure at the

lower end of the section tested does not exceed 16 feet of head above the invert, and in no case shall be greater than 700 feet or the distance between manholes when greater than 700 feet.

Where the test head is other than 6 feet, the measured leakage shall not exceed 0.28 gph per inch diameter per 100 feet times the ratio of the square root of the test head to the square root of 6.

#### SANITARY SEWERS

When the test is to be made one joint at a time, the leakage per joint shall not exceed the computed allowable leakage per length of pipe.

#### Infiltration Test

Infiltration test leakage shall not exceed 0.16 gph per inch diameter per 100 feet, when the natural groundwater head over the pipe is 2 feet or less above the crown of the pipe at the upper end of the test section. The length of pipe tested shall not exceed 700 feet or the distance between manholes when greater than 700 feet.

Where the natural groundwater head is more than 2 feet, the measured leakage shall not exceed 0.16 gph per inch diameter per 100 feet times the ratio of the square root of the natural groundwater head to the square root of 2.

$$\text{Leakage maximum} = 0.16 \times \frac{H}{2} = 0.114 H \text{ gph/inch/100 feet}$$

When a suitable head of groundwater exists above the crown of the pipe and when the pipe is large enough to work inside, acceptance may be based on the repair of visible leakage by means satisfactory to the Engineer.

#### Air Pressure Test For Sanitary Sewers Constructed of Air-Permeable Materials

1. Pipelines may be tested with low pressure air by the pressure drop method, in lieu of water infiltration or exfiltration. The pressure drop shall be from 3-1/2 to 2-1/2 psig greater than the average back pressure of groundwater above the centerline of the pipe. At the Contractor's option, pipe may be tested without pre-wetting; however, the test allowances herein assume pre-wetted pipe.
2. The allowable rate of air loss shall be .003 cfm per square foot of internal pipe surface, but the total air loss shall be not less than 2 cfm nor more than 3.50 cfm. In the event that the Contractor should elect to test air-permeable pipe without pre-wetting, during dry pipe and dry ground conditions, alternate air loss allowances may

be substituted as may be approved by the Engineer, provided it can be demonstrated that the alternate criteria correlates with the standard criteria for wetted pipe.

3. The test equipment to be used shall be furnished by the Contractor and shall be inspected and approved by the Engineer prior to use. The Engineer may at any time require a calibration test of gauges or other instrumentation that is incorporated in the test equipment.
4. Safety Provisions. Plugs used to close the sewer pipe for the air test must be securely braced to prevent the unintentional release of a plug which can become a high velocity projectile. Gauges, air piping manifolds, and valves shall be located at the top of the ground. No one shall be permitted to enter a manhole where a plugged pipe is under pressure. (Four psig air pressure develops a force against the plug in a 12 inch diameter pipe of approximately 450 pounds.) Air testing apparatus shall be equipped with a pressure release device such as a rupture disk or a pressure relief valve designed to relieve pressure in the pipe under test at 6 psi.
5. Pipe under 36 inches in diameter may be tested from manhole to manhole or such shorter lengths determined by the Contractor. Pipe 36 inches in diameter and over shall be tested one joint at a time. Each joint must show no appreciable loss of pressure when held for 30 seconds.

#### Construction Requirements

A cleanout shall be provided for each total change of 90 degrees of grade or alignment and in no case shall the spacing of cleanouts exceed 100 feet. No cleanout will be required at the connection of the side sewer to a riser on the public sewer. A suitably located cleanout in the house piping or plumbing may be considered as a cleanout for the side sewer. Cleanouts shall consist of a wye branch in the side sewer.

All cleanouts located in public right of way shall be extended to grade.

The extension of cleanouts to grade on private property will be optional with the property owner. When extended to grade, cleanouts shall be full side sewer diameter and shall be extended to a point not less than 6 inches nor more than 12 inches below the finished ground surface and shall be plugged with a removable stopper which will prevent passage of dirt or water. When specified, the Contractor shall install an approved casting to provide ready access to the cleanout stopper. A 1/8-bend shall be used to deflect the side sewer upward as a cleanout where the terminal end of the side sewer lies upstream from the last point

of connection.

#### Storm Water

Storm water, run off will not be channeled to sanitary sewer system, to include down spouts and catch basins.

#### Protection of Existing Sewerage Facilities

All existing live sewers including septic tanks and drain fields shall be kept in service at all times. Provision shall be made for disposal of sewage flow if any existing sewers are damaged. Damage to existing sewers shall be repaired by the Contractor, at no expense to the State, to a condition equal to or better than their condition prior to the damage.

Water accumulating during construction shall be removed from the new sewers but shall not be permitted to enter the existing system. The Contractor shall be responsible for flushing out and cleaning any existing sewers into which gravel, rocks, or other debris has entered as a result of his/her operations, and shall repair lift stations or other facilities damaged by his/her operations.

The physical connection to an existing manhole or sewer shall not be made until authorized by the Engineer. Such authorization will not be given until all upstream lines have been completely cleaned, all debris removed, and where applicable, a pipe temporarily placed into the existing channel and sealed.

#### SIDE SEWERS

##### Description

This work shall consist of constructing side sewers in accordance with the plans, these Specifications, and the Standard Plans, at locations as staked by the Engineer, on both the right of way and private property between the main sanitary sewer line and the stubout from a residence or other building.

##### Materials

Materials shall be the same as required for sanitary sewers in Section 7-17

##### Construction Requirements

###### General

The construction requirements for sanitary sewers in Section 7-17 shall apply to the construction of side sewers,

Side sewers shall not be backfilled prior to inspection.

Side sewers shall be constructed with a maximum joint deflection

not to exceed the manufacturer's printed recommendations and in no case shall exceed 2 inches per foot in any joint. Larger changes in direction shall be made by use of standard 1/8-bends.

#### Fittings

Side sewers shall be connected to the tee, wye, or riser provided in the public sewer, where such is available, utilizing approved fittings or adapters. Where no tee, wye, or riser is provided or available, connection shall be made by machine-made tap and approved saddle.

#### Testing

All side sewers shall be tested after backfilling.

All side sewers constructed in conjunction with the main sewer shall, for purposes of testing as specified in Section 7-17, have a 6-inch tee fitting pipe placed at the point where the side sewer crosses the street or other public right of way margin. The tee opening shall be positioned perpendicular to the side sewer slope, unless other wise directed by the Engineer.

When side sewers are not tested simultaneously with the testing of the main sewer, the Contractor, at no expense to the City, shall furnish and place an additional tee in the first pipe out of the main sewer tee or wye branch, so that an inflatable rubber ball can be inserted for sealing off the side sewer and thus permit separate tests.

Lower end shall have a 2 by 4 cleat nailed to it to prevent withdrawal of the stake. The exposed 1 foot shall be painted traffic white and the depth to the side sewer or tee shall be indicated in black paint on the 2 by 4. In addition, a length of 12-gauge galvanized wire shall be provided to extend from the plugged end of the side sewer or tee. The upper end shall emerge at the 4-foot stake, but shall not be fastened to it.

#### ABS Composite Sewer Pipe

This material shall not be used in the City of Fife projects unless specified in the special provisions.

ABS Composite pipe shall meet the requirements of AASHTO M 264.

ABS Composite pipe shall be provided with Type OR (flexible gasketed) joints. Rubber gasketed joints shall conform to applicable provisions of ASTM C 443.

Fittings for ABS composite pipe being connected, except that fittings using other materials or constructed with more than one material may be used subject to the approval of the Engineer. Fittings shall have sufficient strength to withstand handling and load stressed normally encountered.

#### Manhole Ring and Cover

Castings for manhole rings and covers shall be gray iron castings conforming to the requirements of AASHTO M 105, Class 40.

The cover and seat shall be machined to have perfect bearing for the full width and circumference of the bearing surface.

#### PVC Sewer Pipe

This material may be used in City of Fife projects unless specified in the special provisions.

Polyvinyl chloride pipe shall conform to the requirements of ASTM D 3034 SDR 35 or ASTM F 789.

Joints for PVC pipe shall conform to ASTM D 32312 using restrained gasket conforming to ASTM F 477.

Fittings for PVC pipe shall be injection molded tees or factory solvent cemented saddle tees. Normally, all fittings shall be the same material as the pipe being connected except that fittings using other materials or constructed with more than one material may be used subject to the approval of the Engineer. Fittings shall have sufficient strength to withstand handling and load stresses normally encountered. All non metallic pipe will have tracer tape or 14 GA copper wire.

#### Ductile Iron Sewer Pipe

This material may be used in City of Fife projects unless specified in the special provisions.

Ductile iron pipe shall conform to ANSI A 21.51 or AWWA C 151 and shall be cement mortar lined, push-on joint or mechanical joint. The ductile iron pipe shall be Class 50 or the class indicated on the plans or in the special provisions.

Joints for ductile iron pipe shall be rubber gasketed conforming to the requirements of ANSI A 21.11 or AWWA C 111.

Cast iron fittings may be used with ductile iron pipe. Saddles fastened to pipe with external bands shall not be acceptable on any new system. Normally, all fittings will be required for each manufacturer of gasketed helically corrugated lock seam steel pipe. Only those specific pipe sizes and gasket materials approved under the qualification test will be accepted.