STEEP SLOPE RESOURCE PACKAGE

Supporting Guidance for Operating on Steep Slopes
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Disclaimer
The BC Forest Safety Council provides this guidance document as a resource to assist BC forestry employers in planning and conducting operations on steep slopes. This package describes a process for identifying, evaluating and documenting hazards and provides tools for developing and implementing appropriate site-specific steep slope plans.

The information contained in this document does not necessarily provide the only correct way of addressing the identified issues. This resource package is not intended to be exhaustive or include all pertinent requirements or responses that might be appropriate in a particular situation. It does not release readers from their responsibilities under applicable legislation. Ultimately, the individual organization is responsible to ensure, on a case-by-case basis, appropriate application of practices described here. The information provided is subject to review in light of changing government requirements and regulations. Every effort has been made to ensure the reliability of the information contained in this document and to avoid errors and omissions. Address all concerns and suggestions to the BC Forest Safety Council.

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Availability
This resource package, as well as future revisions and additions, are available from:

BC Forest Safety Council
420 Albert St.
Nanaimo, BC V9R 2V7
Tel: 1.877.741.1060
Web: www.bcfreesafe.org
Introduction

Operating logging equipment on steep slopes increases the likelihood of reduced machine stability which can result in an upset or roll-over. Such events can result in serious worker injuries or fatality, significant environmental damage and expensive lost production and machine repairs. This document recognizes that conducting productive, injury-free mechanical harvesting operations on steep slopes requires an integrated approach that draws on the skills and accountabilities of all forestry team members - owners, operational planners and lay out crews, contractors, assessors, supervisors, and operators.

This resource package was developed with input from forest industry technical advisory groups from across BC, including engineers, safety professionals, equipment manufacturers, industry associations, forest professionals, logging managers, contractors, supervisors and equipment operators. These groups collaborated to describe responsibilities and best practices necessary for planning and safely conducting mechanical harvesting operations on sloping terrain.

It is intended to supplement, not replace, existing harvest planning, hazard assessments, and safe work procedures. Users are encouraged to incorporate these procedures and tools into their existing safety management system and planning process.

This resource package is intended to help owners, employers and employees meet their compliance obligations with respect to WorkSafeBC Regulations (e.g. OHS Part 26.16 and 26.2). It does not replace or override WorkSafeBC Regulations or other relevant Act or Regulations. Should actions described in this document conflict with an applicable regulation, the regulation prevails.

Note: There is a wide variety of ownership systems, contractual arrangements and employee structures at work in the BC forest industry. This document considers the typical forest harvesting structure to be a contractor harvesting timber under contract to a forest licensee. Recognizing that private land timber harvesting, timber sales issued by BCTS, woodlot licenses and other harvesting arrangements each confer different responsibilities to each constituent, it is essential that users of this resource package are familiar with the whole procedure, and understand their role(s) given their contractual situation.

Scope

This process contemplates logging machinery identified below operating in typical mechanical operations.

- Tracked machines – feller-buncher, skidder, processor, harvester, log loader, excavator (road construction pioneering, hoe-chucking, site-prep), dozer.
- Wheeled machines – harvester, skidder, forwarder.

Non-standard configurations were not considered extensively. While this framework might be used effectively for those applications, employers likely need to develop safe work practices specific to such operations.
Overview

This Resource Package has four main sections.

**Part 1 – The Steep Slope Hazard Assessment Tool** includes a 2-page form used to identify and evaluate site-specific hazards in the field, and to prescribe controls necessary to eliminate or mitigate those risks. To support thorough form completion and development of effective plans, Part 1 provides instructions on the hazard assessment process, definitions and descriptions of key site variables / characteristics an assessor must consider in their assessment.

Part 1 also provides a brief list of general hazards and risks factors that assessors and planners should consider, as well as site- and machine-specific practices that can be implemented to eliminate or mitigate machine stability risks.

**Part 2 – Steep Slope Planning & Operational Responsibilities** identifies three primary constituents of typical BC forest harvesting operations - owners (e.g. forest proponent / licensee), employers (e.g. contractor) and employees (e.g. machine operator) – and describes planning and administrative responsibilities that would be completed by each of them to accomplish successful logging operations on steep slopes.

Consistent, diligent completion of their respective administrative and planning responsibilities by the identified constituent represents the first level of safe work practices and controls.

**Part 3 – General and Machine-Specific Best Practices** includes general and machine-specific steep slope safe work procedures / practices. General safe work practices are actions or best practices that employers engaged in steep slope mechanical operations would incorporate into their existing safety management system – these are actions that would be standard operating procedures for all phases of mechanical steep slope operations. Machine-specific procedures are the further steps employers will direct operators to conduct for steep slope operations, but targeted to the identified machine.

These two components of the safe work practices are the second level of operations controls implemented to reduce risks associated with harvesting on steep slopes.

**Part 4 – Support Documents** includes generic forms and practical information that can be used in steep slope operations. While most employers will have already integrated these steps (tracking operator and supervisor qualifications, pre-work site review with operators, etc) into their safety management system to ensure regulatory compliance, this information is provided for reference / consideration / revision.

1. Operator Review and Orientation Form
2. Operator Experience / Qualification Record
3. Supervisor Experience / Qualification Record
4. Sample Hazard Matrix
5. Steps for Dealing with Emergencies
Part 1
Steep Slope Hazard Assessment Tool

Using the Steep Slope Hazard Assessment Tool

Who – As described by WorkSafeBC Regulation 26.16, the steep slope hazard assessment must be completed by a qualified person. The related WSBC Guideline provides the full description but generally specifies that a qualified person is “knowledgeable of the work, the hazards involved and the means to control the hazards, by reason of education, training, experience or a combination thereof”.

This process acknowledges that the qualified person collecting and recording site-specific attributes as inputs to hazard assessment risk rating may not necessarily be the same person that designates required controls and builds the steep slope plan. For example, site information (slope, roughness, soils, hydrology, etc) could be collected at the planning / lay out stage by an experienced forester, and communicated to the logging contractor qualified to employ that information and build / implement an effective steep slope plan.

Where – As specified by WorkSafeBC Regulation 26.16.

When – Before harvesting operations commence. Completing the assessment and developing a plan in advance of operations enables the opportunity to schedule the correct machine and operator, and affords time to revise the plan, and secure any necessary amendments.

What – Complete the Steep Slope Hazard Assessment and develop a site-specific Steep Slope Plan.

How:
1. Complete the top part of Page 1 to include important administrative information.
2. Have a copy of a map that accurately shows block boundaries, roads, steep slope sites, plus other key features (e.g. the preliminary steep slope assessment map, current layout map, cutting permit map, etc.).
3. Field review (walk) the area planned for mechanical operations. Identify areas suitable for mechanical operations, particularly those with slopes / characteristics that pose machine stability risks.
4. At each site, consider each Machine Stability Factor and evaluate site characteristics to determine the extent that they will impact machine stability and/or traction.
5. In the “Comments” column, record measurements and other information to support the risk rating and provide information that will be useful in developing operational plans.
6. Based on site attributes, assign a risk rating for each Machine Stability Factor.
7. Identify other site and environmental factors that will influence machine stability / traction (e.g. convex slopes, bluffs, draws and gullies, benches for machine trails, access or escape, etc.). Assign a risk rating.
8. Consider the following as each may confer operational limitations or hazards: soil disturbance and site degradation limits, Silviculture Prescription, retention objectives, riparian management, adjacent danger trees, upslope terrain stability or avalanche risk. If relevant, identify on page 1 and assign a risk rating.
9. Consider the risk rating for each Machine Stability Factor, plus relevant information as per steps 7 and 8 above to develop an Overall Machine Stability Risk Rating. Typically, where more than three (3) Machine Stability Factors indicate a score of “High”, the Overall Machine Stability Risk Rating will be High.
10. On Page 2, considering the Overall Machine Stability Risk Rating and available logging equipment / methods options, identify the additional (i.e. in addition to Safe Work Practices described in Parts 2 and 3 of this document) controls that will be necessary to apply to eliminate or mitigate hazards. Page 2 identifies
various common controls the planner might consider and specify using the appropriate check-box, and it provides space to describe specific control measures.

11. If the risk to mechanical operations cannot be adequately controlled, identify and map as a “No Go” area. Consider building an alternate harvest plan or amending boundaries to designate as WTP, or exclude.

12. Develop a clear, concise Steep Slope Plan map that accurately identifies the location of steep slope sites. Attach it to the completed Steep Slope Plan and/or to the overall logging plan for that unit.

What else – At the pre-work and tailgate meetings communicate the plan.

Definitions & Notes
Below are notes explaining hazard assessment criteria and providing direction on how to use the steep slope hazard assessment tool and develop the associated plan.

Site or Sub-Area – Refers to blocks where the variability of site attributes requires more than one steep slope hazard assessment and more than one steep slope plan. Use the Site and Sub-Area box to identify those areas, and the corresponding label on the steep slope plan map.

Slope – Steepness or gradient of the site as measured using a clinometer, typically expressed as a percentage.

Slope Length – For the site or sub-area being assessed, the slope distance from the bottom of the site to the top. Where significant benches (less than 35%) exist between steeper sections and provide an operational advantage, the slope length may be described as the average distance between benches.

Terrain Classification – Where a Terrain Stability Field Assessment (TSFA) is necessary (either as required by forestry regulation or site characteristics incur due diligence responsibilities), it should be completed by the site owner and the report provided to the qualified assessor and the contractor.

Where a TSFA has been completed, the hazard assessment must consider relevant recommendations of that report. Of particular interest to mechanical harvesting, a TSFA report should address location of skid trails, particularly bladed and excavated trails. Where the TSFA does not address mechanical harvesting considerations, the planner / assessor should consult the owner for clarification.

The table below provides general guidance for the assessor / planner.

<table>
<thead>
<tr>
<th>Terrain Stability Classification</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV, V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Category for Steep Slope</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td>No Go</td>
</tr>
<tr>
<td>Mechanical Harvesting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Instability Indicators – Where a TSFA is not required and has not been completed, the steep slope plan should consider slope instability potential. Examples of instability indicators include landslide scars; exposed soils or notably younger vegetation; pistol-butted or jack-strawed trees; fractured rock formations; seeps or springs at the toe of the slope; shallow, wet organic soils or wet site vegetation (e.g. devil’s club) on slopes >40%.

Ground Roughness – Includes boulders, rocky outcrops, gullies, hummocks, depressions and other physical features that impact machine stability.

Soils – Mineral soils underlying surface organic matter, evaluated to determine its ability to provide machine traction. Soil information can be collected by observing root balls of windthrown trees at specific sites, or generally by observing recent road cuts or as indicated in the Silviculture Prescription.
Soil Depth – Measured as the average distance from top of the mineral soil (i.e. not including organic matter) to bedrock or hardpan layer as would restrict machine stability and traction.

Note: In winter, where conditions are such that soils and soil depth are no longer relevant to machine stability (i.e. frozen ground, or machine is always walking on snow), it is appropriate to score those criteria as N/A. If that is done, the assessor then needs to assess and score the impacts of snow depth and snow conditions (i.e. a risk rating for each one). Use the Soils and Soil Depth rows to provide criteria and scores, add comments.

Pre-Existing Debris – Windthrow, downed woody debris and stumps considered as obstacles with respect to how they would impact the ability of operators to maneuver effectively around (or over).

Understory – Saplings, shrubs and other low vegetation, considered with respect to the operator’s ability to see the ground, and how it would impact machine stability / maneuverability.

Duration of Exposure – The length of time an operator will be working on a specific steep slope area interacts with that operator’s competencies, experience and state of mind, along with dynamic conditions (e.g. weather) and is a risk factor that must be assessed. For example, expecting a fatigued operator with limited experience to work steep slopes for a 10-hour shift on a dark, snowy day presents much greater risks than having an experienced, focused operator do the work on a clear, calm day. Evaluation should be done on a daily basis, or as conditions / circumstances change, and the operational plan adjusted accordingly. See also page 15 of the Steep Slope Operating Resource Package.

Worker Isolation – Should a machine upset or roll-over occur, the time that would be required for first aid assistance to reach the operator. Consider that in some situations mechanical assistance (e.g. another machine to right the upset machine before the door can be opened) may be necessary before first aid can be given.

Hazardous Environmental Factors – Weather conditions that impact machine stability, traction, operator visibility and operational difficulty, including frequency of site exposure to high wind and/or heavy rain, extreme temperatures (more than 25°C or less than -30°C) as they would impact operator fatigue and mechanical durability.

For winter operations, assessors will consider overall snow depth, depth of recent accumulations, snow consistency (e.g. firm or sugary), ice, freeze / thaw cycles, etc.

Poor timber quality factors (e.g. decadent timber, root rots, stem rots, broken tops, excessive limbs, etc.) have implications for stem breakage, resulting in greater debris accumulations and increased difficulty working with or around such debris. Assessors can also use this section to describe a general timber hazard.

Building the Steep Slope Plan
Depending on the characteristics of machines being used to log a site, it is likely that one (1) completed form can incorporate all machines that will be used on that site. By designating specific machinery and operational controls (via checking relevant boxes and adding comments), the planner should be able to describe the plan associated to that assessment knowing that such a plan implicitly includes other standard safe work procedures described elsewhere (e.g. parts 2 and 3 of this Resource Package).

Practically, it is advantageous to use the one-form approach to ensure consistency of communications. By involving all operators in the initial site pre-work, and when updates or amendments are required, there is only one plan to change, and re-communicate. However, assessors need to be aware that because there may be significant separation (time) between phases (e.g. bunching occurs 2 months before skidding), it is necessary to re-evaluate the site to determine if changed conditions (e.g. increased snow depth has partially buried bunches and changed hazards) now require a change in the harvest plan.
Site Identification and Mapping

This hazard assessment process is intended to be used to identify site-specific characteristics that impact machine stability, and to enable development and delivery of safe work results across a harvest unit. In order to determine the size of the area to which an individual hazard assessment applies, the qualified assessor will consider the variability of site attributes across the harvest unit, and the magnitude of hazards each confers. Below is guidance for their consideration.

For purposes of steep slope logging, a “site” can be described as an area having similar site characteristics (e.g. slope, soils, timber, roughness, etc) such that it has one Overall Machine Stability Risk Rating and such that the associated plan identifies one set of operational controls to assure machine stability. Where additional actions or more stringent controls must be applied to assure machine stability, a separate plan must be specified, and a different site exists.

Within a single harvest unit, it may be possible to group sites that are physically separate but have the same characteristics and risk rating. The assessor can complete one hazard assessment form and develop a plan that describes the common set of controls that will be implemented in all of those sites. In all cases, but particularly when separate sites are grouped, clear, consistent identification on maps is critical. Sites with the same set of controls must be colored the same on the map; sites that require different controls must be labeled differently.

For example, a block might have a general slope of 33%, but at 7 sites across the block, there are rocky outcrops and associated sideslopes of 46%. Provided these sites are clearly identified on the steep slope plan map, and provided the plan for each of those 7 sites is the same (e.g. tilt-cab buncher run by John, 527 track skidder run by Sharon, etc.), one hazard assessment and one steep slope plan can be effective.

Conversely, if the west half of Block 767 (call it Site A) has uneven slopes of 38%, poorly-drained soils and heavy windthrow while the east half of Block 767 (Site B) has 53% slopes over well-drained soils and an open understory, the qualified person will likely determine that machine stability can only be assured if two different sets of controls are applied. The assessor will complete 2 hazard assessments to facilitate 2 steep slope plans.

Spatially, a site should usually be larger than 8 metres (or 1 ½ track lengths) before it requires a distinct assessment / plan. The rationale for this parameter is as follows.

- Mobile equipment can be operated to maneuver around obstacles and small steep slope areas, and can therefore avoid spatially brief hazards.
- Mechanical harvesting equipment is equipped with a boom or blade that can be moved to assist in machine stability. For example, a feller-buncher boom typically can be extended 8 to 10 metres, and used as additional support while the machine traverses steep / uneven ground.
- Machines with booms, line skidders and grapple skidders with extendable grapples can be effectively extended, reaching in to access trees, and thereby avoiding the need to travel across brief steep areas.
- It is difficult to map very small areas without contributing clutter that detracts from the rest of the map. However, where hazards occur in a very small area, such “points” should be identified in the field and on the map as specific points, and necessary controls added to the harvest plan.

Note: For some applications, it may not be possible to employ the advantages of reaching-in or micro-site avoidance. For example, some silviculture treatments require 100% coverage to achieve objectives. A disc-trenching steep slope plan must consider machine stability for all steep pitches within the treatment area, and potentially identify NO GO zones even though the block was logged using standard mechanical methods.
### Steep Slope Hazard Assessment Tool

#### Hazard Identification and Assessment

<table>
<thead>
<tr>
<th>Date</th>
<th>Licensee / Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site Supervisor or Contractor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Block</th>
<th>Site or Sub-Area</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Machine Stability Factor</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLOPE &amp; SLOPE LENGTH, TRACKED MACHINES</td>
<td>40 to 50% and Slope Length &lt;50 metres</td>
<td>40 to 50% and Slope Length &gt;50 metres</td>
<td>&gt;50% and Slope Length &gt;10 metres</td>
<td></td>
</tr>
<tr>
<td>SLOPE &amp; SLOPE LENGTH, WHEELED MACHINES</td>
<td>35 to 45% and Slope Length &lt;50 metres</td>
<td>35 to 45% and Slope Length &gt;50 metres</td>
<td>&gt;45% and Slope Length &gt;10 metres</td>
<td></td>
</tr>
<tr>
<td>TERRAIN STABILITY / CLASSIFICATION</td>
<td>No instability Indicators and slopes &lt;50%</td>
<td>Instability Indicators and slopes &lt;50%</td>
<td>Slopes &gt;50%</td>
<td></td>
</tr>
<tr>
<td>GROUND ROUGHNESS INCLUDES BOULDERS, ROCKY OUTCROPS, HUMMOCKS, DEPRESSIONS, ETC.</td>
<td>&lt;30% of steep slope area covered by roughness features</td>
<td>30 to 50% of area covered by roughness features</td>
<td>&gt;50% of steep slope area covered by roughness features</td>
<td></td>
</tr>
<tr>
<td>SOILS</td>
<td>Well-drained (e.g. gravel, coarse sand)</td>
<td>Moderately well-drained (fine sand, silt); indicators of sub-surface flows</td>
<td>Poorly-drained or saturated (silt, clay), high water table</td>
<td></td>
</tr>
<tr>
<td>SOIL DEPTH</td>
<td>&gt;30 cm to bedrock</td>
<td>15 to 30 cm to bedrock</td>
<td>Thin soils (less than 15 cm), or bedrock exposures</td>
<td></td>
</tr>
<tr>
<td>PRE-EXISTING AND POST-HARVEST DEBRIS</td>
<td>Open understory, no windthrow</td>
<td>Moderate downed timber, understory, stumps &lt;30 cm</td>
<td>Heavy downed timber, understory, stumps &gt;30 cm</td>
<td></td>
</tr>
<tr>
<td>DURATION OF EXPOSURE CONSIDER OPERATOR COMPETENCY, STATE OF MIND, CHANGING CONDITIONS</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>WORKER ISOLATION - TIME FOR ASSISTANCE TO REACH OPERATOR</td>
<td>&lt; 15 minutes</td>
<td>15 to 30 minutes</td>
<td>&gt; 30 minutes</td>
<td></td>
</tr>
<tr>
<td>HAZARDOUS ENVIRONMENTAL FACTORS (DESCRIBE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OTHER SITE FEATURES / FACTORS (E.G. UPSLOPE HAZARDS, DANGER TREES, BENCHES, ETC.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Timber Height (Avg.):</th>
<th>Timber Species:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Stem Diameter:</td>
<td>Maximum Stem Diameter:</td>
</tr>
</tbody>
</table>

**Overall Machine Stability Risk Rating:**

3 or More “High” Ratings Results In “No Go” Unless Additional Measures Are Taken (See Page 2).

**Qualified Assessor:**

**Signature:**
# Steep Slope Hazard Assessment Tool

**Practices and Controls to Eliminate or Mitigate Hazards**

<table>
<thead>
<tr>
<th>Cutting Permit</th>
<th>Block</th>
<th>Site or Sub-Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Type of Machine:**
- [ ] Feller-Buncher
- [ ] Skidder
- [ ] Hoe-Chuck
- [ ] Processor
- [ ] Other:

**Designated No Go for Mechanical Operations**

Identify Designated Machines / Name Designated Operators:

<table>
<thead>
<tr>
<th>Indicate those Mechanical Features Prescribed to Ensure Machine Stability</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Non-Tilting Cab</td>
</tr>
</tbody>
</table>

**Picks / Grousers (describe height & spacing):**

- [ ] Non-swivel Head
- [ ] Rotating Head
- [ ] Intermittent Saw
- [ ] Hot Saw
- [ ] Shave Stumps, As Required

**Head Cutting Capacity (Diameter):**

**Tree / Weight Handling Capacity:**

**Allowable Stump Height:**

**Target Bunch / Turn Size:**

<table>
<thead>
<tr>
<th>☐ Chains on 4 Wheels</th>
<th>☐ Flotation Tires</th>
<th>☐ Swing Grapple</th>
<th>☐ Other Devices:</th>
</tr>
</thead>
</table>

**Mechanical Features to Ensure Stability**

- [ ] Approach Steep Slopes From Below
- [ ] Operations During Daylight Hours Only
- [ ] Utilize Existing Benches
- [ ] Up trail, safe turn-around, Direct down-slope Skid
- [ ] Construct & Use Machine Trails (identify on map)

- [ ] All-season Operations
- [ ] Summer Only
- [ ] Winter Only

**Maximum Snow Depth:**

**Communications Process (e.g. 2-way radio, cell, etc.):**

**Man-check Frequency (who, how often):**

**Poor Weather Shut-down Conditions (describe):**

**Available Assistance (machine, operator):**

**Site-Specific Requirements & Notes**

<table>
<thead>
<tr>
<th>Date:</th>
<th>Signature:</th>
<th>Date:</th>
<th>Signature:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date:</th>
<th>Signature:</th>
<th>Date:</th>
<th>Signature:</th>
</tr>
</thead>
</table>

**Qualified Person Building Plan:**

* I have reviewed the associated Steep Slope Hazard Assessment and verify its accuracy. **Signature:**

**Attach Copy of Hazard Assessment to Steep Slope Plan Map**
General Machine Stability Risk Factors

Site Factors
- Steep slopes – Generally slopes over 35%.
- Long pitches of continuous slope
- Slopes or benches less than 35% but located above areas of greater slope
- Broken and uneven terrain, boulders, rock outcroppings, ravines, gullies, etc.
- Hydrology – pre-existing conditions or changed by harvesting operations
- Poor ground surface traction
  - Exposed or shallowly covered rock (thin soils over bedrock, talus, gravel, etc.)
  - Soil types – wet, clay type or high organic content
  - Subsurface flows, springs, poorly drained soils
- Windthrow, stumps, decadent timber, and other woody debris; dense understory or ground cover that obscures operator visibility of the ground.
- Oversized or heavy wood that exceeds the handling / lift capacity of the equipment
- Danger trees

Environmental Factors
- Snow
  - ice / freeze / thaw cycles
  - significant powder accumulations with no base
  - inconsistent temperatures (freeze / thaw)
  - snow over unfrozen / incompetent soils or obscuring hazards beneath
  - snow over frozen ground
  - upslope avalanche
- Heavy rain, extreme heat or cold temperatures
- Adverse or rapidly changing weather conditions
- Poor visibility / lighting conditions (nighttime, fog, snow, etc.)

Human Factors
- Lack of pre-planning, inadequate time to effect required amendments (rush to start job)
- Inaccurate / insufficient hazard identification / mapping
- Inadequate or incorrect measurement / evaluation of hazards
- Poorly constructed or narrow skid trails / roads
- Failing to recognize changed conditions that require different control
- Site not walked or re-assessed by contractor or operator
- Application if improper techniques: double cutting, collecting, cross-slope travel, etc.
- Operator / supervisor attitude – inexperience, over-confidence, complacent, rushing, fatigued.

Mechanical Factors
- Equipment / harvest method not matched to site and timber
- Machine design limitations
- Inadequate power, hydraulic system performance sub-optimal
- Necessary preventative maintenance or repairs not complete
- Component damage, worn hoses, sloppy controls, poor brakes, dull cutting teeth, etc.
- Fuel levels inadequate to complete task
- Worn out lugs or improper tracks for application
Additional Controls to Mitigate Identified Hazards

Below are actions that persons conducting the risk assessment and/or developing the steep slope plan can consider to mitigate machine stability hazards. If appropriate to the site, these actions would be additional to standard controls identified in Part 3. While these are intended to cue the assessor/planner to a few potential tools, the qualified person must use their practical knowledge to identify controls that will be effective for each specific situation, and describe them on Page 2 of the steep slope hazard assessment form.

General

- Use purpose built equipment or attachments (e.g. extended tracks, telescoping boom, stabilization or weight-distribution devices).
- Construct skid trails to hoe-chuck or ground skid felled timber. Trails may also be constructed to enable access between benches or across steep ground for conventional equipment. Trails must be constructed of stable material and be at least 1.5 times the width of machines that use the trails.
- Avoid operations during severe weather events (moderate to high winds, rain that will affect visibility or ground competency, snow accumulations, extreme heat). Specify foul weather shutdown conditions.
- Increase frequency of man-checks for operator on steep slope (provide details in the plan).
- Schedule critical steep slope operations to occur during periods of optimal operator mental alertness. For example, consider avoiding first thing Monday morning or last thing Friday afternoon.
- Tether or anchor machines working on steep slopes.
- Provide machine assistance to ascend or descend where required (e.g. cable snubbing or pulling).

Feller-bunchers

- Do not attempt to fell trees that are beyond safe reach (e.g. further than ¾ of full extension).
- Use a machine with a tilting cab or self-leveling house (give description of unit)
- Use an intermittent (or cold) saw for maximum control and operational flexibility.
- Use feller-buncher modified for better stability (e.g. extended tracks, counterweights, etc.)
- Use a felling head that rotates at the wrist to afford accurate grappling of the tree.
- Minimize stump heights, consider “shaving” stumps.
- Reduce bunch size, specify target bunch size in plan.
- Avoid thin snow over frozen ground conditions.

Skidders

- For wheeled skidders, excavated or bladed side hill skid roads should not exceed 30% continuous grade except for short pitches over which the grade may be up to 40%. Switch backs should not exceed 40%.
- Bladed skid trails must be wide enough to safely accommodate skidding equipment used.
- Use tracked machines to skid (e.g. clambug with tracks, KMC, D5 / 527-swing grapple, etc.).
- Use skidder with stability-improving options (e.g. wheel spacers, wide ‘floatation’ tires).
Part 2
Steep Slope Planning and Operational Responsibilities

A – Owners / Licensees / Project Proponents

In BC, the forestry planning process initiates collection of key information and development of plans that will facilitate safe, productive harvest operations. In order to address their business objectives or as required under various regulations or Acts, owners / licensees / project proponents typically conduct (or direct) initial harvest planning. To accomplish that, they usually have access to information resources (maps, assessments) and experienced personnel necessary to identify areas that have steep slopes and related hazards. As a result, they are well-equipped to compile necessary information into a comprehensive package and communicate that information to subsequent phases (e.g. layout, contractors, etc.).

Regulations confer responsibilities to owners of forestry operations with respect to identifying workplace conditions where there is a known or reasonably foreseeable risk to workers, and with respect to providing employers or prime contractors with information necessary to identify and eliminate or control hazards to the health or safety of persons at the workplace.

Below are steps that should be completed by owners / licence holders / project proponents.

Threshold Practice – communicate basic steep slope hazard information to prime contractor / employers

- Early in the planning phase, develop a map that accurately identifies areas that have slopes >35% and that are planned for mechanical operations. Use suitable topographic information (e.g. TRIM2 maps, air photos, LiDAR); if reliable topographic information is not available, use field measurements (e.g. lay out crew using clinometer). Communicate this information to the site supervisor / prime contractor, as the case may be, for their further application of the steep slope hazard assessment / plan process.

Best Practices

- Early in the planning phase, develop a preliminary map that identifies areas having slopes >35% and that are planned for mechanical operations; use suitable topographic information (e.g. TRIM2, air photos, LiDAR).

- Use experienced lay out crews with knowledge of the steep slope hazard assessment process; consider including a person qualified to conduct an initial hazard assessment. Provide them with the preliminary steep slope map, have them more accurately map steep slope areas, and collect / record site attribute information (as per assessment form).

- Using a suitable mapping standard (1:5,000 is the preferred scale, but greater detail maps may be required to adequately convey information), construct an operational map that identifies areas by slope category (e.g. <35%, 35-50%, >50% and NO GO areas, OR <40%, 40-50%, >50% and NO GO areas).

- Conduct required assessments (e.g. Terrain Stability Field Assessment, gully, riparian assessments) and collect other necessary information (e.g. cruising, Silviculture Prescription, etc.).

- Optional - Incorporate relevant collected information into an initial harvest plan (also useful for business / planning purposes).

- Communicate this information to the site supervisor / prime contractor / employer, as the case may be, for their further application to the steep slope hazard assessment / plan process.

- Periodically review contractor steep slope hazard assessment and harvest practices as necessary to confirm they are performing to expectations / requirements.
B – Employers / Contractors

Given the diversity of arrangements under which forest harvesting occurs in BC, it is difficult to strictly assign a set of duties to each given party. In some cases, the owner is also the employer, and they may delegate specific duties to a supervisor. In much of BC, the contractor is the employer; the company owner might be the supervisor, or they may hire a supervisor. With that in mind, the compilation below identifies planning, operational and administrative safe work practices that are necessary for successful steep slope mechanical operations, and which are the responsibilities of a typical logging company contracting to a licensee.

Planning

- Receive, review and consider preliminary steep slope hazard information received from the site owner.
- Conduct (or direct a qualified person to conduct) a thorough field review using the steep slope hazard assessment form (e.g. as in Part 1) and resulting in a steep slope plan that is practical and achievable.
  OR
  If the employer receives a completed steep slope hazard assessment and/or a plan (e.g. from the site owner), verify information is correct, accurately mapped and operationally feasible.
- Conduct these steps far enough in advance of operations that any required amendments or revisions can be achieved.
- Ensure the steep slope plan considers all machine stability variables (e.g. as identified in the risk assessment) as each relates to a regulatory requirement or best practice, and that maps adequately show information relevant to machine stability.
- Build a plan in which operations in one phase compliment operations in the next phase.
- Before commencing operations, update steep slope plan maps to show any previously unidentified hazards and the resulting changes to the plan.
- Identify the manufacturer's maximum slope operating stability limit for logging equipment (if any is known or provided); review the manufacturer’s specifications for machine capabilities (lift capacity, reach, etc.).
- Ensure any specific modifications are designed / approved by an engineer.
- Engage and assign competent, experienced operators with a safe work record.
- Assign qualified site supervisor(s), instruct them regarding the nature and frequency of their field supervision, and identify them on the harvest plan / pre-work. Instruct supervisors on the process to apply to correct operator deviations from plan / procedures.
- Establish procedures to deal with equipment breakdown, difficult or precarious situations, and upset conditions. General or specific measures may exist in the employer’s emergency response procedure, but should be further customized to site-specific conditions, and reviewed / recorded at the steep slope pre-work meeting. See Appendix 5 Steps for Dealing with Breakdowns & Emergencies for a few possible steps.
- Instruct the supervisor(s) on procedures to manage previously identified risks and changing conditions, and requirements for supervisor field checks, man-check frequency, mandatory operator rests, etc.
Operational

• Review the steep slope plan and walk significant risk areas before directing operators to begin. Operators should participate in the field review. Together, they should verify operating slope percentages with a clinometer, and that harvesting / extraction methods identified on the steep slope plan are appropriate.

• Verify specified equipment is on-site and suitably equipped / configured as per the plan.

• Confirm designated operator (i.e. with necessary steep slope training, experience) is on site.

• Mark significant hazard areas in the field ahead of operations to warn operators against inadvertently venturing onto high risk areas (e.g. during nightshift operations or poor visibility). Identify the marking system used on the plan and/or on maps.

• Before work commences, hold a pre-work meeting to review the steep slope plan and maps with the operator(s), including
  - Orient operators to maps (direction, block boundaries, roads, landmarks, etc.)
  - Review NO GO zones, site-specific hazards (field and map), wildlife tree patches, leave patches / trees, riparian zones, field marking strategy, etc.
  - Identify starting point and schedule of operations.
  - Discuss how to deal with previously un-identified hazards and changing conditions.
  - Discuss frequency of supervisor visits.
  - Identify the man-check frequency appropriate to risks, check-in person (supervisor or other worker on site) and the contact method (e.g. 2-way radio, cell phone, etc.).
  - Identify the frequency of mandatory operator rests.
  - Confirm a machine inspection has been completed, required maintenance and servicing is current, fluid levels are checked to be full.
  - Confirm operators understand when to call for assistance and when to suspend work (e.g. if they are unclear on upcoming terrain or timber, or unsure they are able to complete operations safely, stop the machine in a safe location and get clarification from the supervisor before proceeding).
  - Sign-off steep slope plan.

• Logging sites are dynamic workplaces. Conditions (environmental, human and mechanical) change to create different hazards. Also, the extent to which duration of exposure will pose a high, moderate or low risk depends on the experience level, state of mind (e.g. focused on work versus fatigued or distracted by personal issues) and competencies of the individual operator. On a daily basis, the contractor is responsible to identify these changes (a significant rain or snow event, decreased operator alertness, changes to the equipment, etc.) and apply sound judgment to re-evaluate hazards and determine what different steps or controls are necessary to assure continued safe operations.

• Use effective regular communication (pre-works, tailgate meetings) between operators, supervisors and other workers to discuss work progress, effectiveness of implemented controls, and steps to manage unforeseen hazards / changing conditions.
Administrative

- Document pre-work, field reviews, man-check system, supervisor field checks and other actions in an appropriate form (e.g. via notes in supervisor journal).

- Supervisor(s) must observe operators working to confirm competency and to correct any work method deficiencies or failures to follow the steep slope plan.

- Maintain a copy of the complete steep slope plan with the site supervisor and at a location readily accessible to other workers.

- Maintain operator and supervisor experience and qualifications records (see sample forms in Part 4 below) to provide to licensee, prime contractor or WorkSafeBC on request.

- Develop and communicate procedures specific to steep slope works (e.g. providing assistance in the event of a disabled or upset machine); link those procedures to the Emergency Response Plan for that site.

C – Employees / Operators

The most important link in the steep slope operating plan is the operator. They are most aware of changing conditions and situations, most likely to identify previously unrecognized hazards, have the best understanding of specific equipment capabilities, and are most likely to be directly impacted by machine instability. The following describes responsibilities that reside with the operator(s) conducting the work.

Operators must

- Before starting work in an area, review the steep slope plan with the supervisor and/or the qualified person that conducted the risk assessment; have a copy of the harvest plan and map in the machine at all times.

- ensure they are fully trained and competent to operate the machine they are assigned, and capable of executing procedures and practices described in the plan.

- conduct and document daily equipment inspections, including a functional check of the equipment’s escape hatch(s).

- know the functions and limitations of their machine. They must be able to recognize signs that indicate the machine may not be operating safely (e.g. poor performance, intermittent functions, hydraulic leaks, dull blades, high temperature, etc.

Operators are responsible to refuse work they feel is unsafe. If at any point, the work cannot be conducted safely, the operator must stop work, and consult the supervisor, to develop an alternate safe plan before working again.
Part 3


The following section identifies general and machine-specific safe work practices that should be consistently implemented to mitigate machine stability risks. While the contractor or site supervisor (as the case may be) is responsible to ensure these practices are specified and applied, operators / employees have accountability to comply with direction.

Marking / Mapping Best Practices

- Mark NO GO Zones in the field using unique and highly visible ribbons. Ensure plan maps and legends clearly indicate the marking protocol.

- Avoid trying to communicate too much information on operational maps. Keep it simple and provide all, but only, the information required for steep slope machine operators. It may be necessary to generate separate maps for steep slope works.

General Controls

- Recognize that some areas are not suitable for mechanical operations. Rather than pushing or exceeding operator / mechanical limits to harvest those areas, designate them as NO GO Zones or develop an alternate harvest plan.

- Ensure work on steep slopes is conducted during adequate lighting conditions; consider conducting high risk works during daylight hours only.

- Match equipment, operators and work methods to the job and the hazards. Know the physical capabilities of each machine (certified slope operating stability limit, lift capacity, boom length, width, etc.) and understand them in the context of the site and timber.

- If the designated machine or operator is not available, delay steep slope work until they are.

- Install 2-way radios in all steep slope machines; designate a channel, and ensure operators have reliable communications with the supervisor and/or another worker at the worksite.

- Conduct a thorough machine inspection immediately prior to steep slope works. Confirm equipment is in sound operating condition. Confirm all necessary guarding (including Roll-over Protection System) and other required safety equipment is in place and functional.

- Complete more frequent preventative maintenance for equipment operating consistently on steep slopes (e.g. ensure tracks / rails are tight, check tilt-cab mechanism, etc.).

- Operators will confirm good working condition of the seat belt in the machine, and wear it at all times when operating the machine. Operators will ensure all items kept in the cab are secured (e.g. thermos, radio, tools, etc).

- Identify equipment and/or personnel that are available to render assistance in the event of breakdown, when equipment operators find themselves in difficulty and for dealing with an upset condition.
Mechanical Felling Steep Slope Practices

- Regularly check your immediate work area for hazards (unstable stems, danger trees, rocks dislodged during felling, changing weather) and work with your supervisor to develop a plan that addresses hazards.

- Ensure tracks are in good condition and outfitted to provide traction (e.g. 2-3” picks on every 2nd grouser).

- Do not operate on terrain where you cannot maintain traction / stability to move up and down the slope.

- Conduct work “straight up” or “straight down” the slope; working from the bottom of a steep slope area confers additional safety benefits. Do not approach slopes >50% from above.

- Plan narrower falling swaths. As slope increases, swath width should decrease to allow the operator to keep the felling machine’s centre of gravity close to the face of the slope.

- Reduce the amount of wood collected in the head, i.e. avoid “collecting” trees in the head and avoid packing multiple stems.

- Avoid double cutting; fell trees using a single cut or leave for hand-faller.

- Avoid swinging trees to the down-hill side of the machine.

- Avoid lifting the boom straight up and tilting trees back over the machine (to the downhill side).

- Keep the saw head close to the ground and tucked into machine to provide quick support if required.

- Cut stumps as close to the ground as possible; place felled timber as close as possible to ground level.

- Do not travel over windfall, felled trees, boulders, rock outcroppings or other obstacles that may cause instability or obscure direct view of the ground beneath. Cut and move aside woody debris. Minimize slash creation.

- Confirm the lift / handling capacity of the feller-buncher relative to timber planned for felling. Determine a safe loading capacity given the slopes (i.e. somewhat less than 100%) and describe / understand that limit in terms of a maximum stem diameter to be mechanically felled.

- Do not attempt to fell trees beyond that safe loading capacity; mark on map / notify supervisor for attention by hand-faller.

- Ensure the falling plan will compliment the skidding / hoe-chucking strategy. For example, make smaller bunches to keep skidder loads moderate.

- Fall timber to assist safe skidding. Looking up the slope, place timber at 10 o’clock to 2 o’clock position, preferably on the control side of ground skidders (if being used).

- Timber felled in difficult or steep areas should be placed, packed or hoe-chucked to a less difficult or less steep area to enable safer skidding.
Skidder / Forwarder Steep Slope Practices

- Regularly check your immediate work area for hazards (unstable stems, danger trees, rocks dislodged during felling, changing weather) and work with your supervisor to develop a plan that addresses hazards.

- Ensure tracked machines have tracks that are in good condition and outfitted to provide superior traction (e.g. 2-3” picks on every 2” grouser).

- For wheeled machines, confirm proper tire inflation and condition. Use chains with lugs on front wheels, or all wheels. Frequently inspect chains for integrity, condition and tightness.

- Work straight up and down slopes only, never travel across side hill. It may be necessary to locate and use a circular route to access timber on steep slopes.

- Avoid travel over stumps, boulders, rocky outcrops or other obstacles.

- Limit exposure to skidding on steep slopes that continue for more than 50 metres.

- Use lower gears and reduce speeds when climbing or descending slopes.

- Back straight up steep slopes with grapple outstretched and as close to the ground as possible. Avoid backing up steep slopes when visibility is inadequate.

- Never attempt to turn around on a steep slope unless there is a bench flat and wide enough to safely do so.

- Engage differential lock (if equipped) for added traction travelling uphill but disengage when descending or turning as steering will not respond properly when differential is locked.

- Consider making smaller turns to avoid over-loading or over-balancing the machine.

- Grapple skidder: To avoid loss of steering control due to logs binding on the apron, keep logs close to the apron but not touching it. Adjust grapple position (i.e. slightly increase clearance between butts and apron) prior to making sharp turns and steering around obstacles.

- Line skidder: Travel down slope keeping the logs tight to the apron. Slightly reduce line tension to provide clearance between butts and apron prior to making sharp turns and steering around obstacles.

- Carry turns as low to the ground as possible without hanging up on stumps and rocks.

- Carry the blade high enough to clear stumps and obstructions while skidding, but low enough to provide a quick response for additional stability.

- Equip line skidders with adequate mainline and chokers to reach trees felled on steep ground from area less than 35% or designated skid trail.

- Avoid winching a turn of logs at an angle to the machine.

- Where provided, skid on identified (marked) or designated bladed trails.

- Do not attempt to skid from areas where it is unsafe to do so. Mark on map / notify supervisor for attention by alternate method(s).

- Forwarder: Ensure loads are close to the machine before initiating lift; avoid long reaches.
Hoe-chucking Steep Slope Practices

- Regularly check your immediate work area for hazards (unstable stems, danger trees, rocks dislodged during felling, changing weather) and work with your supervisor to develop a plan that addresses hazards.

- Ensure tracked machines have tracks that are in good condition and outfitted to provide superior traction (e.g. 2-3” picks on every 2” grouser).

- Operate hoe-chucker “straight up” and “straight down” the steep slope. Take advantage of natural benches or sideslope breaks as preferred stable work locations.

- Consider using tandem or multiple machines (to reduce total machine travel on steep slopes, and to provide continuous visual contact between operators re check-in).

- Use trails as provided; ask for additional trails where they are required.

- Plan and implement narrower swing corridors – as slope steepness increases, swing corridor width narrow.

- Reduce the amount of wood in each swing (i.e. avoid swinging multiple stems).

- Swing wood close to the ground so that the log and/or boom can be used to stabilize the machine.

- Swing the loaded grapple close to the machine; avoid extending the boom any further than necessary.

- Avoid walking over stumps, boulders, rocky outcrops or other obstacles.

- Move debris accumulations (broken stems, tops, branches that may be obscuring rocks or depressions) so you can see the ground you intend to travel over.

- Ensure the machine is in a stable position before swinging wood.

- Think about the next phase; build stable decks in locations that are accessible to the next swing, or beside a spot where the processor can operate with stability.

Processor Steep Slope Practices

- Operators will frequently check their immediate work areas for hazards (unstable felled stems, danger trees, rocks that may have been dislodged during felling, changing weather) and work with their supervisor to develop a plan that addresses hazards.

- Operate aligned with the slope (“straight up” and “straight down”); avoid operating across steep slopes.

- Use trails as provided; ask for additional trails where required.

- Plan and implement narrower work corridors – as slope steepness increases, reducing boom extension to maintain stability will reduce the work corridor.

- Swing / process logs close to the ground so that the boom and/or log can be used to stabilize the machine, if sudden instability occurs.

- Avoid walking over stumps, boulders, rocky outcrops or other obstacles.

- Move debris accumulations (broken stems, tops, branches that may be obscuring rocks or depressions) so you can see the ground you intend to travel over.

- Ensure the machine is stable before initiating processing.

- Think about the next operational phase; build stable decks in locations that are accessible to the loader.
Part 4
Support Forms & Documents

Forms Overview / Instructions
Use these form “as-is” or modify them to suit their operations / meeting format.

Operator Review and Orientation Form
Before work commences on steep slopes, contractors / supervisors must meet with operators to do several things that ensure they clearly understand the work that is being assigned to them, are orientated to the worksite(s) and are aware of their expectations / obligations. Most employers will already have a process for documenting the discussions and actions that occur at tailgate meetings. This form can be used to document specific additional steps / discussions that must occur at a pre-work meeting for steep slope operations.

Operator Experience / Qualification Record
Employers are required to confirm that operators are adequately trained / experienced to conduct work that will be assigned to them. They are also required to confirm competency by observing the worker ably completing assigned work.

Most employers will have an existing process to document employee training and experience. This form can be used to document other relevant training and experience to support introduction of a new operator to steep slope operations as well as the dates (frequency increased) the supervisor observes the operator competently completing assigned duties. It also can be used to document qualifications / competencies of operators that are qualified for all steep slope operations. For experienced operators, employers might choose to complete this form once, review / update it annually, and confirm it at steep slope operations pre-works.

Supervisor Experience / Qualification Record
This is a similar process to above, but intended for documenting experience and qualifications for supervising steep slope operations. If the contractor and supervisor is the same person, the contractor must record his / her supervisory experience, and date and sign their qualifications. This should be checked and confirmed by the licensee or prime contractor.

Sample Hazard Matrix
This risk matrix identifies a general evaluation of how steep slope operations vary with increasing slope. Because the wide variety of site characteristics confer a spectrum of hazards, assessors can use this matrix to understand hazards in a relative sense, but also need to apply their understanding of the site to evaluate the actual extent of risk.

Steps for Dealing with Breakdowns & Emergencies
While an employer’s Emergency Response Plan will typically already include steps / practices for operators to observe in the event of machine breakdown, precarious position or upset condition, this summary provides a few concepts that may be useful to review at the pre-work meeting.

WorkSafeBC OHS Regulations & Guidelines
WorkSafeBC Regulations and Guidelines that apply to employers logging on steep slopes can be accessed at: http://www2.worksafebc.com/publications/OHSRegulation/Home.asp
Appendix 1: Operator Experience / Qualification Record

Operator Name: ____________________________

Training completed, Certificates Held: ____________________________

<table>
<thead>
<tr>
<th>Machine (Type, Model, Configuration)</th>
<th>Experience (# of Years or Months)</th>
<th>Timber Type &amp; Size</th>
<th>Slope Steepness</th>
<th>Operator Competency on Steep Slopes Observed On Date</th>
<th>Supervisor Signature</th>
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Operator Name: ____________________________

Training completed, Certificates Held: ____________________________

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Use one line for each type of equipment. Include all relevant mechanical harvesting experience. The contractor or site supervisor is responsible to initially complete this experience record as a means of documenting suitable operator experience before assigning work on steep slopes. The employer also must to ensure a supervisor periodically observes the operator competently applying sound methods to implement the work plan, and to identify incorrect work habits and take necessary steps to correct deficiencies.
## Appendix 2: Supervisor Experience / Qualification Record

**Supervisor Name:** ____________________________

**Qualifications, Training Completed, Certificates Held:** ____________________________

<table>
<thead>
<tr>
<th>Forestry Mechanical Equipment Experience (# of Yrs / Months)</th>
<th>Experience Supervising Mechanical Operations (# of Yrs / Months)</th>
<th>Experience Supervising Steep Slope Operations (# of Yrs / Months)</th>
<th>Qualified to assess hazards and create steep slope plans as of:</th>
<th>Contractor signature</th>
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**Supervisor Name:** ____________________________

**Qualifications, Training Completed, Certificates Held:** ____________________________

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Appendix 3: Operator Review and Orientation Form

- Review identified hazards and the completed hazard assessment form.
- Review site-specific hazard controls and safe work procedures.
- Review general steep slope safe work practices.
- Review Steep Slope Plan with designated operators and supervisors.
- Discuss responsibility to request additional assistance or to refuse unsafe work.
- Operator has received copy of completed Steep Slope Hazard Assessment and Steep Slope Plan map.
- Discussed emergency procedures, work duration, location of equipment available for assistance.
- Review man-check procedures for steep slope operation.
- Designated supervisors and operators qualifications / experience confirmed.

The following operators have received a copy of the Steep Slope Hazard Assessment form and associated Steep Slope Plan map. Each operator has been qualified and assigned to carry out the steep slope plan.

<table>
<thead>
<tr>
<th>Operator Name</th>
<th>Specific equipment assigned to operator</th>
<th>Signed</th>
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Describe Additional Required Corrective Actions

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<th>To Be Completed By Whom</th>
<th>To Be Completed By When</th>
<th>Initials</th>
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Steep slope operating plan approved by:

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<tr>
<th>Position / Title</th>
<th>Date</th>
<th>Initials</th>
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Appendix 4: Sample Hazard Matrix

Risk matrix – For general categorization purposes only

<table>
<thead>
<tr>
<th>Slope %</th>
<th>Low Risk</th>
<th>Medium Risk</th>
<th>High Risk (NO GO)</th>
</tr>
</thead>
</table>
| >50%    | • No low risk operations for most machines  
          • Tracked machines walking for short pitches not greater than track length or reach capability of machine attachments (e.g. walking up bank to get from road onto block)  
          | • Tracked machines configured for slopes & other steep slope designed equipment using site-specific steep slope operating plan  
          | • No site-specific steep slope operating plan  
          • Non-qualified operators  
          • Adverse conditions (ground / weather / visibility as identified in risk assessment) |
| 35-50%  | • Tilt cab machines configured for slopes and following steep slope operating plan with no other risk factors present  
          | • Wheeled machines configured for slopes and following site-specific steep slope operating plan  
          • Flat bottom bunchers and other tracked machines configured for slopes and following site-specific steep slope operating plan  
          | • Machines not configured for slopes  
          • Machines in poor condition  
          • Operating without steep slope operating plan  
          • Non-qualified operators  
          • Adverse weather / poor visibility (including night operation) |
| 10-35%  | • Most machines with qualified operators following basic safe work procedures for slopes  
          • Wheeled machines with chains on clear, unbroken ground  
          • Tracked machines on clear, unbroken ground  
          | • Wheeled machines not configured for slopes  
          • Non-qualified operators while in training and working with close supervision  
          • Poor ground conditions or excessive debris  
          • Machines in poor condition  
          | • Sheet rock, or light snow cover on frozen or icy ground with slopes  
          • Fresh deep snow on adverse slopes (can’t see ground)  
          • Machines not configured properly  
          • Non-qualified operators without close supervision |

NOTE: This risk matrix provides a general outline of Low / Medium / High risk classification using a combination of slope %, type of machine, operator qualifications, and operating conditions. This is a general planning tool and, as such, may not reflect the actual level of risk present in the field. If additional hazards or risk factors are identified, the risk level may need to be increased. If enough risk factors are combined, it may mean that work cannot be conducted safely and a different plan is required. In general, if the risk level is ranked “High (H)”, additional controls must be put in place to reduce the risk ranking to “Medium (M)” before starting work.

This slope hazard & risk matrix has not been reviewed or approved by WorkSafeBC.
Appendix 5: Steps for Dealing with Breakdowns & Emergencies

In the event of equipment breakdown, precarious situations and upset conditions, always
Stay calm – To respond effectively you need to proceed rationally. Don’t jeopardize your own safety. Your example can influence others and thereby aid the emergency response.

Assess the situation – What is the problem or emergency? What has happened, and what will continue to happen if no action is taken? Identify the cause that must be controlled to eliminate immediate, ongoing, or further danger. What are the possible courses of action? Which ones have the greatest likelihood of success? What are the risks and dangers associated with those actions?

Next
- Establish radio contact with your supervisor or on-site contact.
- Identify your location; explain the situation, request assistance.
- Await their recommendations / direction. Do as they say.

Equipment Breakdown on Steep Slopes
Completing repairs while a machine is on a steep slope poses significant hazards and risks. If it is not possible to move the machine to stable location, take the following steps.
- Before exiting, ensure the machine is stable. If the machine feels unstable, and it is safe to do so, lower boom / blade / attachments and release loads to increase stability.
- Survey the area for hazards – danger trees, debris, partially-cut trees, unstable logs, etc.
- Engage and confirm lock-out procedures before undertaking any checks or repairs.
- Conduct only those repairs necessary to allow moving the machine to a flat site.

Precarious Positions – Nearly Upset Condition
- Evaluate the situation. Will releasing the load improve or reduce machine stability? Will raising or lowering the blade / boom / attachments increase or decrease the likelihood of incurring a roll-over?
- Conduct any / all movements and operate controls smoothly and precisely.
- Stay in the cab – exiting the cab may upset the balance, or you may injure yourself as you jump, or inadvertently to a location onto which the unbalanced machine then rolls.
- If your assessment determines the least risk option is to exit the cab, first survey the area for hazards – uneven ground, debris, unstable logs, etc.

Machine in Upset Condition
- Stay in the cab. Heavy equipment sometimes comes to rest in delicately-balanced conditions. Getting out may upset that balance and expose you to further harm.
- Secure yourself against further injury, should further machine movement occur.
- Wait for assistance to arrive.
- If your assessment rationally determines that further machine movement is likely and will result in greater injury to you, survey the area for hazards before exiting.