
**Construction Specification for Sewer Bypass Flow Pumping
for Trunk Sewers**

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TS 4.02.01 SCOPE

This specification covers the requirements related to sewer bypass flow pumping required for the temporary conveyance of sanitary or combined sewage flows during rehabilitation of the sewer pipe or when the sewer pipe is put out of service. This specification is for sewer pipe diameters greater than 450 mm in diameter, such as trunk sewers.

The Work shall include the following: design of a fully operational temporary sewer bypass system, commissioning and decommissioning, spill prevention and cleanup, traffic protection and road crossings.

TS 4.02.02 REFERENCES

This specification refers to the following standards, specifications or publications:

Provincial Statute

Ontario Regulation 129/04 Licensing of Sewage Works Operators Regulation

City of Toronto Standard Specification

TS 4.60 Construction Specification for Utility Cut and Restoration

American Society of Testing and Materials

F2164-13 Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure
F1417-11a Standard Practice for Installation of Acceptable Plastic Non-pressure Sewer Lines Using Low-pressure Air
F714-13 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
F2620-13 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

TS 4.02.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Licensed Wastewater Collection Operator means a person licensed as an operator in the province of Ontario. The person performing operational duties holds a valid license under Ontario Regulation 129/04.

Engineer means the licensed individual or firm responsible for the design of the works or their designate and registered with the Professional Engineers of Ontario.

DR means dimension ratio.

HDPE means high density polyethylene.

Temporary Sewer Bypass System means temporary piping, plugs, pumping and standby equipment installed and operated for the purpose of intercepting the incoming sewage flow, conveying the flow around the work area, and discharging the flow into the existing sewer system downstream of the work area.

TS 4.02.04**DESIGN AND SUBMISSION REQUIREMENTS**

The Contractor shall prepare and submit the following:

- a) A Temporary Sewer Bypass Plan for each temporary bypass stage demonstrating there is sufficient capacity to convey the flow rates as specified in the Contract Documents at all times during the bypass operation; and
- b) A Spill Response Plan acceptable to the Contract Administrator, TRCA (if applicable) and the City.

The Contractor shall not procure or install temporary bypass system, until the Temporary Sewer Bypass Plan and the Spill Response Plan are approved by the Contract Administrator or City or both. The Contractor shall acknowledge that it can take multiple iterations of submission and review, if the plan submitted by the contractor does not meet the requirements listed in this specification and the Contract Documents.

TS 4.02.04.01**Temporary Sewer Bypass Plan**

The Temporary Sewer Bypass Plan shall include all of the following:

- The following are examples of observations, tasks, and site activities that typical report entries for linear projects. Note that not all tasks are applicable to facility or vertical projects:
- Confirmation that the flow rates and any other hydraulic considerations provided by the City will be met with the temporary sewer bypass plan proposed by the Contractor;
- Provide size of the staging areas for the pumps and confirming the staging area proposed in the Contract Documents meets requirements;
- Site and equipment monitoring plan and personnel information;
- Weather monitoring plan and approach. The Contractor shall initiate rehabilitation only if there is a dry weather forecast in the sewer catchment area;
- Anticipated duration of each phase of the work;
- Sewer plugging method, location of plugs, bulkheads and type and size of plugs or bulkheads;
- If sanitary flow diversion is being considered, then information of weir, diverted flows, methodology to distribute flow accurately;
- Pipe material, size, number of pipes and installation method for suction piping;
- Pipe material, size, number of pipes, installation method, location of discharge piping including a suitable site map;
- HDPE fusion qualification certification for the technician from the HDPE pipe manufacturer or the fusing equipment manufacturer. Confirmation that the fusing method and temperatures meet HDPE pipe manufacturer's requirements;

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- Temporary bypass pump sizes, capacity, number of pumps, power requirements of each pump and number of start stops per hour permitted for each pump;
 - Calculations of static lift, friction losses and flow velocity;
 - Pump curves showing pump operating range;
 - Standby power generators' size, location and refuelling requirements at 50 per cent and 100 per cent load;
 - Fuel storage area and re-fuelling point, fuel spill control plan;
 - Demonstrate each pump or generator or both meets requirements as mentioned in this specification;
 - Demonstrate the temporary bypass pumping system has sufficient installed pumping and pipe capacity and redundancy as mentioned in this specification;
 - Temporary pipe support and anchoring details required to protect the pipes from movement;
 - Level of noise for each pump and generator and method of noise control for each pump or generator or both to meet noise criteria specified in this specification;
 - Typical details of temporary bypass pipe crossings, for example driveways and sidewalks;
 - Engineering plans depicting the work;
 - All provisions and precautions that will be taken during the bypass operations to prevent sewage backups, overflows and spills;
 - Name and license information for the operator who will be overall responsible to operate and maintain the temporary sewer bypass system. The operator shall be a minimum Class 2 license holder in the province of Ontario for waste water collection system;
 - The Temporary Sewer Bypass Plan shall bear the seal and signature of a professional engineer qualified to do such work and should have all calculations and assumptions provided in the appendix as required to demonstrate pump, piping and accessory selection; and
 - Emergency evacuation plan: mentioning how long it will take for the contractor to re-establish flows including removing all plugs and other equipment out of the sewer pipes.

TS 4.02.04.02 Spill Response Plan

A site-specific Spill Response Plan shall include the following:

- Procedures for notification to the City and the Ministry of the Environment and Climate Change (MOECC) Spill Action Centre;
- Mandatory regulatory reporting requirements;
- Plan for investigating the cause of the spill;

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- Plan for containing the spill and addressing the source of the spill;
 - Determine if any service connections, storm drains, watercourses or other infrastructure that could be negatively affected by a spill;
 - Plan for preventing public exposure to the spill, including procedures for redirecting pedestrians and traffic away from the impacted area;
 - Measures to be taken to avoid or mitigate the adverse effects of the spill on the environment; and
 - Name of responsible person and their responsibilities to document and liaise with all agencies during a spill.

TS 4.02.04.03 Acceptance of the Plans

The Temporary Sewer Bypass and Spill Response Plans should allow the Contract Administrator and the City to understand the manner in which construction on the sewer is to take place, the flow rates accommodated by the temporary sewer bypass and evacuation and contingency plans in case of a spill including cleanup. The plan or report shall be submitted in searchable PDF format.

The installation of temporary sewer bypass can only commence after the Contract Administrator reviews and approves the plan in conjunction with the review and approval from the City staff. All comments and concerns shall be addressed by the Contractor and the plans be resubmitted to ensure it meets the requirements listed in this specification. The final temporary sewer bypass shall bear the seal and signature of the Contractor's Engineer, responsible to prepare the temporary sewer bypass plan.

The Contract Administrator will then issue the acceptance letter to the Contractor. The letter will indicate whether a pre-construction meeting is required.

Both the Temporary Sewer Bypass Plan and the Spill Response Plan shall be posted at the site office or site trailer during the sewer bypass operations.

TS 4.02.05 MATERIALS – Not Used

TS 4.02.06 EQUIPMENT

TS 4.02.06.01 Pumps and Pumping Redundancy

Provide electric or diesel powered pumps that shall be fully automatic, self-priming and critically silenced-low noise. The pumps shall be equipped with all necessary stop and start controls.

All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.

Maintain one stand-by pump of each size on or near site which are utilized for bypassing local connections and may not have sufficient redundancy.

The temporary bypass system installed for trunk sewer bypass at site shall include one additional back-up pump of similar capacity as other pumps and which shall be isolated from the primary pumping system by a valve and ready to start when required. There should be n+1 redundancy in pumping. Total number of pumps required to pump flow as specified in the contract plus one additional backup pump, fully connected and that can be put in to service within 5 to 10 minutes by operating valves and without requiring piping and installation alterations.

TS 4.02.06.02 Temporary Sewer Bypass Piping and Redundancy

Obtain approval and secure all permits for placement of temporary bypass pumping system and pipeline within public right-of-way including road occupancy and cut permits.

The temporary sewer bypass piping system shall be able to withstand pressures that are greater than the peak bypass pumping pressure. Buried temporary bypass piping shall be designed with consideration of various loads including vehicular traffic loads and loading due to temporary surface restoration. The Contractor shall acquire all permits to cut the road and install temporary pipes in trench and complete temporary restoration to permit residents access to their driveway and permit traffic flow and pedestrian access. Temporary and permanent restoration of cuts shall be according to TS 4.60.

Discharge Piping – Only HDPE pipe shall be permitted for the main trunk line temporary sewer bypassing. All HDPE pipe shall be according to ASTM F714-13. Pipe DR shall be determined based on pumping pressure and maximum pressure anticipated for the temporary bypass system. However minimum DR ratio for HDPE shall be DR13.5 (160 psi). If higher pressures are expected during operation of the temporary sewer bypass system, DR11 or DR9 shall be required.

Suction Piping – Design the suction pipe for vacuum consideration and fused HDPE or welded steel pipe can be permitted.

Only fused HDPE joints shall be made. Fusing shall be according to ASTM F2620-13. Pipe fusion shall be carried out by personnel certified as fusion technicians by manufacturer of the HDPE pipe. Provide certification to the Contract Administrator.

HDPE piping shall be homogenous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, or other deleterious faults.

The number of pipes, diameter and pressure rating of the bypass pipes shall be designed to convey the maximum flow as specified in the Contract Documents. For redundancy purposes, one additional pipe with similar size and pressure rating as the other bypass pipes shall be installed, connected and immediately available for use in case of failure of one of the bypass pipes. The Contractor shall allow for all losses and keep industry standard safety margins in determining the diameter and pressure rating of the bypass pipe.

HDPE fittings shall be fully pressure rated to match the pipe DR pressure rating.

For temporary bypass pumping of local connections to the trunk sewer and laterals, discharge hose may be permitted if flows and risk permit and by specific permission from the stamping design engineer and the contract administrator. Under no circumstances will aluminum "irrigation" type piping or glued PVC pipe be allowed.

If lateral sewer connections from multi-residential and commercial buildings are made directly to the trunk sewer, only HDPE bypass pipes shall be used. In such cases HDPE pipe diameter and pressure rating shall be able to meet pumping requirements. Under no circumstances will aluminum "irrigation" type piping or glued PVC pipe be allowed even for local sewer connections or lateral bypass.

When a service lateral must be disconnected from the main for more than one calendar day, the lateral shall be positively drained or pumped a minimum of once every 24 hours.

Monitor status of flow and storage, and pump lateral more frequently if flows exceed the storage capacity of the lateral or the temporary storage.

If sanitary service for a multi-residential complex will be impacted, the Contractor shall distribute notices to all residents with coordination from the building supervisor at no extra cost to the City. The Contractor shall locate the maintenance hole or other access point to permit bypass of the lateral connection. No further payment will be considered for bypass of lateral connections.

If sanitary lateral for a commercial facility cannot be turned off, the Contractor shall arrange a sewer temporary bypass from a maintenance hole or grit separator, within the private property if required. If temporary bypass is not feasible, the Contractor shall negotiate with the facility owner a temporary washroom facility—men/women separate—including bi-hourly cleaning, maintenance and disposal of waste or facility closure for a day or two and compensate the business owner at their expense. Such costs shall be included under temporary bypass flow line item and at no extra cost to the City.

If the sanitary service for a resident is to remain shut down for more than a period of 8 hours the Contractor shall provide a temporary washroom facility, within 25 metres of the residence. If the sanitary service for a resident is to remain shut down for overnight and beyond that can be stored in their lateral connection. All such costs shall be included under temporary bypass flow line item and no further payment will be considered.

If required the Contractor shall provide a temporary living quarters or hotel accommodations to the resident within the area, and that shall be approved by the Contract Administrator.

TS 4.02.07 CONSTRUCTION

The Contractor shall cease bypass pumping operations and return flows to the new or existing sewer or both. During bypassing, no wastewater shall be leaked, dumped, or spilled in or onto any area outside the existing wastewater system. Evacuation plan prepared by the Contractor shall be feasible and easy to implement in case of an emergency.

The Contractor shall immediately put the Spill Response Plan in action and notify the supervisor in the Divisional Operations Services unit and the Contract Administrator should a sanitary sewer overflow occur and take the necessary action to clean up and disinfect the spillage to the satisfaction of the City and the MOECC and other governmental agencies. If sewage is spilled onto public or private property, the Contractor shall wash down, clean up, and disinfect the spillage to the satisfaction of the property owner at no extra cost to the City.

Protect the environment, public, and private property from any damage during the construction and operation of the bypass system.

Minimize the interruption of existing services to the public, residents, and all facilities connected to the bypassed sewer.

TS 4.02.07.01 Testing

Perform leakage and pressure tests of the bypass pumping discharge piping using clean water prior to actual operation. Leakage testing of HDPE piping shall be carried out according to ASTM F2164-13.

If the temporary bypass piping is to be installed in a trench or buried, a preliminary low pressure air leakage testing according to ASTM F1417-11a shall be permitted to detect any leak prior to burying the pipes. The hydrostatic pressure test according to ASTM F2164-13 can be conducted after the pipe is buried.

The pressure and leakage test according to ASTM F2164-13 shall be conducted at one-and-a-half times the maximum pressure the system will experience based on the approved Temporary Sewer Bypass Plan for a period of two hours. However, the test pressure applied should not exceed the designed pressure rating of any system component. .

The Contract Administrator and the Contractor's Engineer sealing and signing the Contract Drawings shall be given 24 hour notice prior to testing for witnessing the test.

All thermoplastic pipes have reduced strength at elevated temperature. Test pressure must be reduced to 140 to 120 per cent (27°C to 35°C) instead of 150 per cent when the test section is at elevated temperature either from service conditions or from environmental conditions such as being warmed by the sun.

The Contractor Administrator shall witness and approve the leakage test.

The Contractor shall demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle all daily flows by performing a test run for a period of 24 hours prior to beginning the Work. Contractor's Engineer shall be on site to certify the installation as specified in the Contract Documents and to witness operation of the pumping system for the first 2 hours of operation and before declaring the system constructed as per design.

If there are problems identified during trial 24 hours operation, the Contractor shall involve the design engineer and Contractor Administrator and address all issues and repeat the trial 24 hours operations—trial operation can be reduced depending on the type of issue at the discretion of the Contract Administrator—at no extra cost to the City.

TS 4.02.07.02 Operation and Maintenance

Remove maintenance hole top sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access location indicated on the Contract Drawings and as may be required to provide adequate suction conduit. If the Contractor proposes an alternate sewer temporary bypass plan and location, the maximum flow for that section may be adjusted by the Contract Administrator.

Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream

Maintain a checklist-log of all plugs and items being inserted and installed in the sewer and such log should be readily available. When the plugs and equipment are removed from the sewer, these items should be verified against the checklist and any missing items should be reported immediately to the Contract Administrator and City operations contact.

Monitor weather and flow levels upstream of a plugged sewer at all times to ensure flooding of public or private property does not occur.

Place pumps in temporary containments or berms to contain any fuel or sewage that may spill during the bypass operations.

Inspect bypass pumping system every two hours to ensure that the system is working properly.

Insure that the temporary pumping system is properly maintained and a minimum MOECC Wastewater Collection Class 2 license operator shall be on hand at all times when bypass pumping is in operation.

The bypass system shall not be in operation unless it is monitored constantly by the Contractor's employees' at site. A licensed wastewater collection operator from the Contractor and from City operation's staff must be present on site for initial start-up and shut-down of a sewer bypass system to evaluate and inspect the process and the redirection of wastewater flow within the wastewater collection system.

If there is a change to the bypass system after the initial set up such as adding a pump to the bypass system due to spike in flows, removal of a pump, changing discharge point and so on, it should be approved by the Contractor's Engineer and approved by the Contract Administrator. Staff from Toronto Water, Operational Support, Divisional Operations Services (DOS) unit must be present to witness the changes.

When the flow is redirected back to the sewer pipe, Contractor's licensed operator and DOS staff shall be at site, as this is requirement from the MOECC to have licensed operator making such changes to the system.

Spare parts for pumps and HDPE piping repair shall be kept on site as required.

Adequate hoisting equipment required for removal and replacement of pump or a pipe piece in an emergency shall be maintained on the site.

When requested by the Contract Administrator, the contractor shall submit the pump maintenance records, checklist of items in the sewer, pump operation records and fuel monitoring records for review.

Provide standby equipment ready for immediate use in the event of emergency or equipment breakdown.

During all bypass pumping operation, protect the pumping station and main and all local sewer lines from damage inflicted by any equipment. The Contractor shall be responsible for any physical damage to the pump station and main and all local sewer lines caused by human or mechanical failure.

TS 4.02.07.03 Noise from Operations

Minimize the emission of sound by using critically silenced low noise pumps and generators. If further noise reduction is specified in the Contract Documents for sound sensitive areas, provide additional sound attenuation measures, such as soundproof canopy, acoustic foam insulation and anti-vibration devices.

The emission of sound from pumps and generators shall be according to Toronto Municipal Code, Chapter 591 Noise.

Apply for a permit for an exemption from a noise prohibition or noise limitation, if required.

TS 4.02.07.04 Sewer Plugging

Select sewer plugs based on the flow characteristics, size of the sewer and the location of the flow diversion point. Always provide a secondary plug, in the event the primary plug fails. Plug a sewer system by means and methods that will not cause any damage or blockage to the sewer pipes and maintenance holes.

Inspect all plugs for defects prior to every use.

All sewer plugs shall be anchored to a fixed point above ground at all times to prevent the plug being washed down the sewer.

For sewer pipe connections smaller than 300 mm in diameter and for lateral connections a secondary sewer plug is not required. However plugs shall be anchored.

When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances.

TS 4.02.07.05 Removal, Cleanup and Restoration

Ensure all sewage from the bypass pipes, pumps and fittings is discharged to the specified sanitary or combined sewer. Flush the bypass system with potable water before disassembling and removal. The disposal or discharge shall be according to the requirements of Toronto Municipal Code, Chapter 681 Sewers.

Restore bypass pump areas to pre-bypass condition including any cleanup measures necessary due to fuel, oil or sewage leaks. All cleanup measures taken shall be documented.

TS 4.02.08 QUALITY ASSURANCE – Not Used

TS 4.02.09**MEASUREMENT FOR PAYMENT**

Measurement shall be by lump sum and the costs divided among each item listed below. Actual payment shall be based on the Work completed:

- 1) Temporary Sewer Bypass Plan and Spill Response Plan upon approval of these plans.
- 2) Installation of each phase of temporary bypass upon successful hydrostatic testing and trial run.
- 3) Operation and maintenance of temporary bypass system.
- 4) Successful disassembly and removal of the temporary bypass system.

TS 4.02.10**BASIS OF PAYMENT**

Payment at the Contract Price shall be full compensation for all labour, Equipment and Material to do the Work.

Appendix 4.02-A, April 2016
For Use While Designing and Administrating City Contracts

Note: This is a non-mandatory commentary appendix intended to provide information to a designer and contract administrator during the design and construction stage of a contract on the use of this TS specification in a City contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an owner's design decisions and methodology.

Design Requirements – Engineering Consultant's Scope of Work

Definition:

Peak Wet Weather Flow (PWWF) – PWWF is the highest measured hourly flow that occurs during a 2-year wet weather event.

Model Wet Weather Flow (MWWF) – MWWF is the highest hourly flow predicted by the hydraulic model during a 2-year wet weather event

Peak Dry Weather Flow (PDWF) – PDWF is the highest measured hourly flow that occurs on a dry weather day.

Model Dry Weather Flow (MDWF) – MDWF is the highest hourly flow predicted by the hydraulic model on a dry weather day.

Engineering Consultant's Scope of Work

This section clarifies role of the Engineering Consultant or the Owner's Engineer for design/build approach from the Contractor's role. During the design stage the Engineering Consultant or the Owner's Engineer shall complete the following:

- a) Complete a minimum of 6 months and preferably up to 12 months of sewer flow and rainfall monitoring at strategic locations to determine temporary sewer bypass capacity.
- b) Complete modeling of the sewer to determine MDWF and MWWF based on a 2-year storm and compare it with measured PDWF and PWWF. Specify in the Contract Documents the minimum bypass flow requirements to safely carry out the Work. City recommends the following approach indicated below. If the Engineer believes the bypass capacity has to be more than the City's recommended approach, the Engineer may recommend so:

For Cast-in-Place Pipe (CIPP) and other rehabilitation techniques requiring a complete bypass flow setup to keep the sewer pipe empty and dry, the bypass flow capacity shall be for a minimum flow of:

- i. If $PWWF < MWWF$ or if the flow monitoring is not able to capture a 2-year storm event then,

$$\text{Bypass flow capacity for a sewer section} = \frac{PWWF + MWWF}{2}$$

If $PWWF > MWWF$ then,

- ii. Bypass flow capacity for a sewer section = PWWF

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- iii. If there is more than 40 per cent difference between PWWF and MWWF, the Engineer must investigate the cause and make an informed decision depending on which of the two readings is more reliable—PWWF or MWWF.

If the Engineer during detailed design determines feasibility of diverting flow either partial or complete to another trunk sewer in the vicinity and if such option provides cost benefit and reduced risk, the Engineer will have to evaluate capacity of the other trunk sewer as well, to determine feasibility and maximum bypass capacity to the alternate sewer. The total bypass flow capacity shall be according to item i) or ii) herein;

- iv. Redundancy requirements: Review the entire specification to better understand standby and backup redundancy requirements for pumping and pipe capacity. Indicate in the Contract Drawings a route and general layout of the suggested sewer bypass pumping system including pumping compound.
 - v. The Engineer shall provide the bypass flow capacity for each proposed temporary bypass stage very clearly in the construction tender and preferably on the proposed temporary flow bypass drawings. Provide additional information such as measured peak dry weather flow, measured average dry weather flow, measured 2-year storm flow, profile of the temporary bypass path and other parameters required to allow the Contractor to design a temporary bypass system.
 - vi. If the temporary bypass pumping is against a grade, evaluate need for additional check valves, air release valves, thrust blocks, surge suppression and include requirements for further design analysis as a part of Contractor's temporary sewer bypass submission.
 - vii. Clarify in Contract Documents and preferably on the Contract Drawings, that the actual rehabilitation work which needs to be carried out only during a period of dry weather and determine the construction schedule accordingly.
- c) Provide design and specifications to protect the temporary bypass pumping compound and temporary bypass pipes; for example jersey barriers for traffic protection, chain link fence, spill protection for pump, temporary fence in ravines area.
 - d) Review and provide comments and approve the Temporary Sewer Bypass Plan submitted by the Contractor. Staff from Engineering & Construction Services division, Toronto Water–Sewer Asset Planning unit and Toronto Water, Operational Support, Divisional Operations Services unit shall also review and provide comments to the Engineer. It is responsibility of the Engineer to approve the Temporary Sewer Bypass Plan and physically inspect and approve installation of the temporary sewer bypass setup on behalf of the City.
 - e) Review and provide comments and approve the Spill Response Plan submitted by the Contractor. The Engineer shall coordinate with agencies such as the Toronto Region Conservation Authority (TRCA) and Ministry of Natural Resources (MNR) to ensure their spill response plan and other permit requirements are met.
 - f) Review and approve all shop drawings related to temporary sewer bypass work and including restoration proposals and methodology of the Contractor upon completion of the temporary bypass work.