

GUIDELINE FOR GEOTECHNICAL REQUIREMENTS IN STEEP SLOPE AREAS OF DELTA

The purpose of this document is to describe the policy for protection against slope instability for new developments in Delta. It applies to all development in areas of Delta on or near a steep slope such as a ravine or bluff common in North Delta and Tsawwassen. The guideline was approved by Council on November 2, 1999. The guideline was subsequently updated in February 2010, to remain consistent with the B.C. Building Code.

During the winter of 1995 / 1996 questions were raised relative to the adequacy of geotechnical investigations and Municipal policies for development in steep slope areas of Delta. Events of slope instability along the Tsawwassen Bluff, notably the deep-seated slope failure at 207 Graham Drive, the erosion and slope movements in Cougar Creek Ravine, Kendale Ravine, McAdam Ravine and others, led to these minimum standards for development in steep slope areas.

Applicants are encouraged to discuss the requirements with the development section of the Engineering Department prior to development application. This guide is intended to provide a minimum standard for geotechnical engineering professionals working in Delta. Prior to retaining a geotechnical professional, the applicant is encouraged to ensure the consultant is aware of these minimum standards. By following this guide, applicants can avoid unnecessary delays.

February 2000 (updated February, 2010)

INTRODUCTION:

This policy applies to all development in areas of Delta on or near a steep slope such as the many ravines and bluffs common to both North Delta and Tsawwassen. While not all inclusive, Delta's Official Community Plan (available for viewing in the Community Planning & Development Department) provides a guide to some of these slope sensitive areas of the community as defined by the following development permit areas: SD2, English Bluff (Tsawwassen Escarpment), ND1, Fraser River Escarpment, ND2 D'Elsom Village and ND4, River Road Village (Sunbury).

Delta has strived to accomplish a comprehensive approach to slope stability in order to address the questions raised in the past relative to the adequacy of geotechnical investigations and policies for development in steep slope areas of Delta. A combination of detailed geotechnical engineering reports, attention to the preservation of existing vegetation, specific slope instability performance measures, a variety of measures to share knowledge about the slopes, encouraging accountability and supplementary geotechnical peer reviews are presented to guide the development community. Geotechnical submissions in support of development applications must be of high quality and comprehensive. Supplementary peer reviews will be requested on a case by case basis.

SUMMARY:

For the purposes of this guide, development includes building permit, development permit, subdivision or zoning amendments. The following issues should be addressed by a qualified geotechnical engineering consultant retained by the applicant.

- A. A detailed geotechnical review should be undertaken by the applicants consultant to determine whether the proposed development is feasible in a safe manner.
- B. Development should take place in a manner which maximizes the retention of existing vegetation and retains all vegetation outside the developed building area.
- C. Slope stability should be addressed such that:
 - i) there is no net decrease in overall slope stability resulting from the proposed development.
 - ii) there is no greater than a 1 in 2475 probability of significant slope instability in any given year.
 - iii) off-site slope instabilities are mitigated by the applicant to provide for the safe occupation and use of the lands and adjacent nearby lands.
 - iv) a construction management plan is developed and monitored by the applicants' geotechnical engineering consultant.
 - v) the geotechnical engineering consultant has reviewed Delta's Geotechnical Report Library in addition to any other sources of information available to the consultant.

- D. Additional provisions include:
- i) the provision of specific geotechnical assurances.
 - ii) a restrictive covenant registered against the property title.
 - iii) the provision of insurance.
 - iv) the provision of bonding to secure on-site and off-site construction works, as deemed necessary.
 - v) supplementary geotechnical consultant peer reviews as deemed necessary.

GUIDELINE PROVISIONS:

- A. **A detailed geotechnical engineering review must be undertaken by the developer's consultant to establish the feasibility of development in a safe manner.**

The engineering profession, through Provincial legislation, is charged with the responsibility to ensure development proceeds in a manner which limits public exposure to unnecessary hazards through risk to human safety and property damage.

A comprehensive geotechnical assessment is required to support development in steep slope areas of Delta. The geotechnical engineering profession should carry out all necessary background research, site investigation, slope stability analysis and reporting in order to enable it to make recommendations which will provide for a high quality, safe development with minimal impact to adjoining properties.

- B. **Development must place in a manner which maximizes the retention of existing vegetation and retains all vegetation outside of the developed building area.**

Vegetation, in the form of ground cover, shrubs or trees, assists in stabilizing the ground surface. Damage to existing vegetation through removal or disturbance can have significant impacts on slope stability. Any removal of vegetation should, therefore, be discouraged in steep slope areas. Where removal of vegetation cannot be avoided in order to accommodate a development, an acceptable plan to re-vegetate and re-stabilize affected areas should be provided.

- C. **Slope stability shall be addressed such that:**

- a) **there is no net decrease in overall slope stability resulting from the development.**

Development should only occur if it does not adversely impact the stability of the slope, including that of the site and adjoining properties and roadways. While a no net decrease in slope stability is required, there may still be a need to increase slope stabilities of the site and neighbouring lands in order to safely accommodate the proposed development.

- b) **a 1 in 2475 year probability of a slope instability in any given year be the minimum acceptable protection against failure.**

A probabilistic risk assessment of the site and surrounding lands affecting and being affected by the proposed development is required. The minimum standard for protection against failure is a 1 in 2475 probability in any given year with acceptable safety factors.

Applicants are required to submit proposals for development permits and building permits in steep slope areas which address the development in terms of a 1 in 2475 year probability against failure standard for both static and dynamic (including seismic loading) conditions. As the 1 in 2475 year probability of failure is proposed to be a minimum, Council, staff or the geotechnical engineer may set or recommend higher standards as determined by the application. In the consideration of subdivisions and/or rezoning applications, the Approving Officer or Council may set a more stringent, site specific, requirement in consideration of adding additional density to sensitive, steep slope areas of the community.

Under dynamic loading conditions, deformations in structures should be limited so that serious structural damage which leads to building failure or collapse does not occur. This will necessitate specific attention to this issue by the design team, including the geotechnical engineer, architect and structural engineer.

- c) **off-site slope instabilities which could adversely impact the safe occupation and enjoyment of the proposed development or of adjacent or nearby lands should be mitigated by the applicant.**

Critical to the safe use and enjoyment of the developed lands can be the stability of surrounding lands. A geotechnical review in support of an application needs to consider this issue. Where slope stability issues arise due to concerns on neighbouring lands or roadways, which are not part of the applicants property, the following options may be considered:

- a) The applicant may be required to stabilize the adjoining property or road. This approach should be reviewed on a case by case basis;
or
- b) The development may be designed through acceptable clustering, siting or physical design features to limit the potential impact to human safety and property damage on the subject property in the event of an off-site failure.
- d) **A construction management plan developed and monitored by the applicants' geotechnical consultant must be provided and adhered to.**

Steep slopes are often at risk during the construction phase. Excavations, vibrations and heavy equipment typically associated with development must be managed to avoid causing slope instability. In support of addressing this issue, an

acceptable construction management plan addressing critical issues for the safe construction of the development is necessary. The plan should be tailored to each particular development by the applicants geotechnical engineer. Common to the plans should be acceptable discussion of provisions with respect to monitoring of the slope prior to, during and following construction, safe access to the site, excavation and shoring plans, acceptable weather conditions and other issues deemed critical by the geotechnical engineer. The slope should be monitored to legal land surveyor tolerances. Consideration should be given to long term monitoring following completion of the project and the installation of slope inclinometers. Full time site inspection by a qualified geotechnical engineer should be provided during all critical stages of development with reports back to Delta.

e) The Geotechnical Engineering consultant be required to review Delta's Geotechnical Report Library.

An inventory of geotechnical reports received in support of development applications has been established by the Engineering Department. This inventory will assist geotechnical consultants through sharing of knowledge from previous investigations. Geotechnical engineers are required to confirm they have reviewed this material along with other available sources. In support of continuing to build this resource, applicants and their consultants should be aware that geotechnical submissions in support of development applications will become public documents and may be used in the reference library.

D. The developer and his agents are held accountable:

a) Through the provision of specific geotechnical assurances.

The applicant's geotechnical engineer should provide specifically worded assurances acceptable to Delta, which indicate, in the engineers professional opinion the site is suitable for the proposed development and will not adversely impact neighbouring properties if certain specified works are undertaken. The assurances, outlined in Attachment A, include specific reference to the fact that the Municipality is relying on the assurances to issue development approvals. These assurances assist in clarifying Delta's expectations of the professional geotechnical engineer. In addition, the geotechnical engineer is made aware of how the information being submitted on behalf of their client will be used and relied upon.

b) Through restrictive covenant registered against the property title.

Terms of Delta's acceptance of a development application should be incorporated into a restrictive covenant and registered against the property title in order to limit the use of the land. Provisions of such a covenant would commonly include limitations on the removal and disturbance of site vegetation, all geotechnical provisions including reports submitted in support of the application and indemnification of the Municipality. These covenants assist in clarifying the basis for Municipal acceptance of an application and convey this information to future owners of the land.

Enforcement of the covenant provisions through the construction phase are the responsibility of the owner and the geotechnical engineer through the owners commitments and engineers assurances provided to Delta. Delta has the ability to utilize security deposited in support of the application, as outlined in section d) below, to rectify deficiencies.

c) Through the provision of insurance which names Delta as an additional insured.

General liability insurance naming Delta as an additional insured and in a form acceptable to Delta as defined by the Subdivision & Development Bylaw No. 5100, as amended should be provided by the applicant. Delta is named as an additional insured due to its role in approving the application.

The applicant's geotechnical engineer of record should provide proof of a minimum of \$2,000,000.00 occurrence based professional liability coverage which does not lapse. This insurance should also name Delta as an additional insured. This may disqualify some geotechnical engineering consultants who cannot obtain this insurance.

d) Through the provision of bonding to secure the safe completion of on-site and off-site construction works, as deemed necessary.

Security can be utilized by the Municipality to correct such unsafe conditions created by the project. The amount of security and time frames for release is the subject of specific considerations associated with the application. In general, the amount of this bonding will relate to the potential risk and scope of potential damage during the construction of the dwelling and slope retention works.

e) Geotechnical Report peer reviews be commissioned as necessary.

In some cases, Delta may require a geotechnical engineering consultant peer review which will look for conformance with good engineering practice and adherence to these guidelines for development in steep slope areas of Delta. Where a peer review is deemed necessary by Delta, the applicant will be notified. The applicant can expect a significant time delay of approximately 8 weeks, dependent on the availability of an acceptable consultant and the scope of the development project. In order to avoid this additional requirement, applicants and their consultants are encouraged to submit comprehensive, thorough geotechnical reports to support their development application.

MUNICIPAL ACCEPTANCE:

The Development Section of the Engineering Department will review and comment on geotechnical report submissions in support of development applications in steep slope areas. Once the Engineering Department is satisfied with the submissions, appropriate recommendations will be forwarded to the Community Planning & Development Department for incorporation in to development application approval.

Geotechnical Standard Assurances

- a) The geotechnical engineer has carried out all necessary surface and subsurface investigations which that engineer considers necessary to provide the design and supervision undertaking being given;
- b) The engineer will provide the design and supervision such that, in the engineer's opinion, the development does not and will not compromise in any way the stability of the soil on site or soil on lands which are adjacent or nearby, and will not cause or contribute to such soils becoming susceptible to land slip, land slide, rock fall, mud flow, debris flow, debris torrent, erosion, slumping, settling or other such occurrence;
- c) In that engineer's opinion, in the event of any land slip, land slide, rock fall, mud flow, debris flow, debris torrent, erosion, slumping, settling or other such occurrence which occurs after the proposed development is completed, the extent of the property damage and damage to life and limb which occurs is not likely to be in any way greater than the damage or harm which would occur prior to the development taking place; and
- d) The engineer's undertaking that he is retained to fully supervise design and construction of the development, and that on completion of the work he will confirm in writing that he has fulfilled his design and supervision undertakings. In the event his retainer is terminated for any reason by his client, the engineer would be obliged to immediately notify the Municipality in writing of that fact.

PREPARED BY

The Corporation of Delta
Engineering Department