GUIDELINE

Professional Engineers Providing Land Development/ Redevelopment Engineering Services

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SCOPE

This Professional Engineers Ontario guideline is for engineers providing land development or redevelopment professional engineering services, and for those responsible for regulatory review and appraisal of land development or redevelopment applications. It should be read in conjunction with the Foreword and Glossary common to all PEO guidelines.

1. PREDESIGN SERVICES

1.1 General

Predesign services are generally provided before draft plan finalization. When engineers are not engaged before draft plan approval, these services should be provided before engineers undertake detailed design. Engineers should recognize and identify specific land development approval requirements and any concomitant constraints early in the land development process, and communicate these to the client, in order to minimize potential conflict and loss of valuable time, and to protect the client's financial interests.

Predesign services may include advisory services, project familiarization and feasibility studies.

1.2 Advisory Services

These may include some or all of :

- determining the availability of municipal and other services;
- relating proposed land development servicing requirements to official, secondary and other approved plans;
- establishing design criteria for engineering works;
- recommending policies to implement and control development;
- consulting with regulatory authorities to coordinate infrastructure requirements;
- assessing the impact of policies on subdivision agreements;
- assessing boundary conditions and potential external improvements resulting from proposed development;
- preparing preliminary cost estimates for land purchase decisions;
- recommending a subsurface investigation and characterization program, including appropriate geoenvironmental audits;
- reviewing existing agreements on cost sharing and/or front-ending, and advising on their implications;
- reviewing the nature, extent and time of required approvals for each stage of the proposed development;
- assessing the feasibility of developments relying on private sewage disposal and/or water supply systems;
- assessing storm drainage, temporary onsite storage and runoff water quality requirements, and
- advising on the potential limitations of environmental constraints, flood protection zones, hazard land designations, ecologically sensitive natural features and similar constraints.

1.3 Project Familiarization

This may include some or all of:

- reviewing municipal servicing capacity constraints;
- interagency coordination, as necessary;
- exploring cooperative approaches with adjacent owners;
- reviewing municipal practices for provision of stormwater quantity and quality control, according to guidelines established by the Ministry of Natural Resources and the appropriate conservation authorities, and
- determining project status and needs under the *Environmental Assessment Act*.

Engineers should become familiar with the project site, topography, drainage, existing municipal services, transportation infrastructure and draft plan proposals, in order to determine design objectives. Engineers should also deal with the appropriate regulatory authorities to determine or negotiate:

- information on existing and proposed municipal services, roads and other facilities;
- municipal standards and criteria for design and presentation of plans and proposals;
- municipal practice for providing such major services as: trunk sewers and watermains, roads and required widths and treatments, intersection signalization, grade separation structures and stream improvements, including requirements for fish habitat preservation and enhancement;
- municipal requirements for development or subdivision agreements;
- municipal policies on cost sharing and levies; and
- municipal and utility bonding requirements.

1.4 Feasibility Studies

Engineers should study appropriate alternative options for routes, major services, methods of construction and materials for the proposed land development, for capital cost and land economy. The feasibility study should demonstrate a clear understanding of the purpose, concept and limitations of the proposed development by considering:

- engineering design parameters;
- preliminary design briefs on viable alternatives;
- compliance of alternatives with engineering design parameters;
- requirements of other design professionals;
- resolution of unusual problems through creative approaches, including suggested changes to municipal standards;
- mechanisms to satisfy the requirements of jurisdictional authorities;
- preliminary estimates of capital costs for alternatives and staging, together with appropriate cost/benefit analyses and comparisons, including operating and maintenance, as required; and
- the need for additional qualified professional services, including those of hydrogeologists, geoenvironmentalists and fish biologists. In advising clients on additional professional services, engineers should prepare appropriate terms of reference, and review results in light of the alternatives being considered.

The engineer's report should describe preliminary design concepts, alternatives, constraints resolved or imposed, preliminary cost estimates and cost/benefit analyses. It should recommend an alternative with supporting rationale, and include documents, correspondence, drawings and other information required for detailed design of the selected alternative.

2. DETAILED DESIGN

2.1 General

Detailed design involves developing and preparing a final design, including standards and specifications, for economically constructing and operating all of the facilities within the development, as intended. Engineers should prepare surface grading and drainage plans, showing functional relationships between buildings, infrastructure and the developed environment. These should include details of stormwater detention, slope stability, erosion control during construction and, later, protection of fish habitat, and compliance with all natural and regulatory requirements.

2.2 Functional Report

This is the basis for detailed design and should be submitted to the client and the appropriate authorities, to obtain approval in principle before commencing final design. Functional reports should support the draft plan application, and include the following basic data in drawings and text:

- a copy of the draft plan, showing existing and proposed grades and surface features;
- a master watershed drainage plan, showing the routing of sanitary and storm drainage systems;
- water supplies, including domestic and fire flows and pressures;
- infrastructure design, pedestrian facilities, and basic dimensions of special structures;
- measures taken to comply with local and provincial jurisdictional requirements, including conservation authority requirements, and
- proposed construction scheduling and operational features and constraints.

2.3 Design Considerations

In preparing the final design, engineers should:

- develop detailed surface grading and drainage design criteria, incorporating municipal design requirements. This would include defining perimeter and internal lot grades and building elevations, perimeter block grades and all required drainage structures and swales. Engineers should also relate the design to final road grades and storm sewer design.
- conduct field surveys, to obtain profiles, cross-sections and topographical information for designing roadways, sewers, lot grading, surface grading and drainage, and to verify the accuracy of photogrammetric mapping. Field surveys should be undertaken after an Ontario land surveyor prepares a final plan of survey and stakeout of the road allowance and lot fabric, and extend beyond the limits of the subject lands, if such external information is significant to preparing the design. In subdivisions where extensive cuts and fills are required to comply with lot grades, engineered fill may be necessary. Engineers should assume responsibility for the placement of engineered fill, especially for services and building foundations. The control of engineered fill, or imported earth borrow, is critical to the design of private sewage disposal systems and private well installations. Engineers should aim to achieve an economic and practical balance between excavation and filling. They should also provide rough grading plans of the area, identifying all fill and cut sections larger than 400 mm, to minimize the dust nuisance to precompletion home occupants and the potential damage to infrastructure in the future.
- design and prepare flow sheets and hydrological and hydrogeological design briefs for surface and underground storm drainage systems and external drainage flow. Engineers should consider overland routing for emergency overflow and storms exceeding the design capacity of the storm sewer system, so that buildings are adequately protected.
- design the sanitary sewer system, to accommodate adequately the intended population density and land use, allowing for peak flow and low flow conditions, according to the appropriate regulatory requirements. Engineers should design sewage pumping stations forming part of the sanitary sewer system, to minimize future maintenance and operating costs, as well as initial capital cost.
- design the water distribution system, to provide domestic fire service appropriate to the land use and with adequate system security, according to good waterworks practice and fire underwriters' regulations;

- design the roadway system according to current standards and specifications and the geometric standards and criteria established for the development, including provisions for on- and off-street parking as approved. The roadway system design should include, as appropriate, considerations of pedestrian and community safety, including illumination, crosswalks, signalization and signage. Engineers should specify the pavement design and materials quality and compaction criteria.
- design grade separation structures and culverts, including associated retaining structures and approaches;
- incorporate appropriate considerations of ecology and tree preservation in the design, and
- propose architectural styles for buildings compatible with the intended development concept.

2.4 Drawings

Engineers should prepare contract drawings to the standards established, and referenced to an Ontario land surveyor's legal surveys, using the Canada Land Inventory coordinate grid system, where available.

Design drawings should indicate proposed road grades, existing ground contours, parcel dimensions, casements, service connection locations, surface appurtenance locations within the road allowance, existing and final grade elevations at lot corners and along block limits, internal final lot and block grades, embankments, structures, sales, driveway constraints, catchbasins and leads, building types and other relevant information, including the use of engineered fill. In anticipation of building construction and excavation, a rough grading plan may be required to achieve site balancing of earthworks most economically.

2.4.1

The general plan should present a summary of all proposed facilities and services, with street names and lot numbers related to the legal survey plan, registered or to be registered.

2.4.2

The plan and profile for each street should be drawn in sufficient detail to enable construction. The plans should show the locations of sewers, watermains, curbs, sidewalks, maintenance holes, catchbasins, hydrants, valves and other facilities or structures, including street names, lot numbers, lot widths, and reference to adjacent plans. The profile should show invert elevation of sewers (including maintenance hole connections), the length, grade and class of sewer pipe and bedding detail for each section, as well as the length and grade of each tangent or roadway section, the elevation of the existing ground and other relevant details.

2.4.3

The sanitary and storm drainage area plans should define the drainage areas and design criteria for sanitary and storm facilities.

2.4.4

Cross-sections and other standard drawings should include the design details of nonstandard construction, and refer to applicable standards and special provisions. Engineers should use supplementary drawings to illustrate the design of appurtenant structures, if these cannot readily be shown on the plan and profile, or on the general plan.

2.4.5

Surface grading and drainage control drawings, based on legal surveys, should define the requirements and restrictions on surface grading, drainage, and structures.

2.4.6

Utilities coordination drawings, if required, should show all above-ground features and known locations of underground services.

2.5 Schedules for Subdivision Agreement

Engineers should prepare schedules required by municipal authorities, for inclusion in the subdivision or land development/redevelopment agreement. These should include an estimate of costs for financial securities and insurance. Engineers should participate in preparing the subdivision agreement, related to the assumption of roads, and ensure that lot grading is carried out in accordance with design.

2.6 Draft Conditions

Engineers should assist in satisfying conditions of draft approval.

2.7 Control Procedures

Driveway construction over private lands is an area of significant concern in new residential subdivisions. Engineers should be proactive in supervising/controlling driveway grades to the established standards. Engineers should also provide advice on control procedures, and carry out all authorized procedures, including:

- reviewing, correcting and approving builder site plans, prepared in sufficient detail to provide exact grading and drainage definition for the lot or blocks in relationship to the proposed building and lot grading plan, including top of footing elevations;
- applying location information on the drawings for street lights and buried service utilities, and
- reviewing builders' plans for driveway locations and building setbacks for traffic visibility at corners.

2.8 Specifications

These should be complete, clear and concise, describing the work's general scope, various classes, method of measurement and payment. The document should follow normal specification practice, including special provisions and nonstandard sections for special elements in the contract. Nomenclature should be the same as that used in drawings.

2.9 Contract Documents

These should include general and special conditions, priorities, specifications and plans, in addition to forms of tender with estimates of quantities of materials and work required. Engineers should prepare a cost estimate following preparation of the tender documents but before tendering, for acceptance by the client. Plans, schedules and applications for approval should be submitted to the client and regulatory authorities, for review and approval. Engineers should communicate with the regulatory authorities, to discuss the design and provide explanations, help further the land development application's approval.

Engineers should participate in the tendering procedure and make recommendations on the award of the contract, based on the tender bids received.

2.10 Submission of Plans, Tender Call and Contract Award

Tenders should include details of all draft plan conditions, permits/approvals and the subdivision agreements required.

3. ADMINISTRATION DURING CONSTRUCTION

3.1 General

Engineers designing the project should provide general administration services during construction to completion. These usually include:

- administration of construction contracts for each contract, to ensure general compliance with plans and specifications, and
- other development-related office and field services exclusive of contract administration, when so required.

Engineers acting as regulators should administer the development agreement according to the rules and regulations imposed on the proposed development.

3.2 Administration

Administration during construction includes:

- preparing payment certificates and processing contractor requests and claims;
- ensuring that work is executed in general conformity with plans and specifications;
- considering and evaluating alternative methods, equipment and materials, to achieve the desired end results;
- monitoring schedules and budgets;
- preparing, in conjunction with regulatory or approving authorities, work deficiency lists;
- advising on, and coordinating installation of, servicing utilities;
- reviewing shop drawings and other proprietary specifications for general conformity to the intent of project design. Where such drawings bear the seal of a professional engineer, reliance will be placed on the designer's calculations, unless otherwise specifically stated in the review.
- preparing "as-built" drawings;
- organizing and recording site meetings and construction-related decisions, and
- arranging quality control testing and providing quality assurance.

3.3 Resident Services

Engineers may offer to provide resident staff for contract supervision, inspection and layout. The extent of the requirement for resident staff is determined by development agreement obligations, client objectives, contractor's competence, site conditions and other factors, separately or in combination. Engineers should, after taking all such factors into account, recommend the extent of resident supervision services required, avoiding duplication of any services provided by municipal authorities.

Site resident services may include some or all of:

- field layout, or checking the contractor's field layout;
- periodic or continuous supervision of construction, to ensure conformance with approved plans and agreements;
- materials, time and equipment auditing services, including assessment and cost estimation of any extras associated with change orders. Field measurements of quantities. Maintenance of daily diaries and work sheets, signed by the contractor and the resident staff.
- issuance of change initiation orders to the client, where justified by site conditions, with adequate explanation and proposed methods for monitoring the change order;
- inspection of the works to confirm conformity with regulatory/approved conditions;
- follow-up inspection, audit and approval of corrective actions and works, and
- quality control and assurance testing, using independent laboratories and agencies as appropriate, for manufactured and natural products and materials specified.

4. RELATED SERVICES

4.1 General

Engineers or selected subconsultants may perform the following related services, under agreement with the client:

- legal, topographical, condition and location surveys of existing utilities and conduits;
- geoenvironmental audits and subsurface characterization studies;
- environmental impact surveys and studies; and
- natural resource inventories and surveys, including fauna and flora characterization for ecologically sensitive developments.

4.2 Public Hearings

Engineers may be required to conduct public hearings, to publicize the project and inform the public and affected communities on the scope of the proposed development. In such cases, engineers should prepare plans of the proposed development, and arrange for public hearings by suitable advertisement and notice, in concurrence with the affected municipal, provincial and other regulatory authorities.

Engineers should conduct or assist with the conduct of such public hearings and, from the input received, propose conceptual or design alterations that satisfy public and regulatory concerns and the client's development objectives, through negotiations and additional studies if necessary.

4.3 Additional Design Services

Engineers may be required to provide the following additional services in connection with proposed land developments:

- change or add to the design, specifications or contract documents, as dictated by circumstances beyond the engineer's control;
- review and assess the impact of proposed adjacent developments and the requirements of regulatory authorities;
- conduct storm water management studies;
- provide engineering services required under the *Environmental Assessment Act*,
- review or prepare reinforcing bar schedules and shop drawings;
- review or provide town planning services, and
- retain specialized services (e.g., geotechnical, geoenvironmental, architectural, landscaping, inspection and testing, quality control, project management, project audit) on behalf of the client.

4.4 Additional Administrative Services

Engineers may also be required to provide additional administrative services, including:

- easement negotiations;
- participation in legal, zoning and similar meetings;
- coordinating with utilities/services regarding installation schedules and unique locations;
- preparing cost sharing agreements;
- preparing detailed cost analysis, procuring and scheduling special applications for grants, loans, tax rebates and contributions from municipalities and other developers;
- administering financial arrangements;

- administering agreements of purchase and sale with builders;
- calculating and verifying extended footing charges;
- coordinating separate construction contracts and other consultants' work;
- attending special site meetings, dealing with extraordinary or extensive field problems, or situations not anticipated during design;
- providing computer services, except where a computer is used for design under the percentage schedule, or for the consulting engineer's normal office administration;
- providing operating manuals, plant start-up and operating personnel training;
- preparing special theoretical designs, reports and documents required for a project's approval and financing;
- providing translation of contractual documents or reports, conversion to metric or imperial units, and preparation of drawings for reduction, and
- assisting in having all constructed works assumed by the agencies having jurisdiction.

4.5 Additional Field Services

The following are examples of additional field services:

- arranging for subsurface environmental audits, and soil and groundwater testing;
- conducting surveys, to ensure that buildings are constructed in conformity with approved site and lot grading plans;
- conducting surveys and inspections, to ensure conformity of lot grades with approved plans, note deficiencies, supervise, and inspect rectification, and
- certifying that construction and grading are in accordance with the approved plans, as required.

4.6 Administering Subdivision and Development Agreements

When required by clients, engineers should:

- maintain sufficiently detailed records of construction progress that municipalities can authorize adjustments in subdivision securities;
- ensure that the scheduling and order of construction conforms to the requirements of the subdivision agreement and the appropriate regulatory authority, and will achieve the most efficient and economical end product;
- maintain records and follow-up procedures, to ensure that securities, liability coverage, etc., are maintained in, and reduced to, the correct amounts and form required during the term of the development agreement;
- ensure that full-time inspection services are being carried out by either their resident staff or municipal inspectors;
- assume responsibility for ensuring that terms of the subdivision agreement are being followed, and
- provide written declaration to the local municipality, stating that all subdivision works have been constructed according to the subdivision agreement, approved engineering drawings and the municipality's design criteria before "final acceptance" under municipal bylaws.

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