



The INGAA Foundation, Inc.

Construction Safety & Quality Consensus Guidelines

Steep Slope Construction

Document	Revision	Date
CS-R-16	0	January 9, 2019

1.0 ACTIVITY DESCRIPTION

- 1.1 This document is intended to provide basic safety guidelines related to working on hazardous terrain, especially that of steep slopes (e.g., hills, mountains, steep or otherwise hazardous inclines, unstable slope conditions). For the purposes of this guidance, the terms “hazardous terrain” and “steep slope” are considered interchangeable. It is recognized there are other types of hazardous terrains and guidance is beyond the scope of this document.
- 1.2 The purpose of these guidelines is to encourage work practices that promote safety of workers and equipment and promote the highest standards of quality during pipeline maintenance and construction activities, including appropriate:
- Hazardous terrain (e.g., steep slope) identification and assessment.
 - Planning for the location-specific conditions and scope of work.
 - Training, qualification, and competency of crews and other personnel.
 - Emergency response protocols.
- 1.3 The guidelines in this document are not meant to supersede or replace regulatory requirements, nor are they intended to be all-inclusive of the applicable regulatory, site-specific hazard assessments/safety plans or company requirements. Rather, they are intended to be supportive and complimentary to such requirements.

2.0 HAZARD ASSESSMENT

- 2.1 In pipeline construction, steep slopes and other types of terrain may be hazardous and have the potential to greatly impact the safety of personnel and equipment, as well as, quality and production if not appropriately identified, evaluated and addressed.
- 2.2 Perform hazardous terrain/steep slope hazard assessments prior to commencement of the applicable work/operations. The hazard assessment should identify steep slope-related exposures, prescribe appropriate remedies or mitigating controls, and lead into the creation of work plans (or equivalent project documents).
- 2.3 Review and update the hazard assessment prepared for steep slopes when:
- There is a change in how a task is performed. **Note:** “Minor” changes are managed in the field while “Major” changes should be managed more formally and include revising the work plan, (i.e., Management of Change (MOC) process).
 - Modifications are made to equipment, tools or the product being installed.
 - Any time there is a change or modification to the composition of the crews/personnel.
 - Changes in work site conditions occur, (e.g., weather, extreme temperatures).
 - A specific need or concern is identified, (i.e., as needed to protect the safety of personnel or property).



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3.0 ROLES AND RESPONSIBILITIES

Note: Due to various contracting methods, (e.g. lump sum, EPC, time/materials), the roles outlined below may vary. Every effort has been made to define the roles as typical for most projects.

3.1 Project Owner Responsibilities *(Includes, as appropriate, Pipeline Owner/Operator, EPC Prime Contractor, etc.)*

- 3.1.1 Provide accurate and timely site-specific steep slope/hazardous terrain information including native soil slope stability and construction requirements. Confirm that Contractors understand the magnitude and quantity of the hazardous terrain construction areas prior to award.
- 3.1.2 Provide and/or confirm that profile including the slope degree or grade percent along pipeline alignment is prepared.
- 3.1.3 Request and review the Contractor's Steep Slope Construction Plans to include proposed locations during the tender process. Ensure access to the crest and toe of slopes and additional work space in side slope areas is consistent with the Contractor's Steep Slope Construction Plans.
- 3.1.4 Accept Site Specific Safety Plan (SSSP) established for the contract and support Contractor in implementation to protect public safety. (See Guideline Document CS-G-4: *Site Specific Safety Plans*)
- 3.1.5 Include in the contract terms and conditions this guideline or that of the Project Owner so that Contractors may reflect in the bid/proposal.
- 3.1.6 Monitor contractor's compliance to contract-specific plan(s) and procedures.
- 3.1.7 Confirm that Owner's Representatives and/or Inspectors work collaboratively with the Contractor Management team.

3.2 Contractor Management Team Responsibilities *(Includes all construction-related personnel with a supervisory and/or oversight role, however named.)*

- 3.2.1 Confirm that the Project Team has reviewed the Construction Specifications and full Scope of Work provided for the project and evaluated the requirements per the applicable Contractor's guidelines. Any conflicting information should be submitted to the Project Owner as a written question or request for clarification.
- 3.2.2 Establish hazardous terrain identification and assessment procedures, communicate expectations, verify that each hazardous terrain location is individually evaluated (with the appropriate level of detail) and confirm that the designated work procedures are applied appropriately.
- 3.2.3 Communicate and empower all personnel with the responsibility to "Stop Work" whenever hazardous conditions or potentially hazardous conditions are identified.
- 3.2.4 Enforce policies and procedures governing the safe operations on hazardous terrains.
- 3.2.5 Verify that all potentially-affected (or involved) employees are trained on the related steep slope / hazardous terrain safety and general operating procedures.
- 3.2.6 All equipment modifications should be in accordance with industry best practices and manufacturer's guidelines or approved by an appropriate Professional Engineer.



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- 3.2.7 Members of the Contractor Management Team are expected to serve as role-models for all policies, including those related to hazardous terrain construction operations. They are also encouraged to regularly remind employees of their responsibilities in complying with this guideline document.

3.3 Health & Safety (H&S) Responsibilities

- 3.3.1 Assist in the identification of potential hazards, hazardous work, or work that is potentially hazardous to the environment or facilities through the Hazard Identification and Control process.
- 3.3.2 Complete site safety inspections and audits that are in accordance with the Project/Site-Specific Safety Plan (SSSP) for hazardous terrain work on the project. (See Guideline Document CS-G-4: *Site Specific Safety Plans*)

3.4 Employee Responsibilities

- 3.4.1 Operators and Spotters must familiarize themselves with the types of slope/terrain conditions that could adversely affect the operation of the winch machine and other equipment. Consult with the Supervisor or other qualified person(s) concerning the presence of those conditions and confirm their understanding of the potential mitigating/corrective controls.
- 3.4.2 All employees shall take direction from the Supervisor or designated Person-in-Charge of the task being conducted on hazardous terrain.
- 3.4.3 All employees directly involved in the pertinent hazardous terrain operations must be assigned and know their designated radio call name/number prior to work beginning.
- 3.4.4 Wear the PPE as appropriate for the task being performed. (See Guideline Document CS-G-1: *Basic Personal Protective Equipment*)
- 3.4.5 Attend and complete the required training before working on the task.
- 3.4.6 Operators must always use seat belts when operating vehicles and equipment.
- 3.4.7 Refuse to perform work when unsafe conditions have not been properly addressed. Refuse to perform work if not competent in the task assigned. Report potential hazards to a Supervisor or the designated Person-in-Charge of the task.

3.5 Visitor Responsibilities

- 3.5.1 Visitors are required to follow instructions provided at the orientation and remain alert and attentive to their surroundings at all times.
- 3.5.2 Avoid placing themselves (or vehicles/UTVs) in the line of fire of materials and/or equipment and report any apparent safety concerns or potentially hazardous situations IMMEDIATELY to site supervision or project owner representatives.



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4.0 EQUIPMENT AND SUPPLIES

- 4.1 Follow manufacturer guidelines and visually inspect equipment and devices prior to use and at least daily when in use.
- 4.2 Attachments or modifications to equipment, rigging, chokers and winch line size should be in accordance with industry best practices and manufacturer's guidelines or designed and/or reviewed by an appropriate Professional Engineer prior to use on a steep slope or otherwise hazardous terrain.
- 4.3 To increase traction of equipment with continuous tracks, for work on steep slopes as defined in section 5.2.1, single bar grousers should be installed unless the engineering analysis and detailed steep plan indicate otherwise.

5.0 HAZARD MITIGATION

Note: The guidance that follows are considered general best practices. Site specific conditions may require variation from these practices and should be fully evaluated during the hazard identification process.

5.1 General Guidelines

- 5.1.1 Installation locations with steep slopes or similar hazardous terrain should be identified by the Project Owner and confirmed and refined (*as needed*) by the Contractor responsible for construction.
- 5.1.2 Access routes to the top and bottom of steep slopes should be clearly defined and restricted to personnel trained for and equipment designated for work in steep slope areas.
- 5.1.3 All slopes should be inspected prior to beginning work each day. If slope conditions change during the shift, (e.g., due to weather conditions, newly exposed rock) work should be interrupted and the JSA modified to reflect the changed condition.
- 5.1.4 Only essential personnel and equipment should be present while work is taking place on steep slopes.

5.2 Hazardous Terrain (e.g., Steep Slope) Identification, Assessment and Evaluation

- 5.2.1 For purposes of these guidelines, steep slopes are typically categorized as having a measured gradient of 30% (16.7 degrees), or greater. Some shorter length or lower gradient slopes may meet the criteria and require the same qualifications and mitigation measures due to other conditions (e.g., soil types, environmental factors). As stated in Section 3.1, it is the responsibility of the Project Owner to define the conditions for each specific project or location where these guidelines apply.
- 5.2.2 For each location identified as a hazardous terrain, a safe work planning meeting should be held to formulate a plan based on site-specific conditions.
- 5.2.3 Steep Slope Identification and Assessment should be conducted before and during the clearing process, at many locations along the right-of-way as possible, and after clearing to confirm or adjust the site-specific measurements.
- 5.2.4 The purpose of the Steep Slope Identification and Assessment is to:
 - Identify terrain/slopes that may be hazardous.

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- Assess the slope and conditions contributing to potentially hazardous terrain.
- Determine locations, gradients, lengths, and other relevant conditions.
- Determine access requirements
- Designate required control measures.
- Designate the appropriate equipment and rigging.
- Establish procedures and methods for safe execution.

5.2.5 To establish appropriate safety measures, the following general factors should be considered:

- Degree of slope(s) that exists (as noted in topographical maps, LiDAR, fly overs, and/or job walks) and length of slope(s) present. Do not average slope gradient and the slope length.
- Soil conditions, general moisture content, presence of rock and if so the condition of the rock and underlying material.
- Roughness or irregularity of the terrain, including the presence of boulders or stumps.
- Terrain and formations off ROW that may reveal conditions not detectable along the ROW.
- Environmental conditions at the site, such as weather (e.g., snow, heavy rainfall), water, and the possibility of flash floods (e.g., storm runoff). Consider current weather conditions, and near future weather conditions, as related to the work task.
- Anticipated duration of exposure.
- The nature of the tasks to be performed and equipment and rigging to be used.
- Equipment connection points (point on machine) and factors that could affect traction and/or rolling resistance.
- The experience of the Operators on the crew (e.g., previous experience working in the same area or in similar conditions).
- Project Owner’s specific requirements.
- When analyzing hazardous terrain / steep slopes, you must recognize that soil types, other slope conditions and specific equipment being used can GREATLY affect traction on steep slopes.

5.2.6 Take into account the requirements of the machine and base-mounted hoist to be used.

5.3 Hazardous Terrain Work Plans

5.3.1 Many factors can impact machine stability on slopes and should be factored into the Steep Slope Work Plan. For example, but not limited to, the ground condition, winching, sideboom length, load carried, and load overhang have a direct influence on stability.

5.3.2 A “Steep Slope Work Plan” should be developed to provide a sufficient level of detail to describe safe working limitations; addressing each location identified and phase of construction, including:

- Type(s), make and model (e.g., 583K oval track side boom or a 583T high drive) and number of equipment and corresponding procedures (e.g., anchoring equipment and securing procedures, hoisting and rigging configurations, winches and winch lines, cable end connectors).

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- A grading plan identifying how the cut material will be managed in compliance with landowners, permits and environmental regulations. (**Note:** This information may be included in the Work Plan, or a stand-alone document.)
- Soil types and conditions, and corresponding requirements.
- Weather-related procedures and requirements.
- Controls or procedures to mitigate other anticipated hazards.
- Winching diagram for each type of equipment being winched, when applicable to the project. The diagram should show the rigging / configuration to be used, the forces that the winch line will be exposed to, and the factors used to establish forces such as equipment weight, slope angle, friction coefficient, etc.
- Communication devices and procedures, JSAs, inspections, emergency stop signals.

Weather

- 5.3.3 Changing weather patterns can drastically change the conditions of a slope.
- 5.3.4 The Contractor Management Team should be aware of potential changing weather conditions in their work areas, appropriately reevaluate the work practices as part of the JSA process and communicate changes to the crew via the Foreman/Supervisor.
- 5.3.5 When winter weather conditions are encountered, “ice cleats” may be required.

Communication and Signage

- 5.3.6 Methods of communication and verification can include, but are not limited to:
- Use of Spotters at crest of hill.
 - Signage placed at the crest and toe designating the presence of hazardous terrain locations and/or a blind crest or break over.
 - Signage should include slope percentage/degrees and could include list or pictograms of what equipment is not permitted to proceed any further.
 - Signage should be installed notifying workers of approach to the blind crest and identifying its location. This allows for effective communication over two-way radio (e.g., Pickup travelling up slope to 7+300 crest.).
 - Radio checks and channel to use, prior to approaching the break over.
 - Use of safety antennas (i.e., “buggy whips”) on UTVs and vehicles during designated slope projects. Where applicable, a safety antenna may be fastened to equipment/pipe.
 - Operator visual ground verification prior to cresting.
- 5.3.7 The most effective communication devices available should be used by equipment operators, spotters, etc. while working on hazardous terrain installations. Device types to consider include, but are not limited to, hands free (e.g., voice activated two-way radios), remote microphone, or handheld.



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- 5.3.8 A designated person with an air horn should be put in place to warn of falling debris or other hazards. Warning signals shall only be sounded if there is an immediate danger (dislodged rock, sliding equipment, material slide, broke winch line, etc.).

Emergency Response

- 5.3.9 Site-Specific Emergency Response information should be included in the Site-Specific Steep Slope Plan.
- 5.3.10 The following considerations should be addressed, as applicable:
- Response to equipment upsets, cable breaks, winch breakdowns.
 - Response to slope/terrain failure.
 - High angle rescue protocol.
 - Medevac helicopter extraction, or other extraction plans if helicopter access is not possible.
 - First aid / CPR personnel plan.
 - Response protocol in the case of any personal injuries on the slope or any areas around the hazardous terrain that are difficult to access.

Personal Protective Equipment (PPE)

- 5.3.11 Always wear appropriate and approved gloves when handling or pulling cable and grasp the end ring.
- 5.3.12 Use other PPE identified by the hazard assessment process and in work plans (e.g., fall protection).
- 5.3.13 See Guideline Document CS-G-1: Basic Personal Protective Equipment for additional information.

5.4 Employees Working on Steep Slopes

- 5.4.1 No unnecessary ground personnel should be allowed on the slope or near the operation when equipment is moving, or winch lines/rigging are under load.
- 5.4.2 The Foreman will communicate and train his crew on the plan through a daily Job Safety Analysis (JSA). (See Guideline Document CS-G-2 *Job Safety Analysis*)
- 5.4.3 Information to address in the site-specific hazardous terrain JSA include:
- Gradient of Slope (degree, %)
 - Length of the Slope
 - Scope of Work
 - Equipment being used and corresponding safety measures
 - Environmental Concerns (types of soil, weather, etc.)
 - Soil Conditions (wet, dry, frozen, etc.)
 - Qualifications and Experience of the Operator(s)
 - Slope-specific emergency response and communication protocols
- 5.4.4 When the work activity requires that personnel or equipment work beneath others (at a lower elevation along the same slopes), site-specific procedures should be developed and identified in the JSA.
- Workers should never be positioned below active equipment operations, unless suitable barriers have been established to protect the workers from falling debris.
 - Where equipment operations include winching, workers must never be below or near active winching.



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- Temporary equipment activities can take place on a slope where workers below that activity retreat to an established and identified safe zone during these activities.

5.4.5 Hazardous terrain procedures may include, but not be limited to, additional watchmen, barriers, exclusion zones, and rescheduling of nonessential work.

5.4.6 Always have an escape route.

5.4.7 Never position yourself between two pieces of equipment.

5.4.8 Employees will not cross over or under cables when under load, NO EXCEPTIONS.

5.5 Employee Selection / Qualifications

5.5.1 The hazardous terrain/slope working skill/experience of each operator is very important in determining successful operations.

- The Project Owner and/or Construction Management Team should define competency processes, training requirements, and slope work plans.
- Evaluate your crew on their level of experience working on similar hazardous terrain conditions, (i.e., identification of "hill crews".)
- Only Operators trained on specific equipment and with prior experience performing the task in similar conditions should be used.

5.5.2 Due to the increased risks associated with hazardous terrain installations, the skills of Operators new to a crew should be demonstrated or otherwise verified prior to performing the task.

5.5.3 All workers involved in winching operations should be experienced and understand the principles relating to safe winching practices.

5.6 Vehicle and Equipment-Specific Guidelines

5.6.1 Equipment should never be operated beyond the maximum slope limitations established by the manufacturer. *Note:* This may require consideration of special lubrication requirements such as additional fluids.

5.6.2 Communication with the Operator must occur prior to anyone approaching the equipment. Only approach after the Operator acknowledges your presence and purpose.

5.6.3 In the event there are blind spots, Operators should not proceed without being given directions from a Spotter who is on the ground having a clear view of the equipment's surroundings.

5.6.4 When a machine is moving pipe (or other material/equipment) on hazardous terrain, ground personnel should always stay to the side of the ROW until the pipe is in place and the machine has stopped.

5.6.5 Inspect each piece of equipment at least daily and after any upset/unexpected operation. Give special attention to slings, winches, cables, pins, shackles, fuel and oil levels.

5.6.6 Always err on the side of safety regarding equipment operating limits. Do not operate near the maximum stated limits.

5.6.7 When operating equipment on a hillside, all motions should be deliberate and conducted at the proper rate of speed (proper rate of speed to maintain center of gravity of the machine).



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5.6.8 Use tracked machinery to increase stability and traction.

5.6.9 When parking and leaving vehicles or equipment:

- Park on level areas, whenever practical.
- Engage emergency brake, “chock” or “block” the tires and leave the vehicle in park.
- Turn the front tires in a direction that will prevent unintentional movement (e.g., at an angle or perpendicular to the incline, against a berm, placing buckets or blades on the ground, setting parking break) and/or where if the brakes/wheel chocks fail, the vehicle will roll away from the direction of the workers (e.g., angled into spoil and off ROW).

Dozers

5.6.10 Avoid traveling across slopes as much as practical and travel straight up and down slopes.

5.6.11 When working on steep slopes, dozers should avoid travel diagonally across the slope at less than a 45-degree angle.

5.6.12 Keep the dozer blade as close to the ground as possible while travelling up or down a slope.

5.6.13 If the machine starts to slide sideways when working across a slope, turn the machine downhill and drop the blade.

5.6.14 Hook chokers on the top center of a dozer’s blade to allow the dozer to be lowered to the ground. The dozer may require welded modifications for the top pull hook as well as the bolt on “C” frame trunnion attachments. **Note:** Industry best practices and manufacturer’s guidelines should be considered related to any equipment modifications.

5.6.15 Debris and loose rocks along dozer breaks should be stabilized before personnel are allowed to work below them.

5.6.16 When parking a dozer, the blade should be placed on the ground.

Excavators

5.6.17 Create a level area where Excavators are excavating along slope areas, if possible.

5.6.18 Avoid travel across slopes as much as practical and travel straight up and down slopes. Where turning is unavoidable, or where ascending or descending, turn as gradually as possible to maintain stability.

5.6.19 Under no circumstances should an Operator exit the Excavator while positioned on the hazardous terrain. If required, the Excavator should track to the nearest platform for the Operator to dismount.

5.6.20 For uphill travel, extend the boom and half full bucket forward and for downhill travel bring the boom and empty bucket in close, to maximize stability and traction.

5.6.21 When descending a slope, use the same (low) gear range required to climb it.

5.6.22 When parking an excavator, the bucket should be placed on the ground.

Front-end Loaders

5.6.23 Use only track-type front-end loaders on hazardous terrains.

5.6.24 Create a level area for the front-end loader to operate from.



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- 5.6.25 Avoid turning, working, or travelling across a slope, as a sharp turn up or down a hill may cause rollover.
- 5.6.26 Work with the bucket facing uphill to maximize stability and avoid tipping.
- 5.6.27 When travelling with a loaded bucket, descend backward down a slope, if possible.
- 5.6.28 When descending a slope, use the same (low) gear range required to climb it.
- 5.6.29 Avoid using the 'declutch' brake pedal while descending a grade.
- 5.6.30 When clearing road slips, take care that further slips or trees do not fall while moving material. Keep your eye on any material above the machine.

Rigging

- 5.6.31 Rigging should not be allowed to dig into the ground. If this occurs, immediately inspect the rigging for damage and/or take out of service.
- 5.6.32 Rigging should not be used for vertical lifting/hoisting after it is used for towing.
- 5.6.33 Rigging Equipment:
 - Should have permanently affixed and legible identification markings that indicate the manufacturer recommended safe working load.
 - Should not have loads that exceed its safe working limits.
 - Wire rope, nylon slings, etc. should never be tied in knots.
 - If wire rope is kinked in any way or if the diameter of the rope changes, do not use it.

Side Booms

- 5.6.34 A thorough analysis of the lifting capacities of the Side Booms should be completed to verify the operation of the equipment on the slopes.
- 5.6.35 Choose the shortest boom available to accomplish the task.
- 5.6.36 Carry the load as low as safely possible to the ground. Make every effort to control the load. The load should be attached to a winch tractor to prevent the load from cantilevering downhill.
- 5.6.37 During the lift and lay process, keep loads on the Side Booms below the maximum allowable loads. **Note:** Per ASME 30.14B, 85% of the maximum tipping load on the side boom is the maximum limit, however, hazardous terrain often requires adjustments down from this maximum.
- 5.6.38 Under no circumstances should Boom Operators get off their machine while under an active load being worked on by employees on the ground.
- 5.6.39 When parking a side-boom tractor, weight should be positioned uphill.

Vehicles

- 5.6.40 Wheeled vehicles may be prohibited along identified hazardous terrain.
- 5.6.41 Gear down when driving down hills; do not ride the breaks more than is required.



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5.6.42 Towing may be necessary on steep or otherwise hazardous ROW or ROW access roads. Use sufficiently sized tow rigging and/or tow anchor bolts for the vehicle (e.g., heavy duty tow mounts may be needed) and inspect prior to use.

Winch Support

5.6.43 Slope angles of 30% (16.7°) or greater (or as specified by the Project Owner) should be analyzed to determine if winching is necessary for safe equipment usage on such work sites. Other hazardous terrains with less slope may also require winching.

5.6.44 When working on a hazardous terrain that requires winching, only one operation should be underway at a time.

5.6.45 The determination of whether to use a mobile winching system versus a stationary winching system is dependent on the forces required to stabilize the working equipment and centerline alignment.

- Calculate forces based on equipment weight, configuration and application as well as friction coefficients applicable to the specific terrain.
- The Competent Person considers the type of equipment which will be suspended from it, gradient, soil conditions, moisture content, length, etc.
- Stationary winching systems are generally used for lengthy slopes over 1,000 ft and hazardous terrain conditions which prevent the equipment from operating safely. Stationary winching systems are also generally utilized for slopes of consistent pitch.

5.6.46 Prior to winch operations, remove any crew working on the downhill side of the winching operations.

5.6.47 When installing large sections, use winches on both the pipe and the tractors. This will help prevent the pipe from slipping and turning the tractors when installing the sections of pipe.

5.6.48 When multiple tractors are used in winching operations, hands-free two-way radio communication is recommended.

- The on-site Foreman and all Operators involved should have open lines of communication.
- To avoid confusion, rehearsal and pre-job communications are recommended.

5.6.49 Install proper shielding on top of the blade and all other rough edges to protect against cable fray.

5.6.50 Place winching equipment required to hold construction equipment on a flat and level area on the top of each hazardous terrain location and anchor it, if required.

5.6.51 Always have at least 1 full layer plus 5 wraps of cable on the winch drum. *Note:* While OSHA standards allows less than 5 wraps, various equipment manufacturers and best practices indicate 5 wraps as more appropriate.

5.6.52 Winch Equipment Operators should not leave the seat of the machine while equipment is attached. If an Operator needs to leave the seat for any reason (e.g., bathroom break, shift change) cease all operations until the Operator returns to the seat of the machine.

5.6.53 Before equipment is pulled or lowered, the qualified person should double check all attachments.

- No rigging is hooked to the belly pan on any machine.



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- Tail chains should not be used when winching excavators, sideboom tractors, or dozers. When tail chains are used, a positive connection by way of shackle or similar device should be used. Open hooks or logging hooks should never be used.
- Attachment to all equipment must be either to a manufacturer's attachment point rated for the expected forces or must be an engineered and inspected attachment point with sufficient capacity. Side boom attachment points are on the tractor and are never on the boom.
- Do not use chains as a method of towing or winching. Only straps, cable chokers or belts should be used for towing or winching.
- All rigging must be inspected and marked as having sufficient capacity.
- If a sling is constructed on the jobsite, it should consist of a becket on both ends made from wire cable, no clamps are allowed.
- Hooking to the cast parts on a farm tractor should not be allowed. Instead, install a pull eye to hook.
- Use shackles and D-rings for all rigging connections. No direct hooking with pipe belts.
- Use draw bar pins that have a safety latch or serviceable safety keeper and inspect daily.

5.6.54 Use tag lines to control all suspended loads.

5.6.55 Never:

- Winch if crew members are in the line of fire of falling debris or equipment.
- Step over or stand on a hooked winch line or cable.
- Leave the remote control plugged into the winch while free spooling, rigging, or sitting idle.
- Engage or disengage the clutch if the winch is under load, wire rope is in tension, or wire rope drum is moving.
- Touch the wire rope or hook while in tension or under load, or while someone else is at the control switch or during winching operation.
- Touch wire rope or hook while a remote control is plugged into a winch.
- Allow the cables/wire ropes dig into the ground, surface rocks, sharps, or any other source of friction besides that of the winch drum. This includes the rubbing of the cable/wire ropes on the dozer blade.

5.7 Activity-Specific Guidelines

Clearing & Grading

- 5.7.1 Work should progress from the top down. Care should be taken to place unstable material in a manner to prevent the material from leaving the work area.
- 5.7.2 Conditions may yield blind crests or break overs. Where possible, these situations should be mitigated with grading practices.
- 5.7.3 Blind crests or break overs should be identified during initial hazardous terrain identification assessment and during daily work area inspection activities.



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- 5.7.4 All crews working in the area of blind crests or break overs should communicate and acknowledge each other's presence and scheduled work activities for the day. When changes to scope of work occur, the other parties in the area should be notified.
- 5.7.5 Wherever mitigation of blind crests or break overs is unattainable, a method of communication and verification for safe passage should be established.
- 5.7.6 Where blind crests or break overs exist, travel lanes on either side should be maintained clear, where possible.
 - Where the staging of equipment, pipe, or other construction materials in the travel lane is unavoidable, methods of communication and verification of the existence of congestion should be established.
 - Signage should be installed notifying workers of approach to the blind crest and identifying its location.

Drilling and Blasting (if applicable)

- 5.7.7 Create a daily blast plan which includes time of blast, location of blast, number of holes to be blasted, average hole depth, quantity of explosives to be used, and planned tie-in methods. Obtain approval prior to loading the explosives.
- 5.7.8 Confirm that all personnel are out of the line of fire and in safe zones and that responsible blast guards are in place prior to any blast initiation.
- 5.7.9 Hazardous terrain conditions may require specialized equipment to ensure the explosive delivery is completed safely.
- 5.7.10 Static and/or mobile winches may be used to provide equipment traction assistance. In these situations, the following are recommended:
 - Drillers within 2m of a leading edge should wear a fall arrest harness attached to previously installed ground anchor point.
 - Collar all holes carefully so that unnecessary cave-ins do not occur. This will aid in more efficient loading by blast crew.
 - Do not drill angle holes without prior discussion with the Supervisor.

Trench Excavation

- 5.7.11 Have safety measures in place if there is a risk of material rolling down slopes. Netting or barriers shall be in place to stop rocks or debris from rolling down the slopes.
- 5.7.12 The slope of the trench walls may be decreased if the ground conditions warrant in accordance with the excavation requirements, design by a Professional Engineer or excavation competent person. When the ditch is largely trenched in rock, it is beneficial to maintain a steep trench wall to reduce additional rock excavation. The slope of the trench walls will be modified in accordance with the geotechnical assessments completed on site as required.
- 5.7.13 When excavating the trench, large rocks may be encountered that have a possibility of rolling down the hill. The following protective methods/measures should be implemented to mitigate the risks associated with falling rocks:



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- The Excavator Operator will create a benched platform from the spoil materials from the trench to set the large rock on. This will create a stable surface for the boulder to sit on, reducing the possibility of the rock moving down the hill. Additional spoil material should be positioned around the rock to provide support. If the boulder is very large, it should be transported to the top of the platform by the excavator.
- No work will be performed downhill of the trenching.
- Spotters should be positioned in safe zones near the excavation and equipped with safety air horns to pause work if unsafe conditions exist (e.g., a large rock being dislodged and descending the hill).

Pipe Benching

- 5.7.14 When building a two-tone row, material in the fill area needs to be minimized because this area on a side slope can become unstable and pose danger to the pipe gang and to the lowering crew.
- 5.7.15 Benching off side slopes encountered along the pipeline route using a cut-and-fill method is recommended.
- 5.7.16 When preparing a bench on any slope, confirm that the bench platform will support the size of the equipment.
- Regularly assess the soil/ground conditions of their work areas with emphasis on integrity/stability of ground conditions and the potential for undermining.
 - Operators are expected to acknowledge when ground conditions will not allow for benching to be conducted at 45-degree angles and require another method.

Welding

- 5.7.17 Welding crew sizes should be kept to a minimum and procedures may be modified depending upon the inclination, stability, hazardous terrain conditions and available workspace on the ROW.
- 5.7.18 Hazardous terrain operations may require the use of tracked machinery to increase stability and traction, on which the welding units will be securely anchored.
- 5.7.19 Operate equipment within the manufacturer's limits of operation, with special attention to the maximum working angles.
- 5.7.20 Platforms may be set up to provide additional support and stability for welding personnel.
- 5.7.21 On steeper sections, manual hand welding may be the preferred method due to the complexity and increased congestion of automatic welding.
- 5.7.22 Welding equipment should be mounted on a sled with self-leveling platforms to keep the welding machines operating in a level position.

Coating

- 5.7.23 Field coating crew sizes should be kept to a minimum and procedures may be modified depending upon the inclination, stability, hazardous terrain conditions and available workspace on the ROW.
- 5.7.24 Platforms may be set-up to provide additional support and stability for the coating personnel.



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5.7.25 Hazardous terrain operations may require the use of tracked machinery to increase stability and traction, on which the sand/grit blasting units and coating equipment sled would be securely mounted.

5.7.26 Operate equipment within the manufacturer's limits of operation, with special attention to the maximum working angles.

Pipe Installation

5.7.27 Pipe installation direction (uphill from bottom or downhill from top) should be determined subsequent to the slope assessment and when the slope specific safe work plan is created.

5.7.28 The first is installed, padded and backfilled prior to installing the next section. This will anchor the pipe in place. Once the section is backfilled, a trench shield and steel plate are installed on the uphill end to protect the newly installed pipe from rolling material and allow for safe access to weld the next section.

5.7.29 All pipelayers should be tied together with chokers or winch lines and connected to winch tractors with the top-most tractor (anchor tractor) never backing over the crest of the hill. The applicable forces must be calculated before attempting to tie equipment together.

5.7.30 No more than two pipelayers should be used to carry a section. Limits on section length should be established based on the lifting capacity of equipment.

5.7.31 The Lower and Lay Supervisor will have no other responsibilities during the lower and lay, and this individual should be in a safe vantage point to observe the entire operation.

5.7.32 At no time will workers enter the trench for connection or disconnection of any load, except where using an approved bell hole.

5.7.33 To minimize work time on the slope, sections should be fabricated at the top of the steep slope.

Pad and Backfill

5.7.34 Padding and backfill should progress in the same direction as the pipe installation. Every previously installed pipe section should be padded and back filled prior to the installation of the next section.

Restoration – Water Bars and Slope Breakers

5.7.35 All water bars and slope breakers should be graded smooth prior to any equipment traveling up or down slopes.

5.7.36 Never cross a water bar/slope breaker with equipment on slopes, in either direction (up slope or down slope).

5.7.37 Slope breakers may be required at the top of steep slopes.

5.7.38 On all sloped terrain, temporary slope breakers and hard or soft plugs should be installed along the right-of-way and in the trench, at the appropriate intervals.

5.7.39 On steep hills, ditch breakers should be installed, and the hill should be backfilled immediately after lowering to prevent pipe from sliding. Ditch breakers should be installed at the lesser of: intervals listed in design specifications, or at the direction of the Environmental Inspector. Immediate backfilling also minimizes the risk of pipe or coating being damaged and requiring repair in a hazardous condition.



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6.0 TRAINING

- 6.1 Training must be provided to personnel performing, monitoring and/or supervising construction activities associated with hazardous terrain conditions.
- 6.2 Training specific to steep slope installations typically includes the review of:
- Project Steep Slope Work Plan(s) and any other site-specific relevant information.
 - Communication procedures including designated radio call names/numbers.
 - Emergency response plans and procedures.
 - Equipment operation procedures for work on slopes and/or otherwise hazardous terrain.
 - Example or Table of Contents for steep slope work plan
 - Use of mats on hazardous terrains
 - Equipment refueling on slopes and/or otherwise hazardous terrain

7.0 REFERENCES

7.1 The American Society of Mechanical Engineers (ASME)

- 7.1.1 ASME B30.7 *Safety Requirements for Base Mounted Drum Hoists*
- 7.1.2 ASME B30.9 *Slings*
- 7.1.3 ASME B30.10 *Hooks*
- 7.1.4 ASME B30.14 *Side Boom Tractor*
- 7.1.5 ASME B30.26 *Rigging Hardware*

7.2 Canadian OH&S (Occupational Health & Safety) Legislation

- 7.2.1 WorkSafe BC OHS Regulation Part 26, Section 26.16 -- *Slope Limitations*
- 7.2.2 BC Forest Safety Council Steep Slope Resource Package (April 2013)

7.3 Mexico: Social Secretary of Labor and Social Welfare

- 7.3.1 Official Mexican Standard NOM-031-STPS-2011 -- *Construction – Health and Safety Conditions in the Workplace*

7.4 State-Specific Requirements or Considerations

- 7.4.1 Oregon Administrative Regulation OAR 437-007-0935 -- *Machine Operations on Slopes*

8.0 HISTORY OF REVISIONS

Number	Date	Description
0	December 2018	Initial publication of this INGAA Construction Safety Consensus Guidelines document.