Harvesting Timber on Karst Terrain

Operational Planning Guidance

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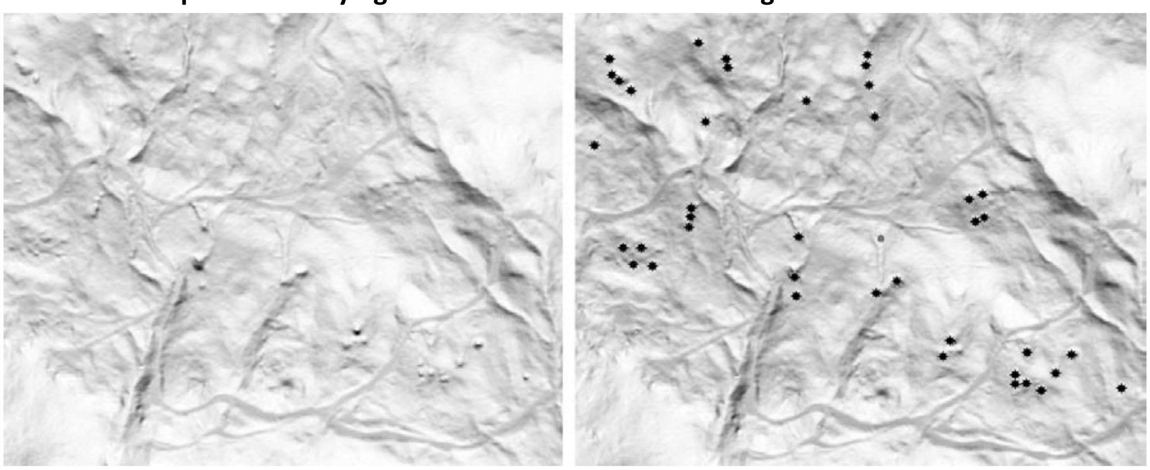
Original: 2017-04-24 Version: 2018-03-27

The process below is broken down as a timed stepped approach when working in Karst Terrain. Missing a step in the timeline of block development and harvesting can be problematic and costly.

1) Identification at a planning or Recce level stage:
    - Identify the karst unit boundaries up to 400 meters beyond the proposed harvesting.
    - Review all data within the Karst Data Base and previous karst assessments up to 5 kilometers from proposed harvest unit or road building.
    - Examine the LiDAR Hill shades to locate sinks and to identify topographic changes from karst areas to non-karst areas.
    - Record and update limestone boundaries and features based on office inspections.

*__Example of identifying sinkholes on karst terrain using Lidar information__



2) Examination: Once a block area is identified for development a Karst Specialist should conduct a detailed examination of all office data and hydrologic sub basin areas, followed by a field review prior to initiating cut block and road layout. The field search is based on the known and projected drainage pattern for the area and the limestone bed characteristics. **Never work alone on or near karst terrain. Always work within eyesight of your partner.** Identify and classify all features found during this review, including the survey of caves . Key elements in the examination are:
    A. Limestone bed and feature characteristic assessment
    B. Sub basin area calculations; higher year round flows correlate to larger karst features
    C. Flow concentration areas; significant features trend in concentration zones

D. Contact zones; most features are located in these zones, shallow ceiling caves or voids generally propagate in these zones.
E. Limestone depth; important in the determination of projected feature size and position below surface, safety and surface sensitivity rely on accurate depths
F. Subsurface flow depth; in line with above indicators
G. Limestone competency; a fractured bed produces subsurface features that do not follow general slope direction, but trend in open fractures, while altered limestone zones can concentrate features which are easily identifiable on the surface.
H. Identify rock intrusions or outcrops, these outcrops are generally hydrologic barriers at bottom contact.
I. All caves that can be entered safely need to be fully explored and surveyed where necessary by experienced cavers, contact the BC Speleological Federation or a known BCTS karst contact person for that area.
J. Majority of sinkholes need to be probed for hidden subsurface passage entrances. Note: training is recommended; this can be a very dangerous procedure if not trained.
K. All significant karst features need to be photographed using a GPS enabled camera.

3) Karst Assessment pre-layout recommendation; is a critical plan, verbal or written, produced by a Karst Specialist to help guide the location of boundaries and roads.
4) Road and Cutblock design elements to **avoid** on karst terrain
   - Roads placement in karst gullies or sinkholes
   - Road alignment over or immediately parallel to a limestone contact edge
   - Road location in line and over an open fracture
   - Roads or harvesting over a thin ceiling cave or subsurface features, especially features that contains a hydrologic flow
   - Harvesting or road building on rock outcrops that contain grikes which extend past the first bedding layer of limestone, extending into the subsurface. High subsurface conductivity can potentially contain bat or other biological habitat.
   - Recommendations of any reserve area without also considering where the root zone interface is located in relation to the upper surface of the limestone bed. An understanding of the overburden depth and limestone competency in the top 2 meters is another crucial consideration in determining whether trees within a reserve will be wind firm.
5) New Feature find; inform the Karst Specialist with an email and photos of any new feature(s) found, may be a safety issue and result in a change of plan.
6) Final Karst report: Upon completion of layout the final karst report is completed with the final block design on a map included in the report.
7) Update Karst Database with all significant karst features as per GAR order.
8) Ensure safety warnings and the best refueling sites are on all operational maps. Pre-works must include the karst component. When previously unidentified features are found during road construction or harvesting, a stop work and get assessed approach must be adhered to.

Definition of terms:

- *Grike; a small open fracture generally extending into the first bedding plane in limestone, has weathered edges, a range of sizes*
- *Fracture; during uplift the limestone bed can be distorted enough to cause stress fractures, these fractures extend past the first bedding plane and generally extend to bottom contact. On ridges they are wider on the surface and narrow as the depth increases. In large gullies the inverse has been noted in caves.*
- *Bottom contact; the zone where the limestone beds rests upon non-limestone material*
- *Contact edge; the zone on the surface where the limestone meets non-limestone rock*
- *Subsurface conductivity; an open void extending from the surface to a larger subsurface void; water, air or biological transportation is possible.*
- *Karst Specialist; a person belonging to an association (ABCFP, APEGBC) that is mandated by a legislative framework that specializes in assessing and making management recommendations for operational harvesting of trees and road building located on karst terrain. Has enough underground caving experience within the regional area to accurately correlate cave surveys with the surface expressions. The person must have a good understanding of the hydrologic sub basin and hydrologic flow zones within the karst unit assessed.*