Usefulness of Terrain Stability Mapping for Bioterrain Purposes – A Discussion Paper

The purpose of this paper is to discuss some of the issues relating to the use of terrain stability mapping (TSM) for bioterrain mapping (BTM) purposes. It is intended to guide those who are responsible for determining terrain mapping contract specifications and/or project objectives as well as to assist the Qualified Registered Professional (QRP) responsible for writing project proposals. It is recommended that a QRP be consulted at the onset of any terrain mapping project to ensure that the required mapping is appropriate for the project objectives.

Bioterrain mapping is terrain mapping used as a base map for terrestrial ecosystem mapping (TEM). Terrain stability mapping is terrain mapping for the production of a slope stability map. These two types of terrain mapping differ as each intended end product requires a specific set of mapping criteria and mapping standards. This results in differences in symbols (coding), linework, and digital data.

Use of existing terrain stability mapping for bioterrain purposes is less than ideal. Re-mapping an area can be more cost effective, less time consuming and will produce a higher-quality mapping product in some cases. Examples of different approaches used to combine TSM with BTM follow:

- In the Wood River Basin, terrain stability mapping and bioterrain mapping were completed on two separate sets of aerial photographs. The cost of a second set of typed aerial photographs must be weighed against the production of independent mapping. Other projects have used the alternate aerial photograph or overlays to re-map for bioterrain.

- In the Lillooet area, reconnaissance (U, P, S) terrain stability mapping and bioterrain mapping were jointly mapped. U (Unstable) and P(Potentially unstable) polygons were delineated, and the remainder of the landscape is divided according to bioterrain principals. The resulting map represents a mosaic of the two methodologies.

- Another approach is to delineate ‘primary’ terrain polygons that emphasize material thickness, material texture, geomorphological process, and drainage (which influence both stability and ecology). Then use a separate overlay (layer) or line colour to divide up the ‘primary’ terrain polygons into ‘secondary’ bioterrain and slope stability polygons. This approach would be most effective with a Softcopy (digital) mapping system.

Terrain from a terrain stability mapping project may be used as an input layer for predictive ecosystem mapping (PEM). The PEM methodology requires that the input layer be described in the metadata. TSM as an input is not a problem in this case because the final resultant PEM attributes are evaluated for accuracy which is reported.

For projects addressing both slope stability and bioterrain mapping, it is important that the mapper(s) is (are collectively) qualified to do both terrain stability mapping and bioterrain mapping or is supervised by someone who is. Mappers and map users should be aware that the average polygon size is smaller when slope stability and bioterrain are both taken into consideration. Extra time should be allotted for quality assurance and subsequent corrections of both terrain stability and bioterrain portions of the project. Quality assurance of both mapping should be addressed from project initiation to completion to ensure that the mapping fulfils both TSM and TEM standards. RISC standards can be found at the following web site: http://ilmbwww.gov.bc.ca/risc/standards.htm. Where there is a conflict between methodologies and standards it must be clearly stated which takes precedence and why.

In general, existing terrain stability maps and reports are useful sources of information for bioterrain mapping. Field data, typed air photos, maps, and reports can be used to increase the reliability of the bioterrain map. Field sites and data can be added to the ecosystem maps and databases.

The following points outline some key differences between terrain mapping for bioterrain and terrain stability mapping:

- *Drainage classes*: For terrain stability mapping, drainage classes range from **v**-very poor to **r**-rapid (6 classes). For bioterrain mapping drainage classes range from **v**-very poor to **x**-very rapid (7 classes).

- The surface expression **x** (very thin veneer) was added to the 1997 terrain mapping standard and is more widely used in bioterrain than terrain stability mapping. A very thin veneer is defined as 2-20 cm; while **R** (rock) can be used for bedrock outcrops covered with up to 10 cm of material. Thin soils, capable of sustaining plant communities, may not be adequately captured on a terrain stability map, as low material volumes may not be relevant to stability. As a result of this, the bioterrain mapping will likely reflect a higher percent of rock than the corresponding terrain stability information.

- Bioterrain mapping uses deciles to indicate proportions of different terrain components in a polygon while terrain stability mapping uses delimiters '***//***', '***/***' and '**.**' (see Table 1).

- Because terrain stability mapping has a different focus than bioterrain mapping, the polygon boundaries are likely not appropriate for ecosystem mapping without alterations. Terrain stability polygons may split areas that would normally be lumped in bioterrain mapping, and lump areas that should be split for bioterrain mapping. Some instances where terrain stability polygon boundaries do not adequately address terrain characteristics that influence ecosystems follow:

    - Aspect splits are not addressed.
    - Thick and thin materials may be lumped, particularly in gently sloping terrain.
    - Range in soil drainage/moisture is often lumped on gentler terrain.
    - Slope position and morphology (as it relates to soil moisture and nutrient regimes) is not emphasized unless it influences terrain stability.
    - Plant communities influenced by terrain may not be delineated in detail, e.g. avalanche tracks, seepage zones and wetlands.
    - Riparian areas may not be pulled out. Terrain lines will often follow the axis of a steam or gully. Delineation of riparian zones has sensitive ecosystem and fisheries applications.
    - Terrain stability polygon boundaries tend to emphasize slope and may have different slope criteria than bioterrain, e.g., for bioterrain mapping slopes of 25% (Interior) and 35% (Coast) are important slope breaks for the application of aspect modifiers.

- Digital data requirements are currently (as of September 2006) different for terrain stability mapping projects and bioterrain mapping for TEM/PEM projects.
    - Some of the attributes in the database for bioterrain projects are slightly different than those used for terrain stability mapping. For example, for bioterrain, texture information is captured in three fields each one character long (e.g. Ttex_1c, Ttex_1b and Ttex_1a), whereas for TSM, one field three characters long is used (e.g. Ttex_1). Also, typically the slope stability and erosion potential attributes are not captured for a bioterrain/TEM project (though we are seeing some combination projects where these attributes are captured.)
    - Bioterrain mapping projects and TSM projects, should use <u>applicable</u> new standardized field names and coding from Errata-2006-1-LBIP for additional attributes mapped, or may use 'user-defined' fields, with appropriate documentation.

- The Terrain digital data capture standards (Errata-2006-1-LBIP) require deliverable files in .e00 format embedded attributes while the TEM digital data capture standards require spatial data in .e00 format with attributes in a .CSV file. Note that the Ministry is planning to integrate the terrain/bioterrain and ecosystem digital standards, so all datasets will use common field names and file formats; Until these planned changes take effect, independent bioterrain mapping projects used as an input to a PEM, may be submitted to the TEM data custodian following either the current Standard for Digital Terrain Data Capture (Errata 2006-1-LBIP) or Standard for TEM Digital Data Capture (Errata No.1.0). Bioterrain mapping for TEM projects continues to require the final data in the format as per the TEM digital standard (Errata No.1.0); however, the new field names and coding from Errata-2006-1-LBIP should be used if applicable to the project.

In conclusion, modifying a terrain stability map for bioterrain purposes is possible. The above points are only examples of some major differences. Data users wishing to use terrain stability maps for bioterrain mapping must consider all of the upgrades required and assess if upgrading or re-mapping is more appropriate. This should be assessed on a project-by-project basis, as mapping style will vary depending on the mapper and the original project objectives. A Qualified Registered Professional should be consulted at the onset of any terrain mapping project to ensure that the required mapping is appropriate for the project objectives, thus saving time and money and avoid unnecessary misunderstandings between mappers, map users and quality assurance reviewers.

Table 1. Conversion Table from Delimiters to Deciles

Delimiter Examples	**Deciles**	**Description***
Mb	10	The entire polygon is Mb
Mb//Rk	8:2 or 9:1	Rk is considerably less than Mb
Mb/Rk	6:4 or 7:3	Rk is less than Mb
Mb•Rk	5:5	Mb and Rk are roughly equal
Mb//Rk•Cv	8:1:1 or 6:2:2	Mb is considerably more extensive than each of Rk and Cv; Rk and Cv are roughly equal
Mb//Rk/Cv	7:2:1	Rk is considerably less than Mb; Cv is less than Rk
Mb//Rk//Cv	6:3:1	Rk is considerably less than Mb; Cv is considerably less than Rk
Mb/Rk•Cv	6:2:2	Rk is less than Mb; Rk and Cv are roughly equal
Mb/Rk/Cv	5:3:2	Rk is less than Mb; Cv is less than Rk
Mb/Rk//Cv	5:4:1	Rk is less than Mb; Cv is considerably less than Rk
Mb•Rk//Cv	5:4:1 or 4:4:2	Mb and Rk are roughly equal; Cv is considerably less than each of Mb and Rk
Mb•Rk/Cv	4:4:2	Mb and Rk are roughly equal; Cv is less than each of Mb and Rk
Mb•Rk•Cv	4:3:3	Mb, Rk and Cv are all roughly equal

* Modified from: Terrain Classification System for B.C. – Version 2 (Howes and Kenk, 1997)

Where more than one option is listed the first option should be used unless the mapper's style is better represented by the second option listed.

E.g., Mb•Rk would be converted to 5Mb 5Rk
Mb//Rk//Cv would be converted to 6Mb 3Rk 1Cv

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