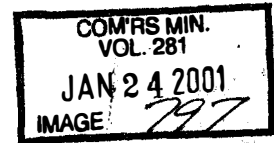


ARTICLE VI

DESIGN OF SANITARY SEWERS



Section 601 Determination of the Amount of Sewage for Sanitary Sewers

A. MSD Design Standards for estimating sanitary sewage flow from new developments

1. Residential Sanitary Sewage

The average flow of sanitary sewage shall be computed on the basis of 100 gallons per capita. The peak flow for various situations shall be in accordance with the following table:

<u>POPULATION</u>	<u>PEAK FLOW</u>
Under 750	4 times the average
Under 1,000	3.9 times the average
Under 1,750	3.8 times the average
Under 2,500	3.6 times the average
Under 5,000	3.3 times the average
Over 5,000	Consult the Director

2. Industrial and/or Commercial Sewage

The amount of sewage shall be fixed after consultation with the Director.

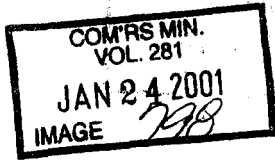
3. Infiltration/Inflow

An allowance of 1000 gallons per acre per day for the gross tributary area of the drainage basin shall be added to the above peak sanitary flows.

B. Determination of the Amount of Sanitary Sewage for Existing Sanitary Sewer Upgrades

1. The design capacity of sanitary sewers and pump stations shall be based on the result of current flow monitoring and modeling in accordance with MSD Guidelines for Sanitary Sewage Flow Estimation (listed below). If these results produce a design flow rate less than that determined under Section 601 (A.), then the amount determined using the method in Section 601 (A.) shall be used.

MSD Guidelines for Sanitary Sewage Flow Estimation:



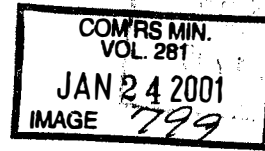
- a. The design flow will be based on the model-projected peak sewer flow rate from a design storm with an applicable recurrence interval. The design flow will be comprised of three components:
 - i. Base wastewater flow (BWF);
 - ii. Groundwater infiltration (GWI);
 - iii. Rainfall-derived inflow/infiltration (RDII).

- b. The design flow components will be determined using the following criteria:
 - i. BWF will be established using either
 - (1) MSD guidelines for peak diurnal flow (per Section 601A. and B.), or
 - (2) Peak diurnal flow observed during flow monitoring, whichever is greater.

 - ii. GWI will be set at the maximum rate observed during a one-year flow monitoring period, or that projected to be the typical annual peak GWI rate (i.e. peak rate expected once per year) if flow monitoring results are considered to be not representative of typical conditions.

 - iii. RDII will be established using the following conditions:
 - (1) The Soil Conservation Service (SCS) Type II rainfall distribution;
 - (2) Antecedent soil moisture conditions that correspond to the maximum observed wet-weather flow during a one-year flow monitoring period shall be assumed in estimating the design RDII flow rate. If flow monitoring results are not considered to be representative of typical conditions for this purpose, then the flow monitoring data shall be used to project to the maximum antecedent soil moisture conditions expected to occur once per year, which will be used for establishing the design RDII flow rate.

2. Flow from any undeveloped portions of the service area of the upgrade sewer/pumping facility will be accounted for using the full build out conditions for those areas and the MSD Design Standards for estimating sanitary sewage flow from new developments (per Section 601 (A.)).



C. Special Conditions

Where special conditions are identified, determination of the amount of sewage shall be fixed after consultation with the Director.

Section 602 Determination of Conduit Size

The minimum conduit diameter for sewer purposes (except building sewers) shall be eight (8) inches. For sewers up to and including twenty-four (24) inches in diameter, design for the above volumes of sewage with the sewer flowing half full. For sewers twenty-seven (27) inches in diameter, design for the above volumes of sewage with the sewer flowing at 0.6 depth and for sewers thirty (30) inches in diameter and larger, design for the above volumes of sewage with the sewer flowing at 0.7 depth.

Use Manning's Formula with an "n" factor of 0.013 in design.

Section 603 Determination of Minimum Allowable Conduit Slope (Manning's Formula)

The Minimum Allowable Slope shall be that which results in a velocity of two (2) feet per second when the conduit flows at 1/4 of full depth.

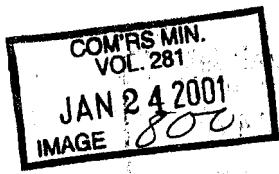
SIZE	SLOPE (PERCENT)
8" Conduit	0.70
12" Conduit	0.40
15" Conduit	0.30
18" Conduit	0.24
21" Conduit	0.19
24" Conduit	0.16
27" Conduit	0.14
30" Conduit	0.12

Section 604 Placement of Manholes

Manholes shall be placed at intersections of two or more sewers; at changes of size of pipe, alignment, or grade; at the head end of the sewer; at curves on sewers 30" in diameter and larger (preferably on the upstream side of the curve); and at intermediate intervals as follows:

8" to 18"	400 ft. maximum
21" to 27"	500 ft. maximum
30" to 42"	600 ft. maximum

Manholes on pipes 24" and larger shall have flat slab tops in accordance with Standard Drawing Accession Number 49049.



Section 605 Location of the Sanitary Sewer

The sanitary sewer shall normally be within the confines of the street right-of-way or the utility easement adjacent to the street right-of-way or a combination of both where there is a conflict with other utilities:

A. Within the street right-of-way:

The location of the sanitary sewer shall be within the confines of the street pavement with manholes located five (5) feet off the centerline of the street. This will allow the other utilities to be located in their traditional location as follows:

1. Storm sewers should be within the confines of the street pavement with manholes located five (5) feet off the centerline of the proposed street.
2. Gas mains should be between the curb line and right-of-way line on the south or west side of the proposed street.
3. Water mains should be between the curb line and the right-of-way line on the north or east side of the proposed street.
4. -- Electric and Telephone Conduits will be within easements adjacent to the street right-of-way.

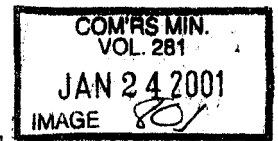
B. Within the utility easement adjacent to the street right-of-way as per the Hamilton County Engineer's Subdivision Standard Drawing #2A:

The location of the sanitary sewer shall be within the confines of the utility easement (minimum ten feet in width), the centerline of sanitary sewer shall be a minimum of ten (10) feet from the centerline of the storm sewer and maximum of 13.5 feet from the curb-line of the pavement. No other utilities except storm sewer shall be installed in this side of the street right-of-way and utility easement where sanitary sewers are installed.

If the above locations are not to be used, the special approval of location shall be obtained from the Director.

Section 606 Drop Connections into Manhole

When branch sewer connections are made to a manhole, the branch line must be connected in such a manner that its crown elevation at the centerline of the manhole matches that of the outlet pipe. The manhole bench shall be channeled in such a manner as to direct the incoming flow to the outlet pipe.



Drop connections into manholes in accordance with Standard Drawing Acc. No. 49003 shall only be used where approved by the District. For new sewer systems, drop connections shall be avoided when the difference in elevation between the outgoing and incoming pipes is less than four (4) feet by increasing the slope of the incoming sewer such that the crown elevation equals the crown elevation of the outgoing pipe. For sewer replacements, existing sidelines may continue to enter the replacement sewer at their present elevation. However, if the invert of the main sewer is two (2) feet or more below the invert of the incoming branch sewer, the branch sewer connection shall be made with a drop connection.

For special conditions, the Director will review written requests for approval of a variance to this section on a case-by-case basis. Examples of such special conditions include:

- A. Unavoidable utility conflicts;
- B. Severe ground conditions;
- C. Inside drop connections for existing manholes;
- D. Unforeseen construction conditions.

Section 607 Joints for Sanitary Sewers

All sanitary sewers, including sanitary building sewers and manholes, shall be built with resilient and flexible compression joints, or an approved equal, as determined by the Director, in accordance with the District's Specifications and Standards.

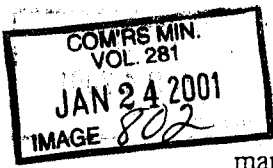
Section 608 Suitable Ground for Sewer Construction

Sewers and appurtenances shall be constructed in original ground, wherever possible. However, when they must be constructed in fill, said fill shall be controlled, compacted and inspected by an approved testing laboratory or an inspector from the appropriate public authority. Minimum compaction requirements, subject to rules or specifications of the public authority, shall be those spelled out in the latest edition of the "STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, CONSTRUCTION AND MATERIALS SPECIFICATIONS," for Embankment Soil Compaction Requirements.

Section 609 Steep Sewer Sections

- A. Conduit Sizes 8" through 24"

For sewer slopes twenty percent (20%) or greater, pipe shall be PVC-SDR35 or material approved by MSD and be anchored with concrete keyblocks as shown on Standard Drawing Accession No. 49039 spaced as follows at joints only. For slopes between 20 percent and 35 percent, keyblocks shall be installed at intervals not more than 36 feet center to center. For slopes 35 percent to 50 percent, keyblocks shall be installed at intervals not more than 24 feet center to center. For slopes over 50 percent, keyblocks shall be installed at every joint of the installed pipe. Such steep sewer sections shall be terminated at the bottom of the steep slope with a special



manhole designed and constructed to dissipate the thrust and downward force of the sewer system at the manhole.

B. Conduit Sizes 27" and Larger

For sewer slopes fifteen percent (15%) or greater, pipe shall be ductile cast iron or material approved by MSD. For sewer slopes between fifteen percent (15%) and twenty-five percent (25%), keyblocks shall be provided at every joint. Keyblocks shall be installed as shown on Standard Drawing Accession No. 49039. Such steep sewer sections shall be terminated at the bottom of the steep slope with a special manhole designed and constructed to dissipate the thrust and downward force of the sewer system at the manhole.

Section 610 Concrete Cradles

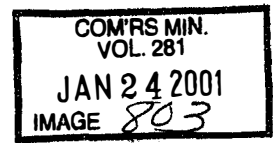
When it is considered advisable in the judgment of the Director, the sewer pipe shall be laid in a concrete cradle, Type "A" or Type "B," as shown on Standard Drawing Accession No. 49044.

Section 611 Sewer Pipe in Creek Beds and Shallow Installations

Sewer pipe in creek beds and in shallow installations shall be encased in concrete when the cover is less than four feet (4') or when it is considered advisable in the judgment of the Director. Type "B" encasement as shown on Standard Drawing Accession No. 49044 shall be used. When the cover on such pipe is two feet (2') or less, the pipe, from manhole to manhole, shall be Ductile Cast Iron, or an approved equal as determined by the Director, encased as noted above.

Special mitigative measures shall apply for all sewer crossings and sewer construction in creek riparian areas:

- A. Sewers crossing streams shall be designed to cross the stream as nearly perpendicular to the stream as possible.
- B. Sewer systems shall be designed to minimize the number of stream crossings, and to be located as far from streams and riparian areas as possible.
- C. Sewer construction easement widths should be minimized.
- D. Unnecessary damage to trees for sewer construction shall be avoided.
- E. Controls to minimize both erosion and sedimentation shall be implemented.



Section 612 Sewer Construction within Special Flood Hazard Areas

No public or private sewer, or system of sewers, shall be constructed or located within any Special Flood Hazard Area unless the Director certifies that the sewer or system of sewers is proposed to be located and constructed in such a manner as to minimize or eliminate flood damage to them and:

- A. Minimize or eliminate the flow or infiltration of flood waters into or out of such systems during and after the base flood discharge, OR
- B. Have all parts elevated at least one (1) foot above the base flood level.

Section 613 Low Pressure Sewer Systems

When the construction of a gravity sewer system is not reasonably possible as determined by the Director, an alternative low-pressure sewer system will be considered for approval. Where approved, the design and construction shall be in accordance with the District's latest specifications, standards, policies and procedures.

Section 614 Backwater Preventer

The District requires that a sewage backwater valve be installed in accordance with the requirements of any local jurisdiction's plumbing code for plumbing fixtures where the elevation of the overflow rim of the lowest plumbing fixture is below the elevation of the rim of the next upstream manhole in the sewer system that the building is connected to.