

GUIDELINE

# **Engineering Services to Municipalities**

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## PHASES OF SERVICE

Normally four phases of services are required from engineers during the design and construction of municipal services, as noted in phases 2-5 below. A fifth phase (advisory and special services) and a sixth phase (post-construction services) may be required.

Engineers having a regulatory capacity should also ensure that the services set out below for each phase of the work have been completed as appropriate.

The six phases are:

- Phase 1–Special Services
- Phase 2–Preliminary Design and Reports
- Phase 3–Detailed Design, Final Drawings and Specifications
- Phase 4–General Review During Construction
- Phase 5–Resident Staff Services During Construction
- Phase 6–Post-Construction Services

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## PHASE 1 - SPECIAL SERVICES

Most designs require feasibility or predesign investigations to determine which of several alternatives best meets the objectives. The following are examples of additional or special services, some of which may precede the preliminary design and detailed design services described in Phase 2 and Phase 3:

- ◆ Advisory services, including special consultations and advice, preparation of rate structures, research and soil investigations.
- ◆ Preparation of feasibility studies comparing alternative routes for services and alternative methods of construction or materials, which may be appropriate and advantageous in terms of capital cost, land requirements, operating efficiency, or for environmental or energy conservation reasons.
- ◆ Public hearings before the Environmental Assessment Board, the Ontario Municipal Board or other public authorities regarding the environmental impact of the project, the financial capability of the municipality, the method of charging for the works and property evaluation for easements and purchases.
- ◆ Appearance in litigation, arbitration proceedings and attendance at hearings on behalf of the municipality.
- ◆ Topographic plans or the obtaining of photogrammetric mapping.
- ◆ Negotiations for easements and purchases.
- ◆ Preparation of local improvement assessment sheets, attendance at the Court of Revision and similar services under The Municipal Act, The Public Utilities Act or The Drainage Act.
- ◆ The allocation of costs between the municipality and other municipalities, authorities or private interests, including the administration of extended financial arrangements, computation of principal and interest, and preparation of accounts.
- ◆ Additional services required by reason of contractor's insolvency.
- ◆ Changes in design made necessary or desirable by factors beyond the control of the engineer.
- ◆ Preparation of special progress certificates and final certificates for subsidy payments, grants or rebates.
- ◆ Carrying out prolonged negotiations with public authorities on behalf of the municipality.

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## PHASE 2- PRELIMINARY DESIGN AND REPORTS

### 2.1 Outline of Services

The engineer should prepare preliminary plans or reports in the form of drawings and text outlining the nature of the project, a summary of the principal design standards, an outline cost estimate and the extent of services and recommendations. This work is sometimes identified as the preliminary “Engineering Report” but is not to be confused with predesign and feasibility studies, which are included in Phase 1 -Special Services.

### 2.2 Services to be Provided

The engineer should provide the following preliminary services in connection with the functions shown:

#### 2.2.1 Attend Meetings

Meet with the appropriate representatives of the municipality, including the municipal engineer, planning director, works committee or council, to:

- ◆ obtain full information on existing and proposed municipal services, roads and other facilities;
- ◆ determine the municipality’s standard criteria for design;
- ◆ determine the extent of engineering services to be provided and the manner of presentation, and
- ◆ determine the municipality’s practice for the sharing of costs with other public authorities, private developers and the public.

#### 2.2.2 Familiarization

Conduct a physical reconnaissance and review topographical maps of the project area to ascertain the location, topography, drainage and existing municipal services.

#### 2.2.3 Planning

Study existing plans and reports define zoning and land use and predict the rate and direction of probable community and traffic growth, and apply these factors to the design, as may be required.

#### 2.2.4 Preliminary Design

##### a) Sewers and Watermains

Carry out preliminary design of sanitary sewers and water distribution systems in accordance with accepted engineering practice and, where applicable, with standards established by the local municipality and other regulatory authorities. In the design of each of these systems, take into consideration the present and future land use, the areas to be serviced, the pipe location, size, depth, material and bedding, suitable inlets and outlets, the design and location of catch-basins, maintenance holes, hydrants, building connections and other appurtenances.

##### b) Plants and Associated Works

Incorporate sound functional design into all structures, including equipment forming parts of pumping stations, water purification and pollution control plants. When required to design plants will be used for process operations, engineers should avail themselves of special processes may be used, including the nature of, and factors governing, the process.

They should evaluate the various processes, types of instrumentation, automation, etc., and should recommend the adoption of a specific process and type of control, while remaining aware of the required results, the economy of construction, operation and maintenance. Due consideration should be given to the planning and preliminary design of all energy consuming facilities to minimize the impact on future energy demands. This consideration should include energy conservation and utilization practices in the selection of machinery, the location and orientation of structures, and the insulation of buildings.

The engineer, where directed, should produce suitable procedures and documents for the pre-selection of machinery and equipment. A diagrammatic flow-sheet and hydraulic flowsheet should be pro-

vided for treatment plants. An original process design is not a part of this preliminary design service, but is considered to be a special service.

#### **c) Road and Street Construction**

Establish the design criteria essential for a proper design consistent with the municipality's long-range land-use and traffic plans. Traffic and land-use studies will assist in providing design criteria to establish the type of street, traffic density, design speed, sight distance, grade and curvature. A further study of the adjacent land use and proposed environmental considerations should provide design criteria for the best dimensional arrangement of the pavement, median, shoulders, right-of-way, intersecting roads, bus bay entrances and other cross section elements. The subsequent engineering design of the subgrade, pavement, sidewalks, curbs and gutters, drainage, utility relocations, minor structures and railway crossings should then be carried out in accordance with accepted practice. Due consideration should be given to such ancillary features as illumination, signs, signals, fences, landscaping and zone painting.

#### **2.2.5 Environmental**

Environmental parameters, which have been defined during the predesign studies, should be highlighted and identified, and included in the preliminary design process.

#### **2.2.6 Soils**

Existing soils data should be assembled and evaluated. On the basis of this evaluation, a preliminary soils investigation program shall be carried out to obtain sufficient data to permit appropriate decisions to be made during the preliminary design stage. This soils investigation program is part of Special Services.

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## **PHASE 3 - DETAILED DESIGN, FINAL DRAWINGS & SPECIFICATIONS**

### **3.1 General**

The engineer should design all structures and facilities to serve the best interests of the public, with due regard for environmental concerns, capital cost and operating efficiency in accordance with current engineering practice and acceptable standards established by the municipality and regulatory authorities.

### **3.2 Services to be Provided**

#### **3.2.1 Surveys**

The engineer should obtain detailed profiles and cross sections for the detailed design and computation of tender quantities, as necessary.

#### **3.2.2 Soils**

The engineer should prepare a soils investigation program that will subsequently provide all of the subsurface data required for the detailed design. Such a program should include location of boreholes, laboratory work and recommendations in respect to loads, and any special conditions that must be satisfied during construction of the work. The soils investigation is normally carried out as part of Special Services.

#### **3.2.3 Drawings**

Engineers should endeavour to standardize plan sizes and scales in the best interests of their clients. The drawings for municipal projects will be of two basic types: a) those relating to work within road allowances, either for roads or for services therein, and b) those relating to treatment plants, pumping stations, bridges and other structures:

#### **a) Works within Road Allowances**

These drawings should generally show plan and profile, augmented with cross sections and detailed drawings as required.

Plans and profiles should normally be drawn to a horizontal 1:500 scale and a vertical scale of 1: 100, subject to the requirements of the municipality. The north point should be shown on each plan, together with the names of the streets, lot numbers, property lines and frontage dimensions obtained from existing municipal plans.

Design details of standard units of construction, such as road sections, maintenance holes, catch-basins, valve chambers, hydrants, street light standards, guiderails and pipe bedding, should be presented on standard drawings at appropriate scales. Plans should show the location of all known existing utilities both underground and on the surface, all existing topographic features, including embankments, buildings, mature trees, entrances, signs, fences, etc., within the road allowance or in proximity to the work.

Profiles shall show the existing surface profile, the approximate location and elevation of known existing utilities that will be intersected by the new work, and any available soils information.

For roadwork, the profile should indicate the finished road surface, giving the length and grade of each tangent section of vertical curve.

For sewers and watermains, the profile should show an invert and obvert profile of the pipe. For sewers, invert and basement elevations should be shown and, for watermains, centreline elevation of depth of cover. For each section, the length, grade and class of pipe, and type of bedding or encasement for each section should be indicated.

#### **b) Treatment Plants, Pumping Stations, Bridges and Other Structures**

Design of pumping stations and plants shall be such that competitive bidding should be encouraged for the supply of equipment and structures, unless special conditions require the supply of specific equipment or structures.

These drawings should be grouped according to the type of work to which they relate and, where applicable, should comply with PEO guidelines in the structural, mechanical and electrical fields.

A general plan should show a summary of all proposed facilities and services at an appropriate scale. For large projects, a location plan at a convenient scale should be provided, showing the geographic location of the project in the municipality.

The manner of presentation of the work in the plan form, the rendering of detail in line diagrams, the dimensioning and lettering and all other drafting work should be carried out in a professional and skilled manner, to ensure that the work is presented in an orderly fashion, the facilities and structures are shown in a recognizable manner, and that the wording on the plans is simple, concise, grammatically correct and completely legible.

### **3.2.4 Specifications**

The specifications should be for all works shown on the drawings or for which the engineer is responsible. They should be complete, clear and concise, with a statement setting forth the general scope of work, followed by an adequate description of the various classes of work, segregated by trade and under proper sections and headings. The quality of materials and standard of work required of the contractor should be described in detail. Each section and heading should be identified for easy reference. Where applicable, standard specifications related to the type of work to be carried out should be used, and the nomenclature should be the same as that used on the plans.

### **3.2.5 Other Contract Documents**

As well as plans and specifications, the design function should include the provision of forms of bonds, a form of tender, schedule of quantities, articles of agreement, general conditions of the contract and special conditions that may be required by the client or other public agency.

### 3.2.6 Final Cost Estimate

The engineer should provide the client with a cost estimate based on the final design.

### 3.2.7 Approvals

Engineers should become familiar with all authorities having jurisdiction over any component of the works. They should submit plans, specifications, schedules, and applications for approval to clients and appropriate authorities, as required. They should attend meetings at the offices of these public authorities to discuss designs and provide explanations, for the purpose of furthering the applications towards approval.

In addition, engineers may be required to prepare special applications or reports, to assist the municipality in obtaining subsidy payments, grants or special financing from senior levels of government.

### 3.2.8 Tender Call

The engineer should provide advice to the client during tender call, including tender evaluations and recommendation for award.

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## PHASE 4 - GENERAL REVIEW DURING CONSTRUCTION

### 4.1 General Outline of Services

When, in the opinion of the engineer, a resident engineer and staff are required, the engineer should so advise the client. This service may be provided by an authorized representative of the engineer, or by a sub-consultant reporting to the engineer, or by a representative retained directly by the client.

These services are provided by the engineer to determine that materials used and results achieved by the contractor are in general conformity with the design. Contractors are responsible for discharging their obligations under the terms and conditions of the construction contract. The engineer, on behalf of the client, should carry out a review of the work during its execution.

Contractors are responsible for discharging their obligations under the terms and conditions of the construction contract. The performance of the contract is not the engineer's responsibility, nor are review services rendered for the contractor's benefit. The contractor is responsible for the quality of the work.

It is to be understood that only work that has actually been seen during examination of representative samples can be said to have been appraised, and comments on the balance of the work are assumptions based upon extrapolation.

The extent of the engineer's duties for general review during construction should be clearly defined in the engineer's agreement with the client.

### 4.2 Services to be Provided

The office and field services to be provided by the engineer during this phase are as follows:

- ◆ advise the contractor on the interpretation of the drawings and specifications and issue supplementary details and instructions during the construction period as required;
- ◆ review for approval the construction schedule proposed by the contractor and comment on the procedures, methods and sequence of work;
- ◆ review submitted shop drawings to the degree necessary to determine if the contractor's work is in general compliance with the design requirements;
- ◆ consider and advise on alternative methods, equipment and materials proposed by the contractor;
- ◆ advise on the validity of charges for additions or deletions and advise on the issue of change orders;
- ◆ process contractor's progress and final requisitions and issue progress certificates for the client's acceptance;
- ◆ maintain adequate records related to the contracts;

- ◆ make periodic visits to the site during construction, to ascertain that the work is being executed in reasonable conformity with plans and specifications;
- ◆ arrange for the testing and inspection of materials and work by an authorized inspection and testing company, where the construction calls for such testing;
- ◆ attend job meetings as deemed necessary, and
- ◆ report progress and deficiencies to the client.

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## **PHASE 5 - RESIDENT STAFF SERVICES DURING CONSTRUCTION**

Normally the resident staff services will be provided by the engineer on a full- or part-time basis. This service may be provided by an authorized representative of the engineer, or by a sub-consultant reporting to the engineer, or by a representative retained directly by the client.

Such services should include:

- ◆ provide reference line and elevation to the contractor and, where necessary, check the contractor's line and grade;
- ◆ determine if the contractor is carrying out the work in accordance with the contract documents and communicate with the contractor, the engineer's authorized representatives, and the client regarding deficiencies in the work, and other matters of direct interest or concern;
- ◆ arrange for, or carry out, all necessary field testing and inspection of materials and equipment installed;
- ◆ investigate, report and advise on unusual circumstances which may arise during construction;
- ◆ carry out final inspection at the conclusion of the construction contract, as part of the acceptance program of the client;
- ◆ obtain and record field information of construction details for the modification of contract drawings to show the work "as-built";
- ◆ maintain sufficient data to determine periodic progress of the work, and
- ◆ prepare recommendations to the client regarding payments to the contractor, taking into account progress of work, materials and equipment delivered to site, and contractual and statutory holdbacks.

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## **PHASE 6 - POST-CONSTRUCTION SERVICES**

The services in this category vary in scope and detail according to the needs of the client and should be described in the scope of the assignment.

They include but are not limited to:

1. Commissioning and start-up assistance.
2. Preparation of maintenance and operating manuals.
3. Preparation of "as-built" drawings.
4. Determination of deficiencies during the guarantee period and final acceptance documentation at its expiry.



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