CATARAQUI REGION
CONSERVATION AUTHORITY

Appendix 'D': Guidelines for Geotechnical Investigation

This document should be read in conjunction with Section 3.3 of the CRCA Planning Policy.

1.0 PURPOSE

This document is intended to summarize the recommendations of the Cataraqui Region Conservation Authority (CRCA) for the preparation of geotechnical investigations by qualified Professional Engineers and Geoscientists for areas within its jurisdiction. It is intended to facilitate the preparation of reports that will meet the intent of provincial policy, thereby ensuring sound development practice within an expedient review time period. The guidelines reflect the current knowledge of the CRCA, and may or may not satisfy the specific requirements of other agencies. This document will be updated from time to time.

These guidelines include a glossary which defines all words in italics, exclusive of those defined by the Provincial Policy Statement (PPS) (Ontario 2005).

2.0 POLICY CONTEXT

As stated in the PPS:

> "Development shall be directed away from areas of natural or human-made hazards where there is an unacceptable risk to public health or safety or of property damage."

Hazards addressed by the PPS include dynamic beach hazards, flooding hazards, and erosion hazards. The preference is to avoid the hazard entirely, thereby avoiding or minimizing the potential for property damage or risks to personal health and safety. The PPS allows for some flexibility for development and site alteration in those situations in which the *hazard is* considered to be minor and can be addressed in an environmentally sound manner.

The specific interests of the CRCA include the following:

- The effect of increases in loading on slope stability/failure;

- The effect of infiltration of surface water on slope stability/failure;
- Evaluation of the susceptibility of slopes above or adjacent to a development to collapse; and
- The use of appropriate and environmentally-sound protection works.

3.0 GUIDELINES

Detailed technical guidelines have been prepared to establish standards and procedures for regional and site-specific investigations. These include the Natural Hazards Training Manual (NHTM) (MNR 1997), and the Geotechnical Principles for Stable Slopes (GPSS) (Terraprobe, Aqua Solutions 1998) prepared as part of the Great Lakes-St. Lawrence River System and Large Inland Lakes Technical Guideline (GL-SL TG) (MNR, 2001).

The NHTM (1997) and GL-SL TG (2001) were developed by the Ministry of Natural Resources to help implement the natural hazards component of the PPS. These documents define the *erosion hazard* limit for all areas of the province while allowing for further refinement through regional or site-specific analyses. Within the CRCA jurisdiction, the *erosion hazard* limit has been further defined for the Lake Ontario and St. Lawrence River shoreline (J.D. Paine 1995 - see Appendix 'C'). If development is proposed within these established limits, there will be a requirement for a site specific geotechnical investigation.

An investigation is required primarily to examine the erosive potential of the *hazardous lands*. The NHTM has determined three differing areas of *hazardous lands* interest; the *Great Lakes-St. Lawrence River System* and *River and Stream Systems* are the two which are found within the Cataraqui Region. Each area has established criteria for examination to determine the extent of *erosion hazards*. The Great Lakes criteria includes a *stable slope allowance* plus the expected recession over a period of 100 years or an *erosion allowance*. The River and Stream criteria include *stable slope allowance* plus a *toe erosion allowance* plus an *erosion access allowance*. These are defined in Table 1 of the NHTM.

Suggested Report Format

The study report should include the content and general format that is outlined in the GPSS Sections 8 and 9. We suggest that the report could be broken into two parts. Part One would include the factual data itself, such as:

- Terms of reference
- Details of field investigations, site conditions
    - slope configuration/profile - height, inclination andshape, scaled cross-section drawing
    - subsurface conditions (actual and inferred) - soil stratigraphy and layering, soil type and composition, soil density and strengths, groundwater levels/observations, seepage
    - external loadings - structures, traffic, earthquakes, trees, fill
    - site drainage - surface runoff, ditches, channels, seepage, creeks, rivers, lakes, excavation
    - erosion - location, extent, severity, rates, wave action

    - vegetative cover and species
    - history of instability
    - site inspection record
- Results of testing
- Laboratory test results
- Photographs
- Borehole logs and piezometer monitoring data
- Discussion of site inspection and measurements taken
- Scaled site plan, with the relation to:
    - existing and proposed structures
    - current water's edge
    - top of bank, toe of slope, and other topographic information
    - required water or top of bank setbacks as specified in the applicable Zoning By-law
    - regulatory floodplain (where defined)
    - drainage features, erosion features, indicators of past instability or movement
    - vegetation cover

The GPSS includes a sample Slope Inspection Record form (Table 7.4, attached) and a Slope Stability Rating Chart (Table 8.1, attached), both of which should be completed and included with the report . These items aid in determining the required level of investigation.

Part Two would include recommendations based on the proposed construction, such as:

- Design bearing values
- Caisson/pile designs
- Potential settlement
- Potential causes of instability
- Safe slopes of banks and excavation walls
- Earth pressures for shoring
- Soil stabilization methods and comparison of benefits
- Relation of hazards to proposed development
- Long-term stable slope crest position and inclination
- Factor of safety
- Failure surfaces
- Reference to stable slope, erosion allowances etc. as outlined in NHTM and Technical Guidelines
- Methods for soil erosion/sedimentation control
- Methods by which to minimize impact on vegetation, and root systems
- Timing of site works
- Long term monitoring requirements

The report is to make <u>explicit</u> reference to the PPS, NHTM, and Technical Guidelines, all of which are available for viewing at the CRCA office near Glenburnie, Ontario (north of Kingston on Division Street). Only SI (metric) units should be used. The CRCA assesses a fee for our review of this type of report. The fee assessed will be that in place at the time of report submission.

The report will require the stamp and signature of a Professional Engineer or Professional Geoscientist as per GPSS Section 8.2.

Reports which do not include the above content may not be reviewed until the appropriate information has been included.

For more information, please contact the CRCA Watershed Engineer at (613) 546-4228 or via fax (613) 547-6474.

DEFINITIONS

Additional definitions are found in Section 4.0 of the CRCA Planning Policy. It is intended that the definition of these and other terms be consistent with the definitions listed in the Provincial Policy Statement, as amended.

Erosion: means the loss of land, due to human or natural processes.

Erosion Allowance: a horizontal allowance measured landward from the toe of shoreline cliff, bluff, or bank reflecting the possible erosion of the slope over a 100 year period.

Erosion Access Allowance: a horizontal allowance measured from the top of the stable slope, including toe erosion allowance, to provide access to the site for emergencies, regular maintenance, or unforeseen conditions.

Stable Slope Allowance: a horizontal allowance measured landward from the toe of the shoreline cliff, bluff, or bank reflecting a long-term stable state of the existing slope material.

Toe Erosion Allowance: a horizontal allowance measured landward from the toe of the shoreline cliff, bluff, or bank reflecting the possible erosion of the toe of the slope.

TABLE 8.1 - SLOPE STABILITY RATING CHART

Site Location: File No.
Property Owner: Inspection Date:
Inspected By: Weather:

				Rating Value
1.	**SLOPE INCLINATION**			
		degrees	**horiz. : vert.**	
	a)	18 or less	3 : 1 or flatter	0
	b)	18 - 26	2 : 1 to more than 3 : 1	6
	c)	more than 26	steeper than 2 : 1	16
2.	**SOIL STRATIGRAPHY**			
	a)	Shale, Limestone, Granite (Bedrock)		0
	b)	Sand, Gravel		6
	c)	Glacial Till		9
	d)	Clay, Silt		12
	e)	Fill		16
	f)	Leda Clay		24
3.	**SEEPAGE FROM SLOPE FACE**			
	a)	None or Near bottom only		0
	b)	Near mid-slope only		6
	c)	Near crest only or, From several levels		12
4.	**SLOPE HEIGHT**			
	a)	2 m or less		0
	b)	2.1 to 5 m		2
	c)	5.1 to 10 m		4
	d)	more than 10 m		8
5.	**VEGETATION COVER ON SLOPE FACE**			
	a)	Well vegetated; heavy shrubs or forested with mature trees		0
	b)	Light vegetation; Mostly grass, weeds, occasional trees, shrubs		4
	c)	No vegetation, bare		8
6.	**TABLE LAND DRAINAGE**			
	a)	Table land flat, no apparent drainage over slope		0
	b)	Minor drainage over slope, no active erosion		2
	c)	Drainage over slope, active erosion, gullies		4
7.	**PROXIMITY OF WATERCOURSE TO SLOPE TOE**			
	a)	15 metres or more from slope toe		0
	b)	Less than 15 metres from slope toe		6
8.	**PREVIOUS LANDSLIDE ACTIVITY**			
	a)	No		0
	b)	Yes		6
	SLOPE INSTABILITY RATING	**RATING VALUES TOTAL**	**INVESTIGATION REQUIREMENTS**	**TOTAL**
1.	Low potential	< 24	Site inspection only, confirmation, report letter.	
2.	Slight potential	25-35	Site inspection and surveying, preliminary study, detailed report.	
3.	Moderate potential	> 35	Boreholes, piezometers, lab tests, surveying, detailed report.	

NOTES: a) Choose only one from each category; compare total rating value with above requirements.
b) If there is a water body (stream, creek, river, pond, bay, lake) at the slope toe; the potential for toe erosion and undercutting should be evaluated in detail and, protection provided if required.

TABLE 7.4 - Slope Inspection Record

1. FILE NAME / NO.
INSPECTION DATE (DDMMYY):
WEATHER (circle): ○ sunny ○ partly cloudy ○ cloudy
○ calm ○ breeze ○ windy
○ clear ○ fog ○ rain ○ snow
○ cold ○ cool ○ warm ○ hot
estimated air temperature:
INSPECTED BY (name):

2. SITE LOCATION (describe main roads, features)

SKETCH

3. WATERSHED

4. PROPERTY OWNERSHIP (name, address, phone):

LEGAL DESCRIPTION
Lot
Concession
Township
County

CURRENT LAND USE (circle and describe)
○ vacant - field, bush, woods, forest, wilderness, tundra,

○ passive - recreational parks, golf courses, non-habitable structures, buried utilities, swimming pools,

○ active - habitable structures, residential, commercial, industrial, warehousing and storage,

○ infra-structure or public use - stadiums, hospitals,
schools, bridges, high voltage power lines, waste management sites,

5. SLOPE DATA
HEIGHT ○ 3 - 6 m ○ 6 - 10 m ○ 10 - 15 m ○ 15 - 20 m
○ 20 - 25 m ○ 25 - 30 m ○ > 30 m
estimated height (m):

INCLINATION AND SHAPE

○ 4:1 or flatter 25 % 14°	○ up to 3:1 33 % 18½°	○ up to 2:1 50 % 26½°
○ up to 1:1 100 % 45°	○ up to ½:1 200 % 63½°	○ steeper than ½:1 > 63½°

6. SLOPE DRAINAGE (describe)
TOP

FACE

BOTTOM

7. SLOPE SOIL STRATIGRAPHY (describe, positions, thicknesses, types) TOP FACE BOTTOM
8. WATER COURSE FEATURES (circle and describe) SWALE, CHANNEL GULLY STREAM, CREEK, RIVER POND, BAY, LAKE SPRINGS MARSHY GROUND
9. VEGETATION COVER (grasses, weeds, shrubs, saplings, trees) TOP FACE BOTTOM
10. STRUCTURES (buildings, walls, fences, sewers, roads, stairs, decks, towers,) TOP FACE BOTTOM
11. EROSION FEATURES (scour, undercutting, bare areas, piping, rills, gully) TOP FACE BOTTOM
12. SLOPE SLIDE FEATURES (tension cracks, scarps, slumps, bulges, grabens, ridges, bent trees) TOP FACE BOTTOM
13. PLAN SKETCH OF SLOPE
14. PROFILE SKETCH OF SLOPE