

DRAFT B441 - WATERMAINS - OPSS 441

(As specified in OPSS 441, April 2026)

441.1 GENERAL

Watermains are a component of a water supply network. Watermains are a system of engineered hydraulic components designed for the conveyance of water from storage to consumption. Watermains come in a variety of materials including concrete, iron, PVC, polyethylene, polybutylene, steel and copper. Valves, hydrant sets, service connections pipes and connections comprise the watermain system.

The ministry does not often do watermain projects independently of municipalities. A typical project may involve a municipal watermain crossing a highway right-of-way. Liaison with the local municipality is usually necessary and use of municipal documentation for watermains within ministry contracts is often done.

441.2 REFERENCES

CDED B206-1 Earth Grading
 CDED B206-2 Rock Grading
 CDED B314 Untreated Subbase, Base, Surface, Shoulder, Selected Subgrade, and Stockpiling
 CDED B493 Temporary Potable Water Supply Services
 CDED B517 Dewatering and Temporary Flow Passage Systems
 CDED B902 Excavating and Backfilling - Structures

441.3 TENDER ITEMS

Item Code	Title	Col Type	U.O.M.	PQP
0441-0010	Watermains	Variation	m	Y
0441-0020	Valves	Variation	Each	Y
0441-0030	Hydrant Sets	Variation	Each	Y
0441-0050	Service Connection Pipe	Variation	m	Y
0441-0055	Service Connection Appurtenance Sets	Normal	Each	Y
0441-0060	Connections to Existing Watermains	Normal	Each	Y

441.4 SPECIFICATIONS

The requirements for watermain and watermain related tender items are specified in OPSS 441.

Trenching, backfilling and compaction requirements are specified in OPSS 401.

Where dewatering is required for watermain installation, the details of the operation shall comply with the requirements of OPSS 517.

Where rock excavation is required for watermain installation, the details of the operation shall comply with OPSS 403.

441.5 SPECIAL PROVISIONS - None**441.6 STANDARD DRAWINGS**

Applicable standard drawings are contained in the 1100 series of the Ontario Provincial Standard Drawings Manual; however, other OPSD or MTOD series may also apply.

441.7 DESIGN**441.7.1 General**

The designer should ensure that appropriate design documentation is made available for viewing by bidders at the tender stage or included in the tender documents. This includes but is not limited to soil boring data, geotechnical reports, foundation investigation and design report.

441.7.2 Watermain

The general pipe layout, size, type and class of a watermain network are established, based on acceptable hydraulics theory by the designer. The designer shall use accepted hydraulics design methods by which to establish the watermain layout that satisfies required hydraulic standards and criteria for the highway project.

441.7.2.1 Size

The design of a watermain network involves determining the sizes of pipes that will permit the watermain network to function within set design requirements and standards. The designer will determine the pipe size that will still permit the watermain network to function within the design parameters set.

441.7.2.2 Type and Class

Pipe type and class refer to the material specifications of the pipe products. These specifications include load and pressure ratings, pipe wall thickness, protective coatings, and reinforcement. Acceptable material specifications of a watermain network are established, based on structural loading and material durability requirements, by the designer. The designer shall use accepted structural and durability assessment methods by which to establish the pipe type and class that satisfies both structural and material durability criteria.

441.7.2.3 Valves

The designer shall make an assessment of the type of valve required for the watermain network.

441.7.3 Trench**441.7.3.1 Excavation**

Excavated earth material may be used for embankment construction or used as native backfill to the excavated watermain trench as determined by the designer based on foundation or geotechnical reports. Surplus or unsuitable excavation material should be managed as outlined in B206-1 and B206-2 of this manual.

In view of the high unit cost for rock excavation, the designer should endeavour to reduce the volume of rock excavation by relocating, pipe skewing, etc., wherever possible.

In most cases, watermains are constructed below the frost line and would not require any special treatments for frost. In rock fills, frost tapers are not required, but fill material must be provided.

When the watermain cannot be constructed below the frost line, special treatment will be required. Foundations or geotechnical reports shall contain information regarding recommended fill materials and the configuration and extent of frost taper excavations. Where fill material cannot protect the watermain or frost tapers cannot be constructed, other frost protection options need to be considered. Designers may consider using styrofoam or other insulation materials to prevent frost from penetrating into the watermain critical zone.

441.7.3.2 Dewatering

Dewatering refers to pumping, bailing, temporary ditching or vacuum removal of uncontaminated groundwater, rain water, melt water, surface runoff, water pipe leakage from excavations and trenches or within sheeted cofferdams to improve the soil stability or for other construction purposes. Unwatering refers to lowering of the groundwater table in the excavation site area in a manner that enables completion of the construction work.

Although the Contractor is responsible for any dewatering or unwatering plan, the designer shall note any recommendations included in the foundation investigation and design report.

Under conditions of high ground water, external fluids may enter via air release and air/vacuum release valves; therefore, appropriate measures should be taken.

441.7.3.3 Fill Material

To prevent damage to the watermain network due to “live” and “dead” loads, fill material is provided as protective and support layers. Fill material for rigid pipe installations is placed in distinct bedding, cover and backfill layers. Flexible pipe installations require fill material to be placed as distinct embedment, which is from the bottom of the bedding layer to the bottom of the backfill layer, and backfill layers.

The minimum or maximum height of pipe fill material is placed in accordance with Height of Fill tables (800 series OPSDs) for the materials identified.

A foundation or geotechnical report will include recommendations for the supply, placement, and specifications of fill material or any special conditions for bedding, cover, embedment in the case of flexible pipes and backfill layers.

The designer shall specify the fill materials required for the installation, based on the recommendations of the foundation or geotechnical report. The designer should be familiar with the various installation methods available as referenced in the 1100 series OPSDs for the watermain installation so that the fill materials recommended are appropriately specified.

The contractor, not the designer, is responsible for selecting the appropriate watermain installation method at the time of installation based on the soil types found on the construction site in accordance with the Occupational Health and Safety Act and Regulations for Construction Projects.

441.7.3.4 Reinstatement

Where existing driving lanes must be excavated to allow the construction of the watermain network, the affected roadbed must be rebuilt to acceptable standards to maintain the continuity of the pavement. This is particularly important where there is to be no resurfacing of the highway. The designer shall determine and specify bedding, cover and backfill depths and materials up to subgrade. Above subgrade, the designer shall determine the types and depths of granular and pavement courses necessary to achieve roadbed integrity. Granular base and paving is not covered by OPSS 441, See CDED B206 and CDED B300 series.

441.7.3.5 Protection Systems

These systems will be applicable where the stability, safety or function of an existing roadway, railway, etc. may be threatened or impaired due to the construction of a watermain or in cases where the watermain will be installed at a depth where protection schemes are required.

When watermains are to be placed in deep installations or in areas of rock excavation or where an exceptionally large and complex watermain layout is to be constructed, the designer shall request that soils borings be taken along the actual watermain alignment for more precise data. The foregoing is also relevant to the selection of backfill materials and procedures.

The design, installation and monitoring of protection systems is the Contractor's responsibility and the Contractor should base his plan on information as found in foundation or geotechnical reports. Problematic soils, high groundwater tables or other installation issues, if identified, will give rise to recommendations regarding the design, installation and removal and would also be provided in these reports. Recommendations for performance levels can also be found in foundation investigation and design reports.

Requirements for field investigation, laboratory testing and engineering recommendations for protection systems are to be specified in the foundation engineering terms of reference for any specific project such that appropriate information for the Contractor is provided.

441.7.3.6 Temporary Potable Water Supply Services

Temporary Potable Water Systems requirements are outlined in B493 of this manual.

441.8 COMPUTATION**441.8.1 Item Payment Basis**

The following items are Plan Quantity Payment items:

Watermains
Valves
Hydrant Sets
Service Connection Pipe
Service Connection Appurtenance Sets
Connections to Existing Watermains

441.8.2 Method of Calculation**441.8.2.1 Watermains**

The unit of measurement for watermains is the metre. Measurement for the length of the watermain will be made horizontally over the centreline of the pipe from the point of connection to a chamber, water treatment plant, or existing watermain to a point vertically above the end of the new watermain.

441.8.2.2 Valves

The unit of measurement for valves is each. Measurement shall be by the number of units installed.

441.8.2.3 Hydrant Sets

The unit of measurement for hydrant sets is each. Measurement shall be by the number of hydrant sets installed.

441.8.2.4 Service Connection Pipe

The unit of measurement for service connection pipe is the metre. Measurement shall be horizontally from the point of connection to the watermain to a point vertically above the end of the service connections

441.8.2.5 Service Connection Appurtenance Sets

The unit of measurement for service connection appurtenances is each. Measurement shall be by the number of units installed.

441.8.2.6 Connections to Existing Watermains

The unit of measurement for connections to existing watermains is each. Measurement shall be by the number of units installed.

441.8.3 Accuracy

The tender items Watermains and Service Connection Pipe are measured to an accuracy of 0.1 m. The tender item totals are rounded to the nearest metre.

441.8.4 Trench**441.8.4.1 Excavation**

Earth excavation required to place watermains is included in the tender item: 'Watermains'. However, rock excavation is paid under a separate tender item, 'Rock Excavation for Trenches and Associated Structures', and administered under OPSS 403. Rock excavation quantities are based on information from the foundations or geotechnical reports, the soils profile and field survey notes.

441.8.4.2 Dewatering and Unwatering

For further information, refer to CDED B517, Dewatering and CDED B902, Excavation and Backfill for Structures.

Should a rare situation occur where it would be unfair to the Contractor to include an expensive dewatering or unwatering operation in the watermain bid price, then consideration could be given to using a separate tender item through a non-standard special provision. There is a non-standard item for "dewatering" and a standard item for "unwatering structure excavation".

441.8.4.3 Fill Material

Granular volumes for frost tapers, bedding, cover, embedment in the case of flexible pipes and backfill material for watermains are computed as shown in Ontario Provincial Standard Drawings or from detail drawings when applicable.

The total granular requirement for each watermain is computed in cubic metres, and may be converted to tonnes using the conversion factor shown in Section B314 "Untreated Subbase, Base, Surface, Shoulder, Selected Subgrade, and Stockpiling" of this manual. This quantity is used for Geotechnical ASL purposes only.

441.8.4.4 Protection Systems

When the designer deems a protection system is required, the protection system is included using the "Protection System" tender item per OPSS 539.

441.9 DOCUMENTATION**441.9.1 Drawings****441.9.1.1 Watermain**Location

All watermains are to be indicated on the new construction plans of the contract drawings. Profiles, rock line, sub grade and original ground must be indicated where applicable on the contract drawings. The watermain configuration and a direction of flow arrow are to be indicated. Thrust restraints should be shown on the plan, with the applicable OPSD number.

Connections to Existing Watermains, Hydrants and Service Connections

Locations of connections to existing watermains, hydrants and other service connections are to be indicated on the new construction plans of the contract drawings. The plan should show locations of Gate valves and their end-configurations. Hydrants should be shown on the plan, with type noted. Valves should be shown on the plan, with type noted. Air release valve and air/vacuum valve locations should be shown on the plan and labeled. The location of service connections should be shown on the plan, with size noted.

441.9.1.2 Trench

Fill Material

Typical cross-sections must be included in the contract drawings, giving dimensions of frost depth, slope of tapers and depth of fill material layers.

If special conditions for bedding, cover, embedment or backfill materials are required, the appropriate dimensions must be shown.

Reinstatement

A typical section, traditionally known as "trench reinstatement," must be shown on the contract plans. The drawing shall include bedding and backfill up to subgrade. Above subgrade, the drawing should specify the types and depths of granular and pavement courses necessary to achieve roadbed integrity.

If no highway pavement resurfacing is to take place in the area of the reinstatement, all reinstatement works should be noted for the contractor to include in his watermain tender item bid.

Special Foundation Treatment

A detailed typical drawing and/or a modified OPSD will be necessary to show the depth of bedding and location if any special foundation treatment such as articulation, soil mixing, ground improvement, etc is required as noted in the foundation investigation and design report.

Protection Systems

When protection systems are required, the line of protection or a protection system shall be shown on the contract drawings depending on the magnitude of the protection required. Performance levels shall be included on the Contract Drawings. These are only approximate lengths or locations and it is up to the contractor to design, install and remove with actual lengths and locations defined.

441.9.2 Quantity Sheets

'Watermains' is a variation tender item. Each length of watermain pipe is entered in one line in the Quantities - Miscellaneous 1 sheet. Start and end chainage are provided in the Station to Station column. Lateral offset, left or right, is provided in the Location and Position column. Each column is to be labelled with a combination of watermain pipe size (diameter), type and class. The quantity (meters) is entered in the appropriate column

'Valves' is a variation tender item. Each Valve is entered in one line in the Quantities - Miscellaneous 1 sheet. The location chainage is provided in the Station column. Lateral offset, left or right, is provided in the Location and Position column. Each column is to be labelled with a combination of valve type, pressure, class and end connection. The unit quantity (1) is entered in the appropriate column. For cases where a valve box is required, the words "valve box" shall be entered in the "Reference" column.

'Hydrant Sets' is a variation tender item. Each Hydrant Set is entered in one line in the Quantities - Miscellaneous 1 sheet. The location chainage is provided in the Station column. Lateral offset is provided in the Location and Position column. Each column is to be labelled with the type of hydrant. The unit quantity (1) is entered in the appropriate column.

'Service Connection Pipe' is a variation tender item, for connection pipe size. Each length of service connection pipe is entered in one line in the Quantities - Miscellaneous 1 sheet. The start chainage is provided in the Station to Station column. Lateral offset, left or right, is provided in the Location and Position column. Columns are labelled with the tender item name and the size of the pipe connection, typically 25 mm, 38 mm and 50 mm, as applicable. The quantity (meters) is entered in the column

'Service Connection Appurtenance Sets' is a normal tender item. Each Service Connection Appurtenance is entered in one line in the Quantities - Miscellaneous 1 sheet. The location chainage is provided in the Station column. Lateral offset is provided in the Location and Position column. One column is to be labelled with the tender item name. The unit quantity (1) is entered in the column. Any additional notes required may be entered in the References column.

'Connections to Existing Watermains' is a normal tender item. Each Connection to Existing Watermains is entered in one line in the Quantities - Miscellaneous 1 sheet. The chainage is provided in the Station to Station column. Lateral offset, left or right, is provided in the Location and Position column. One Column is labelled with the tender item name.