CTL Cable-assisted Harvesting

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Discussion Overview

- Cable-assisted system types
  - Static
  - Dynamic
- Ponsse harvester-forwarder system
  - Bear, Elephant King, Herzog Synchrowinch
- Why does cable-assistance work?
- Underlying mechanisms, pressure reduction, horizontal and vertical benefits
- CTL Layout Tips
  - Corridors, winch, landing/roads, weather, tree characteristics, etc.
  - Pricing
- Benefits and challenges with CTL
- Management implications, take-away messages

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System Types

- Static Line System
  - One line remains fixed relative to ground
  - Tree or machine anchor
  - Common in thinning applications (short logs up to 28’)
  - Fully integrated winch

System Types

- Dynamic Line System
  - Two lines moving
  - Machine anchor
  - Excavator-based harvesting machine and anchor
  - Clearcut application
  - Radio-controlled anchor machine
  - Harvesting often followed by tethered grapple skidder or skyline system

Ponsse Harvester-Forwarder System

Bear Harvester

Elephant King Forwarder

Ponsse Harvester-Forwarder System

Bear Harvester

- Approximately 52,470 lbs.
- 322 hp Mercedes-Benz diesel engine
- 51,706 lbf tractive force
- Versatile platform for difference cranes and heads
- 8W Bogies, articulated chassis

Elephant King Forwarder

- Approximately 52,250 lbs.
- 275 hp Mercedes-Benz diesel engine
- 53,954 lbf tractive force
- Load capacity of 44,092 lbs.
- 8W Bogies, articulated chassis

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Ponsse Synchrowinch

- ~9/16 inch, 1,150 foot high compacted construction line
- 0-10 tons continuously variable and consequently constant tensile force
- Installs on front of harvester, rear of forwarder
- 4,299 pounds for harvester, 4,189 pounds for forwarder

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Ponsse Synchrowinch Line Safety

- Specially engineered – doesn't whip when broken.
- Lockouts are in place on the machine to prevent unintended operation
- Winch has a remote control operator can use outside of the machine when testing/spooling line
- Safety should always be a priority

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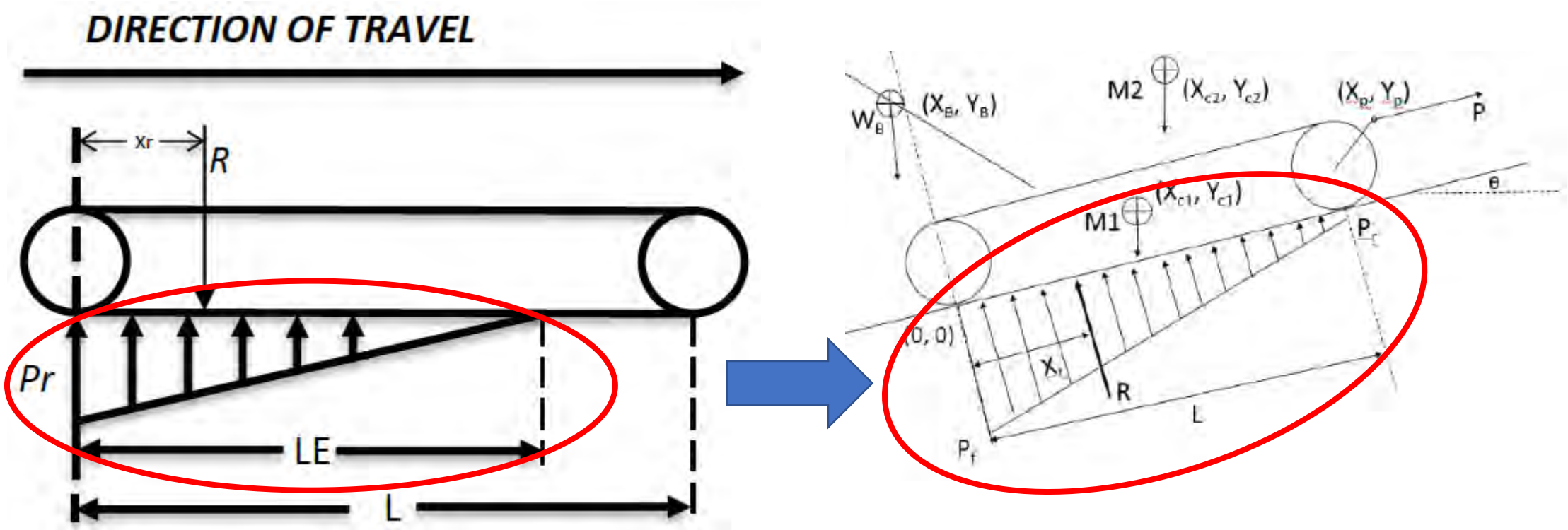
Ponsse Synchrowinch Control Systems

Why does cable-assistance work?

Have to understand machine-soil interaction…



Why does cable-assistance work?

…And soil type!

Why does cable-assistance work?

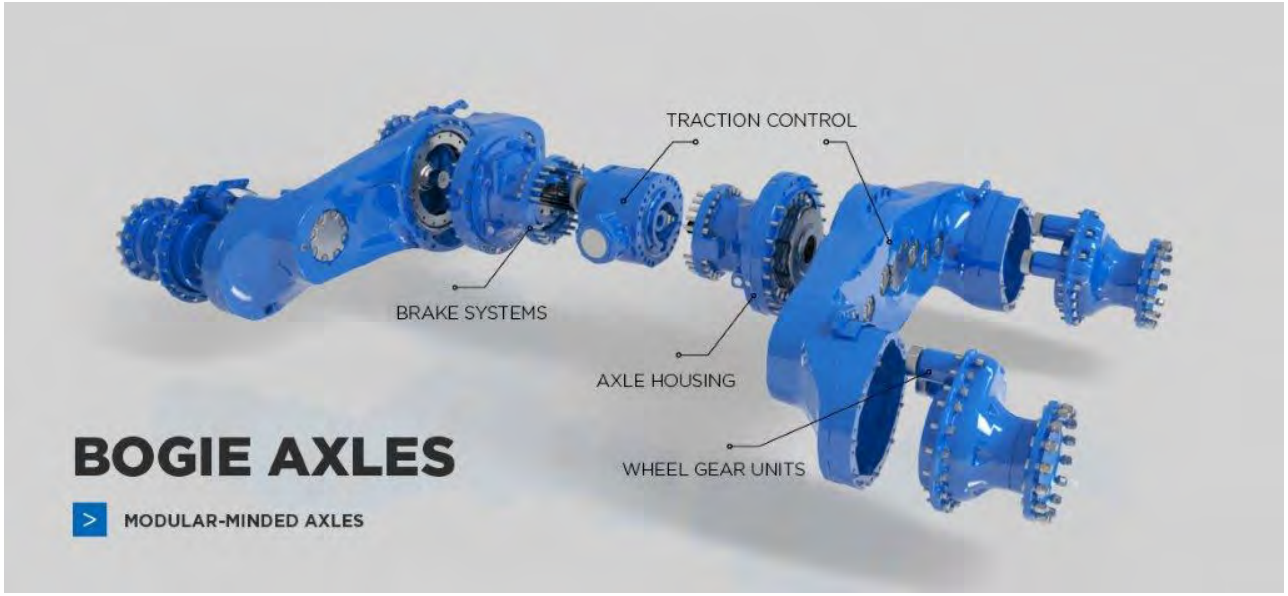
1. 8-wheeled Harvesters

- Wheeled harvesters in the past were primarily 6 wheeled machines
- Development of the 8-wheeled harvesters offers superior traction on steep slopes
- This is largely due to all wheels being on dual boogie axles rather than only one axle being a dual bogie
- Bogie axles have two sets of wheels on each end of the axle

Why does cable-assistance work?

2. Balanced Bogie Axles

- Balanced bogie axles apply equal pressure to both bogie wheels on an axle when the wheels encounter an obstacle such as a rock or stump
- With non-balanced bogies the leading wheel rises up when encountering an obstacle and traction is lost on the front wheel
- With a balanced bogie the front wheel maintains downward pressure on the ground that is equal to the rear wheel and traction is maintained
- This allows the machine to maintain full traction



Why does cable-assistance work?

3. Track Design

- Trac-bands are flexible steel tracks that are fitted around rubber tires on a bogie axle
- Trac-bands have long been used on harvester and forwarder bogie wheels to improve traction and reduce ground pressure
- Improved trac-band design allows for superior traction and reduced soil compaction when operating on steep slopes

Why does cable-assistance work?

4. Engines Adapted to Steep Slopes

- Increased oil pan size
- Lowered oil intake for steep angles

Why does cable-assistance work?

5. Benefits of a Long Frame

Long frame lowers ground pressure

Long frame increases stability

Why does cable-assistance work?

6. Flexible Frame, Multiple Articulation Points

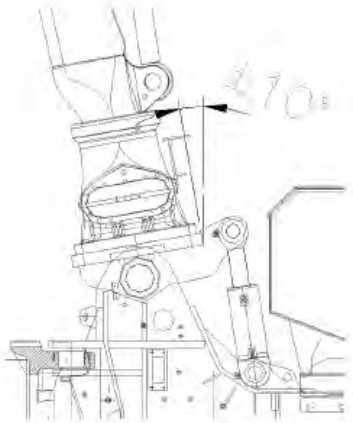
- Multiple articulation points allow for the machine to conform to the land instead of the land conforming to the machine
- Bogies operating independently roll and flex over ground obstacles
- Track-bands also flex over stumps and logs
- High levels of adhesion and stability are achieved due to multiple points of contact

Why does cable-assistance work?

7. Tilting Crane Base

PONSSE

Tiltable crane pedestal



The tiltable crane pedestal allows tilting the loader by 10° in both front and rear (total movement 20°). This gives the loader a better slewing torque and operability in slopes.

A logger's best friend
www.ponsse.com

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Why does cable-assistance work?

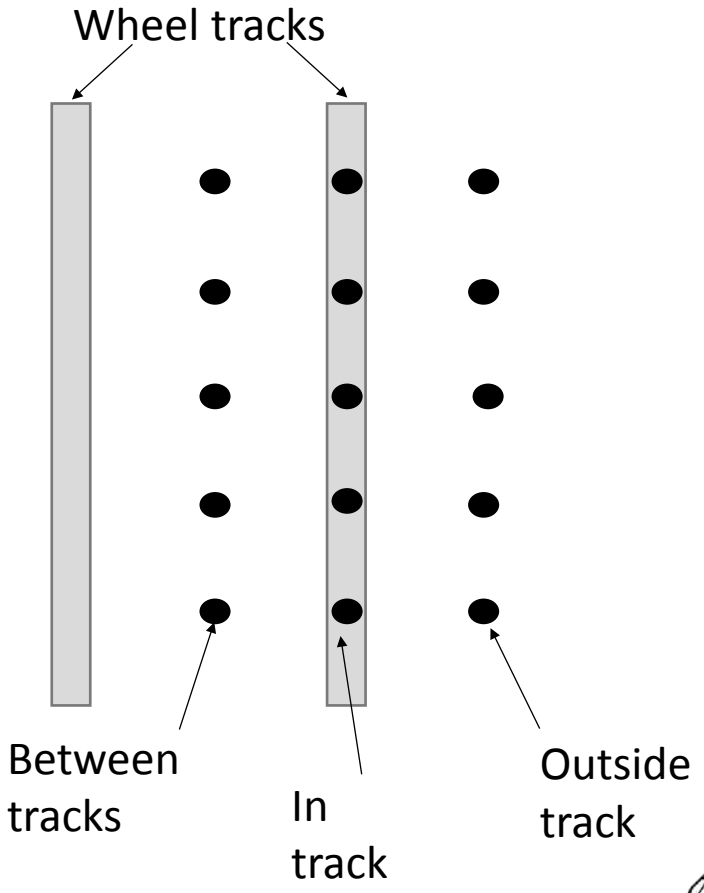
8. Synchronized Winch Assist

- A good analogy to illustrate winch assist is when you try to pull a stuck log truck out of a muddy ditch
- If you leave the stuck log truck in neutral and try to “pull” it as dead weight, it can be difficult
- However, if you “drive” the stuck vehicle out of the ditch and the towing vehicle is there to “assist”, it is a much easier task
- A synchronized winch is designed to assist, not pull the machine up a hill

Why does cable-assistance work? Quick overview of Research Work @OSU

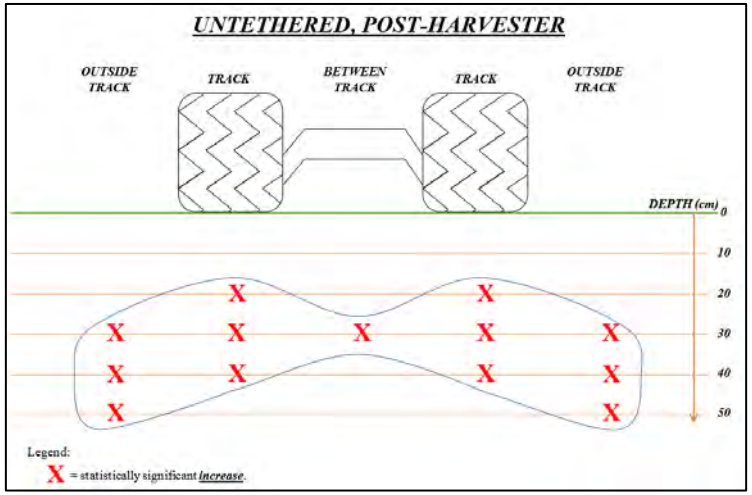
Control of vertical and horizontal spread of influence (harvester-forwarder testing):

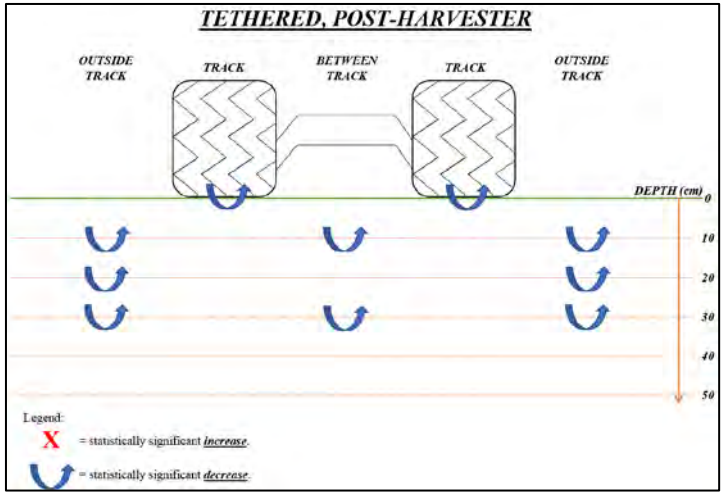
- Paired corridor approach
- Untethered on gentler terrain, tethered on steeper terrain
- Fixed sampling before harvest, after harvest, after forwarding
- Surficial and at-depth measurements taken
  - Dry bulk density and penetration resistance

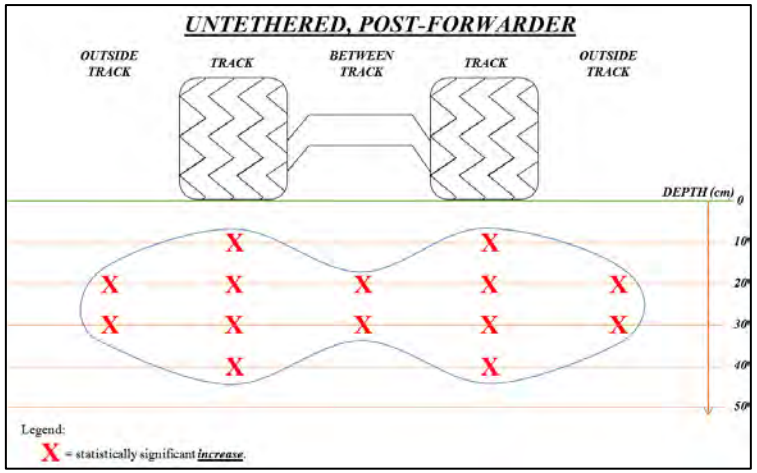


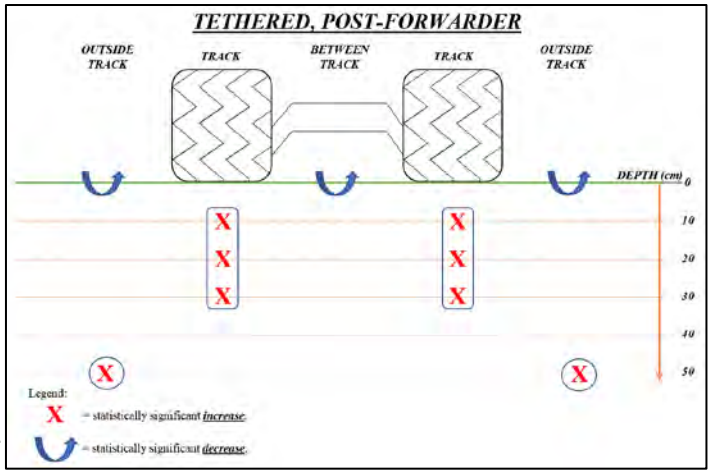
Why does cable-assistance work?

Control of vertical and horizontal spread of influence (harvester-forwarder testing):









Why does cable-assistance work?

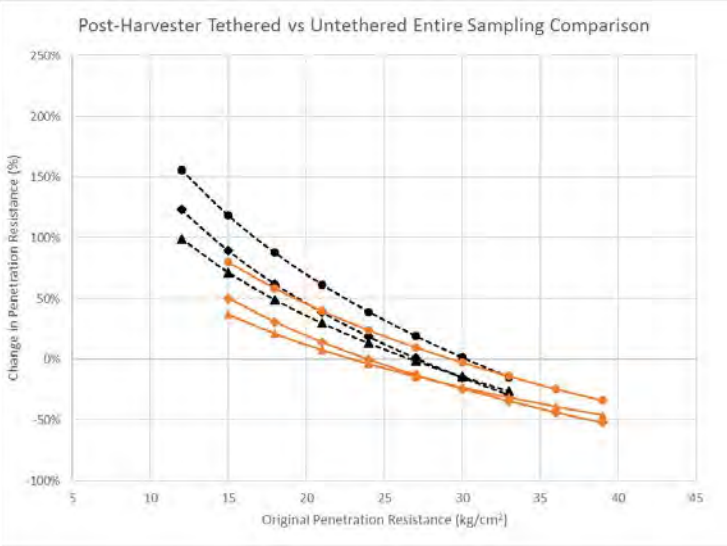
Soils are important! Particularly the original soil condition:

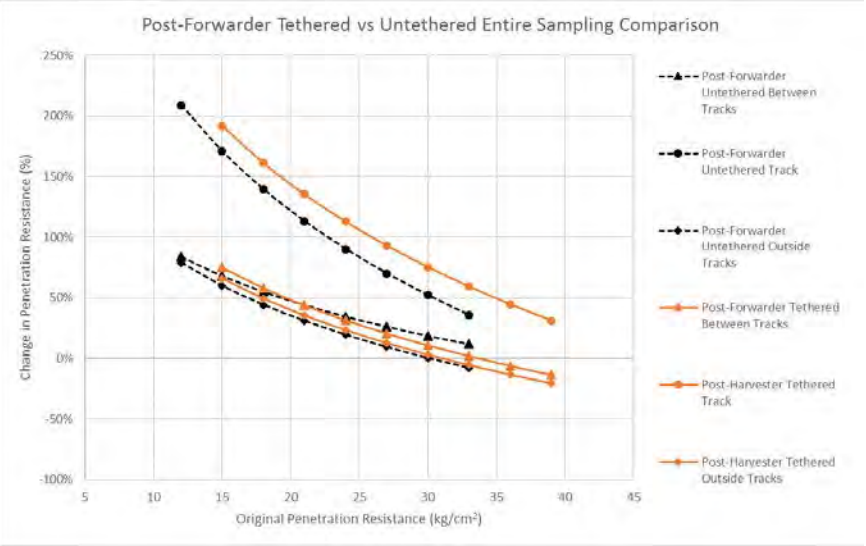
Post-Harvester

Rank	Location	% Change
1	Untethered Track	51%
2	Untethered Outside Track	30%
3	Untethered Between Tracks	22%
4	Tethered Track	7%
5	Tethered Between Tracks	-15%
6	Tethered Outside Track	-17%

Post-Forwarder

Rank	Location	% Change
1	Untethered Track	106%
2	Tethered Track	89%
3	Untethered Between Tracks	41%
4	Untethered Outside Track	27%
5	Tethered Between Tracks	18%
6	Tethered Outside Track	11%

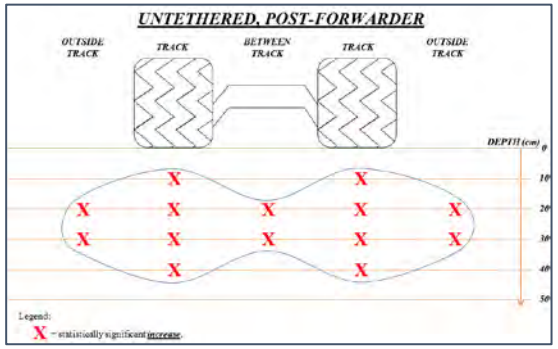




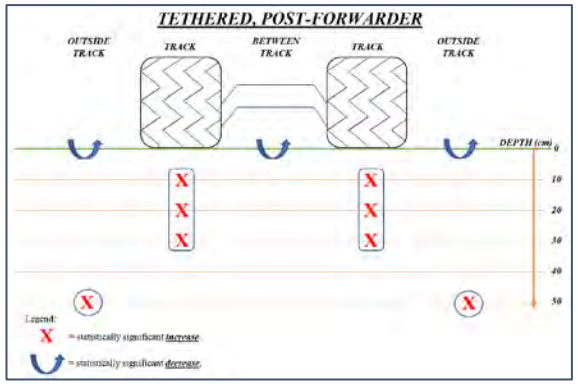
Why does cable-assistance work?

Horizontal benefits

- Controlled ‘track wander’
- Less significant ground coverage

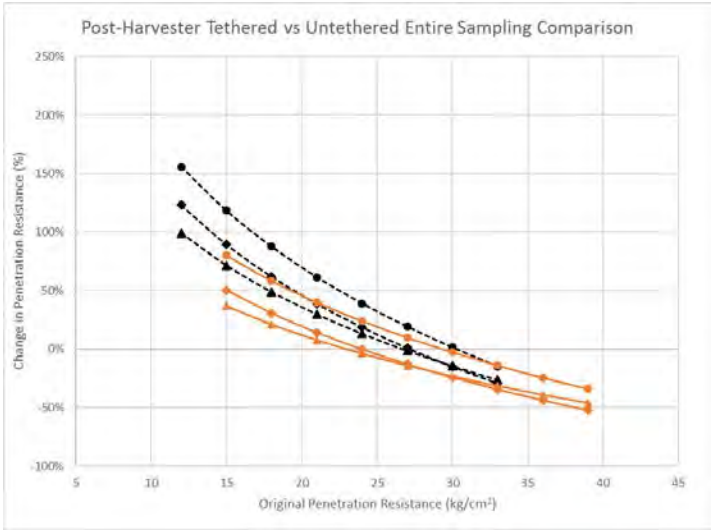


versus…



Vertical benefits

- Reduces maximum ground pressure → reduces shear displacement (maintaining soil profile) → enables more passes to reach densification



Cable-assist Layout – Operating Direction

Uphill

- Forwarder typically works uphill
  - Winch is on front of bunks
  - Better to be on your way out in case you get stuck
  - Don’t want logs sliding out of bunk!

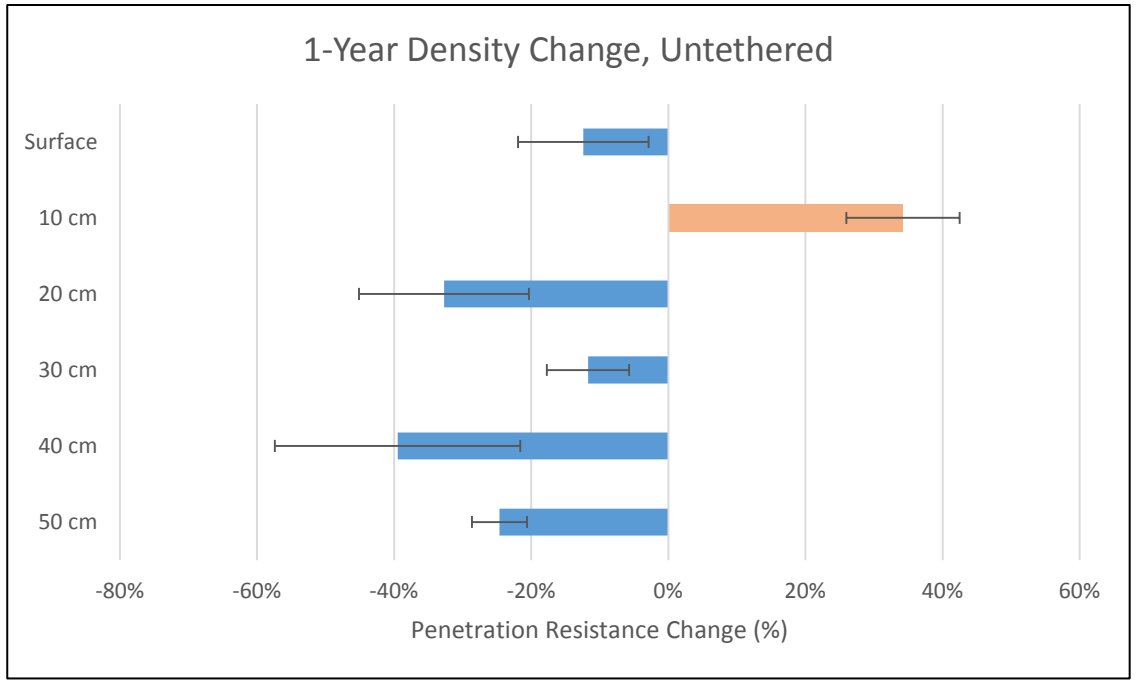
Downhill

- Harvester typically works downhill
  - Can’t cut uphill and tether at the same time as winch is on back of cab
- Excavator-based systems typically cut downhill

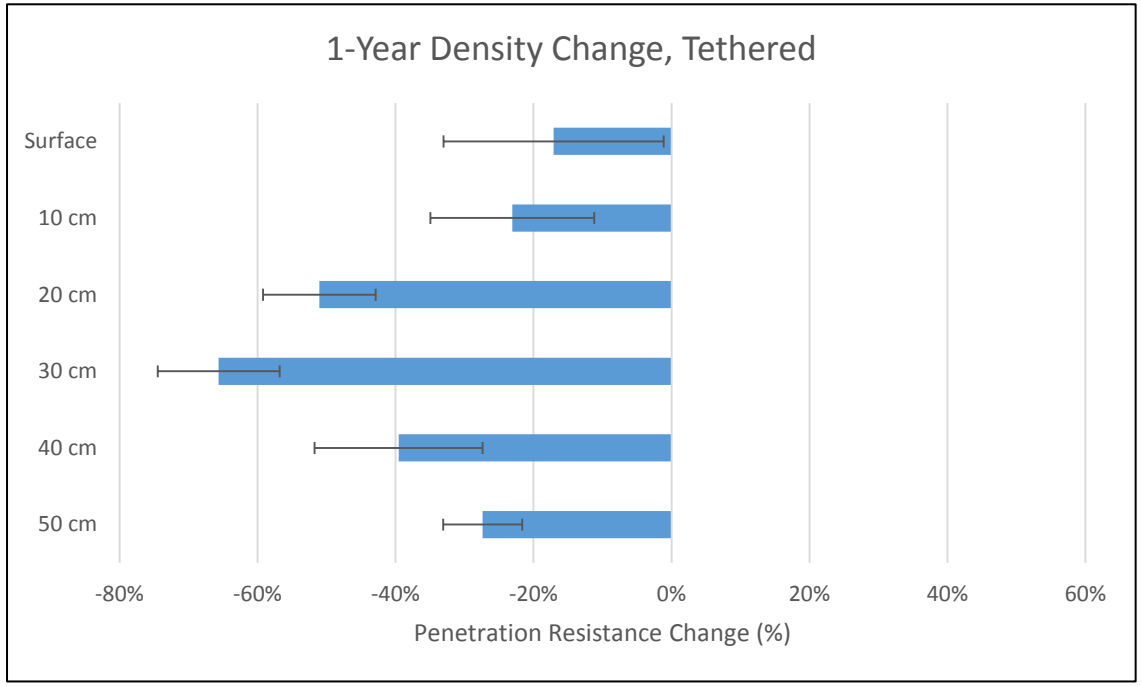
What about long term impacts?

Long Term Impacts – 1 Year Post-Harvest

Untethered



Tethered



7 Months Post Harvest 2016 Planting

3 Years of Seedling Growth


Harvester Cable
Forwarder Cable

Cable-assist Layout – Slope Limitations

- As with most things…it depends!
- Soils
  - Greater strength = greater ability to cover slope
  - Snow and frozen ground can be great operating surfaces (to a point)
  - Different track types (or even just tires) can allow coverage in multiple terrain conditions
- Payload
  - Forwarder more often limits terrain coverage due to loaded weight and size

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Cable-assist Layout – Corridor Selection

- Avoid sidehill! Corridors should go with the slope.
- Primary corridors typically placed on ridgetops if possible, with secondary corridors off that, tertiary corridors off that, etc. Think veins of a leaf…
- Watch for bluffs and other obstructions that make machine passage impossible. Machines are purpose-built but not designed to dangle from the winch.
- Avoid sidehill!

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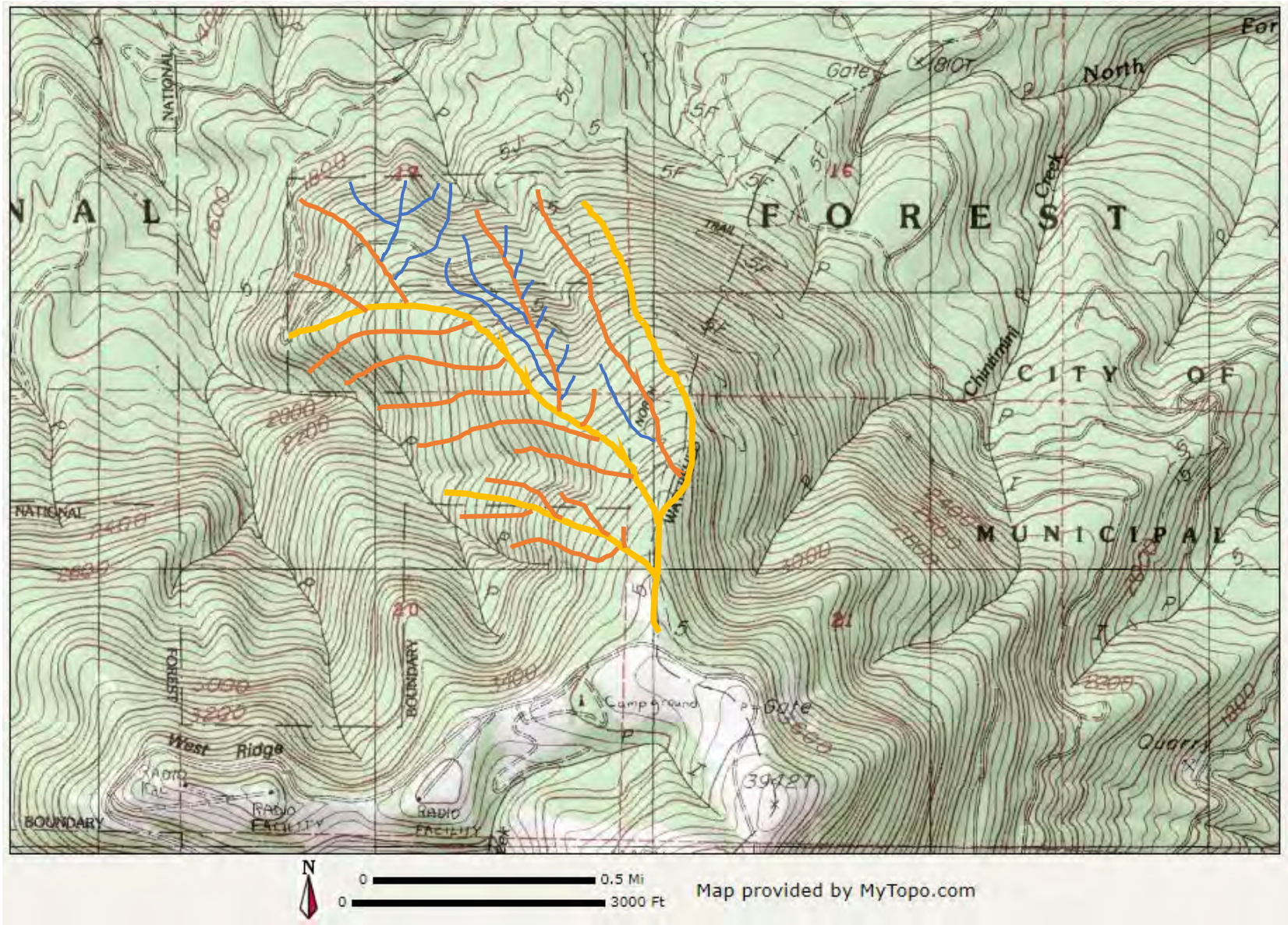
Cable-assist Layout – Corridor Selection



= 1st order corridor
= 2nd order corridor
= 3rd order corridor

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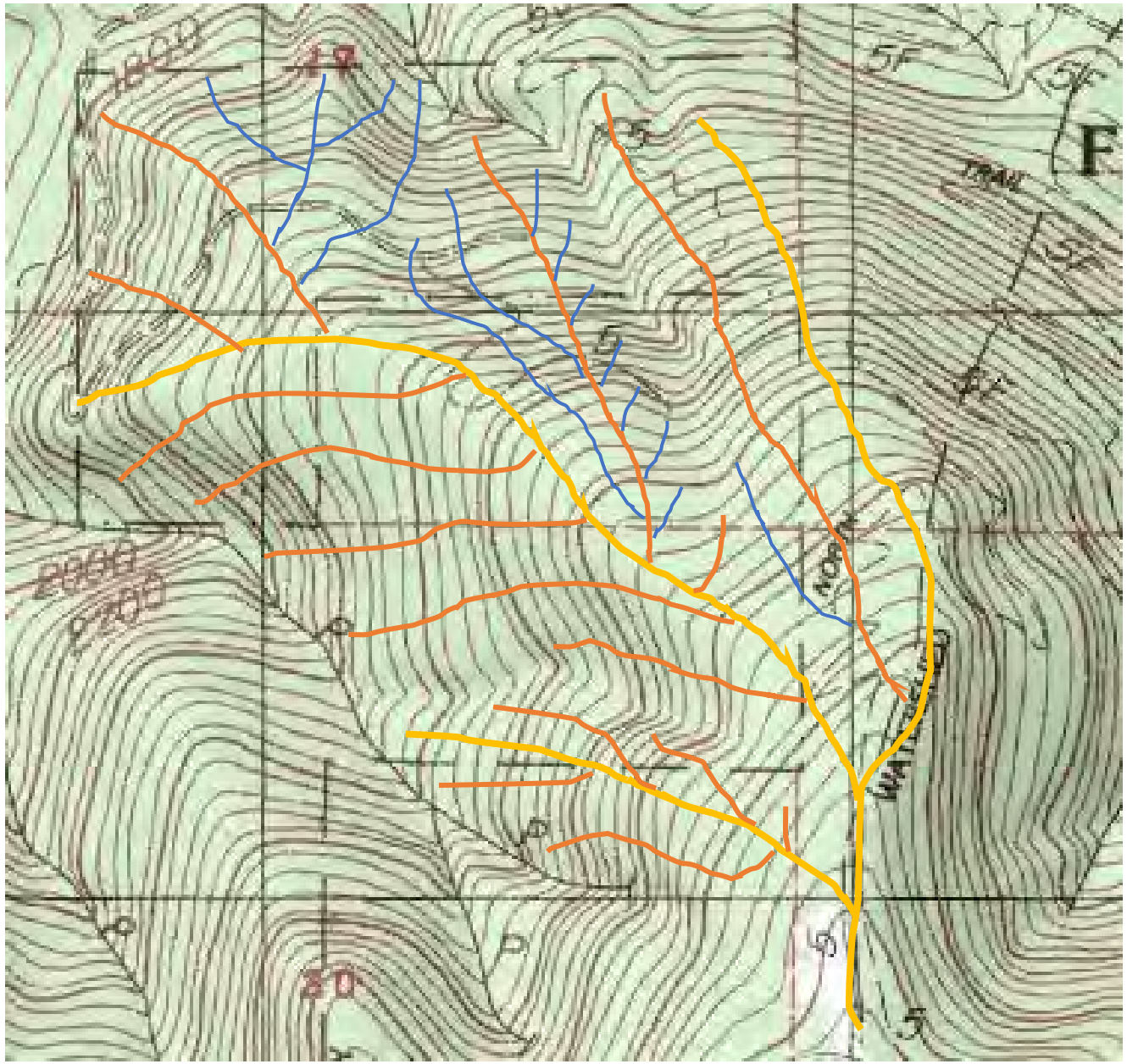
Cable-assist Layout – Corridor Selection



= 1st order corridor
= 2nd order corridor
= 3rd order corridor

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Cable-assist Layout – Corridor Selection

Cable-assist Layout – Corridor Distances

- Generally, longer corridors translate to greater production efficiency
  - Less ‘dead’ ground to travel
  - Operators get established and comfortable
- What about distances longer than ~1,000 feet?
  - A separate “live” winch system can also be used in addition to the standing system to increase reach.
  - Operator can unhook and re-hook the cable
    - Can use re-load points in the stand to transfer material
  - Unhooking and hooking is quick – typically just a couple minutes each way.
  - Line can be remotely controlled outside the machine as well.

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Cable-assist Layout – Roads and Landings

- One central landing no longer required
- Deck almost anywhere; Cold decking logs ok and ship them when road conditions allow
- Harvest/decking patterns more typical of mobile yarders as they move throughout a road system
- Little new road construction usually required for CTL – most legacy roads just need improvement/maintenance for trucking
- Forwarder can deck from behind, minimizing the travel impact on road when aggressive tracks are used
- Can load for forwarder or shovel/loader

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Cable-assist Layout – Weather and Seasons

- Soils are important!
- Wet: minimize lead time between harvester and forwarder
  - Minimizes precipitation absorption (and future rutting/displacement) on freshly opened corridors
- Dry: can let lead times vary, though machine scheduling can become more challenging
- Different tracks for different soil/ground conditions
  - Some tracks meant for climbing and traction, some meant for flotation on saturated soils, powdery snow, sandy soils with low cohesion, etc.

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Cable-assist Layout – Weather and Seasons

- Fire season (ODF regulations)
  - CTL can operate during Level 3
    - Bar saw (instead of hotsaw), static line (instead of running lines), and rubber tires (versus tracks)
- Can even work on the fire line…

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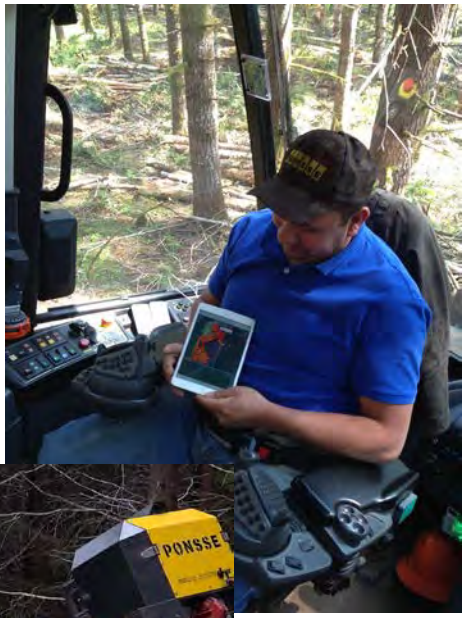
Cable-assist Layout – Harvesting Productivity

- Drivers – 4 S's
  - Stem size
  - Stocking
  - Slope
  - Skill



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Cable-assist Layout – Pricing

Average yarder side

2 timber fallers

7 crew members

1 yarder

New: $1.7 – $2.5M

1 shovel

New: $.35 – $.45M

1 processor

New: $.55 – $.65M

Total: $2.6 – $3.6M

Cable-assist Layout – Pricing

Average yarder side

0 timber fallers

2-3 crew members

1 tethered harvester

$.85M

1 tethered forwarder

$.775M

1 small loader

$.29M

Total: $1.915M

$.685 – $1.685M less than yarder side

Other benefits of CTL

- Lowest Carbon Footprint of any mechanized harvesting system
- Increased tree utilization and product recovery – better economics in low-value stands, higher amount of fiber and value recovered than other systems
- No landings = reduced road network and construction
- No landings = no slash piles = reduced spatial impact of harvesting
- Wood can be cold decked until road conditions allow for hauling
- Ability to work around sensitive areas (riparian, mgmt. areas, etc.)
- Quieter than other systems (less acoustical disturbance to wildlife, people)
- No need to hang cables through riparian areas for lift.
- Safer, cheaper and more efficient than cable yarding alternatives
- Versatile operating ability – night, snow, rain, wet, dry, etc.
- Better control and handling of trees for reduced residual damage
- Two machines and operators reduces transportation and overhead costs

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Challenges with CTL

Systems need year-round work, but are designed to work in a variety of conditions

Sidehill – the machines can turn with the landscape and terrain features, but are not advised on excessive sidehill

Learning curve and training take time, experience, and skill

Cultural challenges with short log acceptance and outdated scaling rules (ie Scribner vs cubic)

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Take-away Messages, Management Implications

- Tethered CTL is changing the way timber is managed on steep slopes around the world; it has environmental, safety and economic benefits over other systems
- Horizontal and vertical benefits through careful implementation of cable-assistance
- CTL is a versatile operational tool very well suited for small and mid sized trees and restoration activities
- As we develop steep-slope CTL technology, where are our new opportunities for improvement?
  - Operator training/ability – key to developing future workforce?
  - Machine maintenance/design
  - Regulatory environment

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Thank you! Questions?

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