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FOREWORD

This Edition replaces and supersedes the 1972 Edition of "Guidelines for Assessing Sewerage Works". As before, the intent of the Guidelines is to provide guidance and assistance in the preparation of plans and specifications required pursuant to Section 26 of the Pollution Control Act and to facilitate checking certificate requests.

These guidelines are largely an adaption of the "Recommended Standards for Sewage Works" issued under the auspices of the Great Lakes - Upper Mississippi River Board of State Sanitary Engineers, 1978 Edition, commonly referred to as the Ten State Standards, and the same format has been used in presenting the material.

In the Ten State Standards, where the term "shall" is used, it is intended to be mandatory. The terms "should", "recommended", "preferred" and the like indicate best practice. Although a similar format has been adopted herein, it is recognized that many aspects of design are not covered by the Guidelines and the responsibility for these and for the criteria adopted in any particular case rests with the professional engineer carrying out the design. Where such criteria differ from the Guidelines, an indication to this effect and an explanation of the alternative proposed is requested to facilitate processing.

In this edition, consideration of sewers remains limited to conventional gravity systems. This is not intended to preclude designs utilizing vacuum or low pressure pumping systems when warranted by specific conditions.

B.E. Marr
Deputy Minister of Environment

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CHAPTER 10
PLANS AND SPECIFICATIONS

12. PLANS

12.1 General

Drawings must have a suitable title showing the name of the Municipality, Sewer Authority or Institution and must show the scale in metres, a graphical scale for plan views, the north point, the Engineer's name and designation, his signature and imprint of his registration seal.

Drawings must be clear and legible and drawn to a scale which will permit all necessary information to be plainly shown. The maximum recommended size is 75 cm x 100 cm. Any datum used is to be indicated and the location and logs of relevant test borings shown.

Drawings must include such plan views, elevations, sections and supplementary views, which, taken together with the specifications and general layouts, provide adequate working information for the contract and construction of the works. They are to encompass dimensions and relative elevations of structures, the locations and size of piping, water levels and ground elevations.

12.2 Drawings for Sewers

12.2.1 General Plan

The plan views must show geographical features as relevant and existing sewers where these are significant in considering the works proposed as follows:

12.2.1.1 Geographical Features

a. Topography and elevations - existing or proposed streets, all streams or water surfaces and contour lines at suitable intervals.

b. Streams - the direction of flow in all streams and high and low water elevations of all water surfaces at sewer outlets and overflows.

c. Boundaries - the boundary lines of the municipality and the sewer district or area to be sewered.

12.2.1.2 Sewers

The location, size and direction of flow of all existing and proposed sanitary and combined sewers in the area concerned.

12.2.2 Detail Drawings

Detail drawings must include profiles having a horizontal scale of not more than 1200:1, a vertical scale of not more than 120:1, plan views drawn to a corresponding horizontal scale and details to a larger scale as required to encompass the following:

a. Location of streets and sewers.

b. Line of ground surface; size, material, type and class of pipe; width of trench and pipe bedding; length between manholes, invert and surface elevation at each manhole and grade of sewer between each two adjacent manholes. All manholes systematically numbered.

The elevation and location of the basement floor, plotted on the profile of the sewer for any house where there is any question of the sewer being sufficiently deep.

c. Locations of all special features such as inverted siphons, concrete encasements, elevated sewers, etc.

d. Location of all known existing structures both above and below ground which might interfere with the proposed construction, particularly water mains, gas mains, storm drains, etc.

e. The location of any relevant services proposed under other contracts.

f. All stream crossings and sewer outlets with elevations of the stream bed and of normal and extreme high and low water levels.

g. Details of all special sewer joints and cross-sections.

h. Details of all sewer appurtenances such as service connections, manholes, inspection chambers, inverted siphons, tide gates, elevated sewers, bedding details and any other details relevant to the system.

12.3 Drawings for Sewage Pumping Stations

12.3.1 Location Plan

Any necessary location plan must show:

a. The location and extent of the tributary area.

b. Any municipal boundaries within the tributary area.

c. The location of the pumping station and force main, and pertinent elevations.

12.3.2 Detail Drawings

Detail drawings must show as applicable:

a. A contour map of the property to be used.

b. Existing pumping stations.

c. Proposed pumping station, including provisions for installation of future pumps or ejectors.

d. Elevation of high water at the site, and maximum elevation of sewage in the collection system upon occasion of power failure.

e. Test borings and groundwater elevations.

12.4 Drawings for Sewage Treatment Plants

12.4.1 Location Plan

Location plans must show the sewage treatment plant in relation to the remainder of the system and include sufficient topographic features to indicate its location with relation to streams and the point of discharge of treated effluent.

12.4.2 General Layout

General layout plans must show:

a. Topography at the site.

b. Size and location of plant structure.

c. Schematic flow diagram showing the flow through various plant units.

d. Piping, including any arrangements for by-passing individual units. Materials handled and direction of flow through pipes.

e. Hydraulic profiles showing the flow of sewage, supernatant liquor and sludge.

f. Test borings and groundwater elevations.

12.4.3 Detail Drawings

Detail drawings must show the following as applicable:

a. Complete engineering and architectural details of the proposed plant.

b. Location, dimensions and elevations of all existing and proposed plant facilities.

c. Elevations of high and low water level of the body of water to which the plant effluent is to be discharged.

d. Type, size, pertinent features and manufacturer's rated capacity of all pumps, blowers, motors and other mechanical devices.

e. Minimum, average and maximum hydraulic flow in profile.

f. Adequate description of any features not otherwise covered by specifications or engineer's report.

13. SPECIFICATIONS

Specifications accompanying construction drawings are to include, but not be limited to, all construction information not shown on the drawings which is necessary to inform the builder in detail of the design requirements as to the quality of materials and workmanship and fabrication of the project and the type, size, strength, operating characteristics and rating of equipment; allowable infiltration, the complete requirements for all mechanical and electrical equipment including machinery, valves, piping and jointing of pipe; electrical apparatus, wiring, and meters; laboratory fixtures and equipment; operating tools; construction materials, special filter materials such as stone, sand, gravel or slag; miscellaneous appurtenances; chemicals when used, instructions for testing materials and equipment as necessary to meet design standards and operating tests for the completed works and component units.

14. REVISION TO APPROVED PLANS

Any deviations from approved plans or specifications affecting capacity, flow or operation of units shall be approved in writing before such changes are made. Plans or specifications so revised should, therefore, be submitted well in advance of any construction work which will be affected by such changes, to permit sufficient time for review and approval. Minor changes not affecting capacities, flows, or operation will be permitted during construction without approval.

15. OPERATION DURING CONSTRUCTION

Specifications shall contain a program for keeping existing treatment plant units in operation during construction of plant additions. Should it be necessary to take plant units out of operation, a shutdown schedule shall be adhered to which will minimize pollutional effects on any receiving stream.

16. CALCULATIONS

Where the nature of the scheme so warrants, computations must be presented to substantiate sewer sizes in terms of the depths of flow and the minimum, average and maximum flows for the different sizes of sewer proposed. Where considered necessary, computations must also be presented to substantiate the class of pipe proposed having regard to bedding, depth of cover, loadings, etc.

CHAPTER 20

DESIGN OF GRAVITY SEWERS

25. DETAILS OF DESIGN AND CONSTRUCTION

25.1 Minimum Size

No sewer shall be less than 200 mm in diameter except for the upstream 400 m of sewers serving residential property where extension in the future is precluded for evident reasons (physical barriers, existing alternate pickup of adjacent area, etc.).

In no case shall sewers be less than 150 mm in diameter.

25.2 Depth

In general, sewers shall be sufficiently deep so as to drain all basements at a minimum grade of 1½% and to prevent freezing. In general cover should be no less than 1.5 m in travelled areas and 1.0 m elsewhere.

25.3 Slope

All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 0.6 m/s based on Kutter's formula using an "n" value of 0.013. The following are the minimum slopes which should be provided; however, slopes greater than these are desirable.

Sewer Size	Minimum Slope in metres per 100 m
200 mm	0.40
250 mm	0.28
300 mm	0.22
350 mm	0.17
375 mm	0.15
400 mm	0.14
450 mm	0.12
525 mm	0.10
600 mm	0.08
675 mm	0.067
750 mm	0.058
900 mm	0.046

Note: The values in the above table correspond closely for smaller sizes to those obtained using Manning's formula with n = 0.012, for which tables are readily available, and v = 0.7 m/s.

Slopes slightly less than those described above may be permitted under special justifiable conditions, but in no case will velocities below 0.46 m/s be permitted, based on Kutter's formula using an "n" value of 0.013 as above, (corresponding velocity using Manning's formula and an "n" value of 0.012 = 0.55 m/s). Flatter slopes may cause additional sewer maintenance expense. Sewers shall be laid with uniform slope between manholes except under the most exceptional circumstances where any deviation must be justified. Sewers on steep grades shall be anchored as required to ensure stability.

25.4 Alignments

Sewers 600 mm or less in diameter shall be laid with straight alignment between manholes except that horizontal curving of not less than 60 m radius may be permitted where conditions so warrant and where continuous and adequate engineering surpervision of laying and backfilling is provided. Compound curves will not be permitted and design velocities on curved sections shall not be less than 0.75 m/s.

25.5 Size Changes

25.5.1 Increasing Size

When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

25.5.2 Decreasing Size

Sewers shall not decrease in size progressing downstream, except that such size changes may be permitted on trunk sewers, with adequate design for the transition, where it can be shown special circumstances apply.

25.6 High Velocity Protection

Where velocities greater than 4.6 m/s are attained, special provision shall be made to protect against displacement by erosion and shock.

25.7 Materials

The sewer material selected should be suitable for local conditions, such as character of industrial wastes, possibility of septicity, soil characteristics, exceptionally heavy external loading, abrasion and similar problems.

25.8 Joints and Infiltration

The method of making joints and the materials used should be included in the specifications. Sewer joints shall be designed to minimize infiltration and to prevent the entrance of roots. Leakage tests shall be specified. This may include appropriate water or low pressure air testing. The leakage outward or inward (exfiltration or infiltration) shall not exceed 0.2 m^3 per cm of pipe diameter per kilometre per day for any section of the system. The use of television cameras or other visual methods for inspection prior to placing the sewer in service is recommended.

25.9 Construction

Pipe bedding, concrete protection and depth and nature of cover should be designed to meet the anticipated loadings and ground conditions and should generally conform to pipe manufacturer's recommendations.

26. MANHOLES

26.1 Location

Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections; and at distances not greater than 120 m for sewers 375 mm diameter or less, and 150 m for sewers 450 mm to 750 mm diameter, except that distances up to 180 m may be approved in cases where adequate modern cleaning equipment for such spacing is provided. Greater spacing may be permitted in larger sewers and in those carrying a settled effluent.

26.2 Drop Type

A drop pipe should be provided for a sewer entering a manhole at an elevation of 600 mm or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 200 mm benching shall be designed to prevent solid deposition. Drops between 200 mm and 600 mm should be avoided by adjusting sewer gradients.

26.3 Diameter

The minimum diameter or width of manhole chambers shall be 1000 mm; larger diameters are preferable. Where depths require access shafts, the minimum diameter shall be 750 mm.

26.4 Flow Channel

The flow channel through manholes should be made to conform in shape and slope to that of the sewers.

26.5 Watertightness

Watertight manhole covers are to be used where ever the manhole tops may be flooded by street run-off or high water. Manholes of brick or segmented block should be waterproofed on the exterior with plaster coatings, supplemented by a bituminous waterproof coating where groundwater conditions are unfavourable.

26.6 Covers

Covers shall be cast iron or equal with separate frames, designed for the anticipated loading. The minimum recommended access diameter is 500 mm.

27. INVERTED SIPHONS

Inverted siphons should have not less than two barrels, with a minimum pipe size of 150 mm and shall be provided with necessary appurtenances for convenient flushing and maintenance. The manholes shall have adequate clearances for rodding and sufficient head shall be provided and pipe size selected to secure velocities of at least 1.0 m/s for average flows. The inlet and outlet details shall be arranged so that the normal flow is diverted to one barrel, and so that either barrel may be cut out of service for cleaning.

28. SEWER EXTENSIONS

In general, sewer extensions shall be allowed only if the hydraulic and structural adequacy of the sewer system downstream has been substantiated and any discharge arising to provincial waters or to the ground is authorized under the Pollution Control Act.

29. PROTECTION OF WATER SUPPLIES

29.1 Water Supply Interconnections

The design shall ensure that there can be no physical connection between any public or private potable water supply system and any sewer or appurtenance thereto which would permit the passage of any sewage or polluted water into the potable supply.

29.2 Relation to Water Mains

29.2.1 Horizontal Separation

Whenever possible, sewers shall be laid at least 3 m horizontally from any existing or proposed water main. If local conditions prevent this, a sewer may be laid closer than 3 m to a water main if:

a. It is laid in a separate trench.

b. It is laid in the same trench with the water mains located at one side on a bench of undisturbed earth.

In either case, the elevation of the crown of the sewer shall be at 450 mm below the invert of the water main.

29.2.2 Vertical Separation

Whenever sewers must cross under mains, the sewer should be laid at such an elevation that the top of the sewer is at least 450 mm below the bottom of the water main. If this is not possible, the water main should be relocated.

Where trench lines cross at different elevations the support for the upper pipe shall be adequately designed to span the trench width.

29.2.3 Special Conditions

Where it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be constructed of iron pipe and both services should be pressure tested to assure watertightness.

CHAPTER 30

SEWAGE PUMPING STATIONS

31. GENERAL

31.1 Flooding

The elevation and construction of pumping stations shall be such as to prevent flooding or flotation.

31.2 Grit

Where it may be necessary to pump sewage prior to grit removal, the design of the wet well should receive special attention and the discharge piping shall be designed to prevent grit settling in pump discharge lines of pumps not operating.

31.3 Access and Rights of Way

Vehicular access must be maintained at all times. Superstructures should be clear of any right of way.

32. DESIGN

32.1 Type

Sewage pumping stations should be of the dry-well type, with sewage elevation at pump cut-in above the impeller elevation. Alternatively, submersible pumps may be used for smaller installations where the design incorporates ready removal facilities for maintenance or replacement. Above-ground structures for housing electrical equipment and permitting stairway access to the dry well are preferred. Below-ground structures should only be used for smaller installations where design considerations so warrant.

32.2 Structures

32.2.1 Separation

The structure housing the electrical equipment and dry well access shall not cover any wet well without a wall or floor to effect separation.

32.2.2 Pump Removal

Provision shall be made to facilitate removal of pumps and motors. Submersible pumps shall be removable without dewatering the wet well or impeding operation of other units.

32.2.3 Access

Suitable and safe means of access shall be provided to dry wells and to wet wells containing either bar screens or mechanical equipment requiring inspection or maintenance. Stairways should be installed with rest landings not to exceed 3 m vertical intervals.

32.2.4 Materials

The nature of the ground and sewage to be pumped shall be taken into account in selecting materials for construction.

32.3 Pumps and Pneumatic Ejectors

32.3.1 Multiple Units

At least two pumps or pneumatic ejectors shall normally be provided.

If only two units are provided, they should have the same capacity. Each shall be capable of handling flows in excess of the expected maximum flow. Where three or more units are provided, they should be designed to fit actual flow conditions and must be of such capacity that with any one unit out of service, the remaining units will have capacity to handle maximum sewage flows.

32.3.2 Protection Against Clogging

Pumps handling raw sewage should be preceded by readily accessible bar racks with clear opening not exceeding 65 mm, unless pneumatic ejectors are used or special devices are installed to protect the pumps from clogging or damage. Where the size of the installation warrants, a mechanically cleaned bar screen with grinder, or comminution device is recommended. Where screens are located below ground, convenient facilities must be provided for handling screenings. For the larger or deeper stations, duplicate protection units of proper capacity are preferred.

32.3.3 Pump Openings

Pumps shall be capable of passing spheres of at least 75 mm in diameter. Pump suction and discharge openings shall be at least 100 mm in diameter.

32.3.4 Operation

Pumps, including submersible pumps, shall be capable of unsubmerged operation without damage or reduction of service capability.

32.3.5 Electrical Equipment

Electrical equipment in enclosed places where gas may accumulate shall comply with the National Board of Fire Underwriters specifications for hazardous conditions (NEMA Type 7).

32.3.6 Intake

Each pump should have an individual intake. Wet well design should be such as to avoid turbulence near the intake.

32.3.7 Dry Well Dewatering

A separate sump pump shall be provided in the dry wells to remove leakage or drainage with the discharge above the overflow level of the wet well. A connection to the pump suction is also recommended as an auxilliary feature. Water ejectors connected to a potable water supply must not be installed. All floor and walkway surfaces should have an adequate slope to a point of drainage.

32.3.8 Pumping Rates

The pumps and controls of main pumping stations, and especially pumping stations operated as part of treatment works, should be selected to operate at varying delivery rates to permit discharging sewage from the station to the treatment works at approximately its rate of delivery to the pump station.

32.4 Controls

Control float tubes should be so located as not to be unduly affected by flows entering the well or by the suction of the pumps. Float tubes in dry wells shall extend high enough to prevent overflow. In small stations with duplicate units, provision should be made to automatically alternate the pumps in use.

32.5 Valves

Suitable shutoff valves shall be placed on suction and discharge lines of each pump. A check valve shall be placed on each discharge line, between the shutoff valve and the pump. Suction and delivery valves, including those for submersible pumps, shall be conveniently located in the dry well.

32.6 Wet Wells

32.6.1 Divided Wells

Where continuity of pumping station operation is important, consideration should be given to dividing the wet well into two sections,

properly interconnected, to facilitate repairs and cleaning.

32.6.2 Size

The effective capacity of the wet well shall provide a holding period short enough to restrict septicity. Minimum pump run time should normally be 2½ minutes.

32.6.3 Floor Slope

The wet well floor shall have a minimum slope of one to one to the hopper bottom. The horizontal area of the hopper bottom shall be no greater than necessary for proper installation and function of the inlet.

32.7 Ventilation

Adequate ventilation shall be provided for all pump stations. Where the pump pit is below the ground surface, mechanical ventilation is required, so arranged as to independently ventilate the dry well and the wat well if screens or mechanical equipment requiring maintenance or inspection are located in the wet well. There shall be no interconnection between the wet well and dry well ventilation systems. In pits over 5 m deep, multiple inlet and outlets are desirable. Dampers should not be used on exhaust or fresh air ducts and fine screens or other obstructions in air ducts should be avoided to prevent clogging. Switches for operation of ventilation equipment should be marked and conveniently located. All intermittently operated ventilating equipment shall be interconnected with the respective pit lighting system. Consideration should be given to installing automatic controls where intermittent operation is used. The fan wheel should be fabricated from non-sparking material. Dry wells constructed below ground should have automatically operated dehumidifiers.

32.8 Flow Measurement

Suitable devices for determining sewage flow shall be provided at all pumping stations.

32.9 Water Supply

There shall be no physical connection between any potable water supply and a sewage pumping station which under any conditions might cause

contamination of the potable water supply. Where submersible pumps are used, a pressure water supply to enable hosing down of pumps following removal, should be provided.

34. ALARM SYSTEMS

All pumping stations should be equipped with an alarm system which is activated in cases of power failure, pump failure or any cause of pump station malfunction and, in any event, if the sewage rises above a determined elevation. Where a municipal facility with 24 hour attendance is available, pumping station alarms should be telemetered thereto. Where no such facility exists, an audiovisual device shall be installed at the station for external observation.

35. EMERGENCY OPERATION

35.1 Objective

The objective of emergency operation is to prevent the discharge of sewage to any waters or to the ground and to prevent back up of sewage and subsequent deposition of solids in sewers and manhole overflow to basements, streets and the like.

35.2 Emergency Power

Provision of two independent electric supply lines and/or automatically operated internal combustion engine equipment should be made. Alternatively, for installations only serving a limited number of homes, mobile generating units, pumping equipment or tank carrier units may be used.

35.3 Overflows

The provision of a high-level wet well overflow to supplement alarm systems and emergency power generation should be considered. Where such facilities are provided, suitable screens shall be incorporated in the design. Where a high level overflow is utilized, consideration shall be given to also installing storage-detention tanks or basins which shall be made to drain to the station wet well. Where such overflows could affect public water supplies, shell-fish production, or waters used for swimming, culinary or food processing purposes, a storage-detention basin or tank shall be provided generally having a two hour detention capacity at the anticipated overflow rate.

36. INSTRUCTIONS AND EQUIPMENT

Sewage pumping stations and their operators should be supplied with a complete set of operating instructions including emergency procedures, maintenance schedules, tools and such spare parts as may be necessary.

37. FORCE MAINS

37.1 Velocity

At the lowest pump delivery rate anticipated to occur at least once per day, a cleansing velocity of at least 0.75 m/s should be maintained. Maximum velocity should not exceed 3.5 m/s.

37.2 Air Relief Valve

An automatic air relief valve shall be placed at high points in the force main to prevent air locking.

37.3 Termination

Force mains should enter the gravity sewer system at a point not more than 0.6 m above the flow line of the receiving manhole.

37.4 Size

The minimum diameter for mains discharging raw sewage shall be 75 mm.

37.5 Materials

The materials selected should be suitable for local conditions such as character of industrial wastes, soil characteristics, exceptionally heavy external loadings, abrasion and similar problems.

37.6 Construction

Pipe bedding, concrete protection and depth and nature of cover should be designed to meet the anticipated loadings and ground conditions and generally conform to pipe manufacturer's specifications.

37.7 Markers

Permanent markers shall be provided to enable valves to be located.

APPENDIX I

RECOMMENDED SI UNITS AND CONVERSION FACTORS

TO CONVERT	TO SI UNITS	SI SYMBOL	MULTIPLY BY
foot	metre	m	0.304 800
inch	centimetre	cm	2.540
inch	millimetre	mm	25.40
mile	kilometre	km	1.609 344
feet/sec.	metre/sec.	m/s	0.304 800