

REDUCING SOIL DISTURBANCE IN FOREST OPERATIONS

October 31, 2018

Mark Partington, RPF, MSc

FPInnovations



PROTECTING FOREST SOILS IN FOREST OPERATIONS

October 31, 2018

Mark Partington, RPF, MSc

FPInnovations



ENSURING CLIMATE RESILIENT FOREST OPERATIONS

October 31, 2018

Mark Partington, RPF, MSc

FPInnovations



EXTENDING THE OPERATING SEASON OF FOREST OPERATIONS

October 31, 2018

Mark Partington, RPF, MSc

FPInnovations

FOREST SOILS

INTEGRATING FOREST SOIL PROTECTION INTO OPERATIONAL PLANNING ENSURES :

- **Health (environmental)** of forest, landscape and wildlife
- **Health (economic)** of industry, contractors, employees
- Compliance to **forest certification** standards
- Compliance to provincial forest health and **soil protection standards**
- Optimization of the number of **operating days of a forest operation**
- Reduced machine maintenance, reduced fuel intensity
- Development of **forest operations that are adaptable** to changing weather and climate
- Plus many more…

Learning Objectives

Upon completion of this course, participants should be able to:

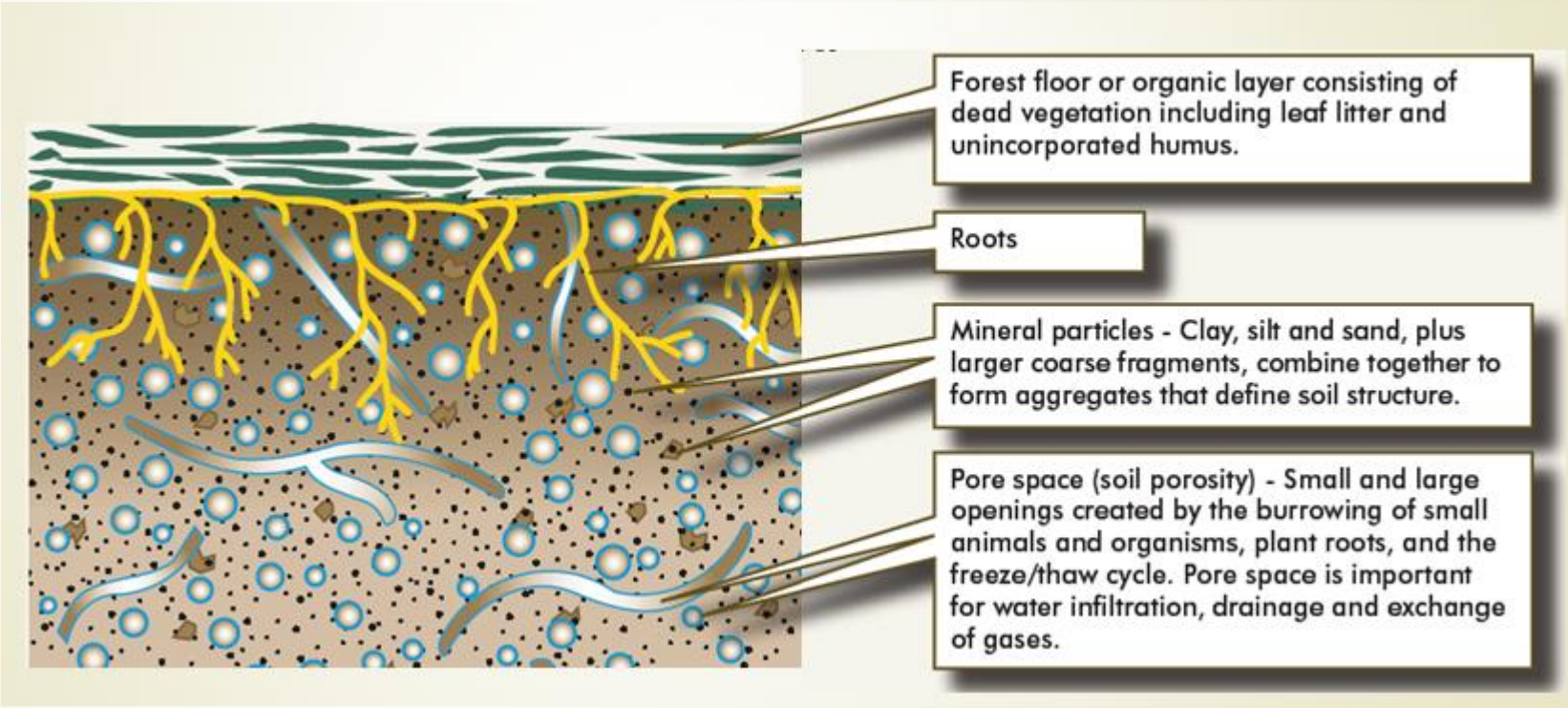
- Describe the function of soil organic matter, structure and pore space
- Participate effectively in planning and team action processes
- Describe the three main types of soil damage
- Recognize the legislation and guidelines designed to protect soils
- Recognize operational BMPs to reduce soil damage
- Describe soil reclamation and site preparation practices

WOODLAND SOILS

INTRODUCTION

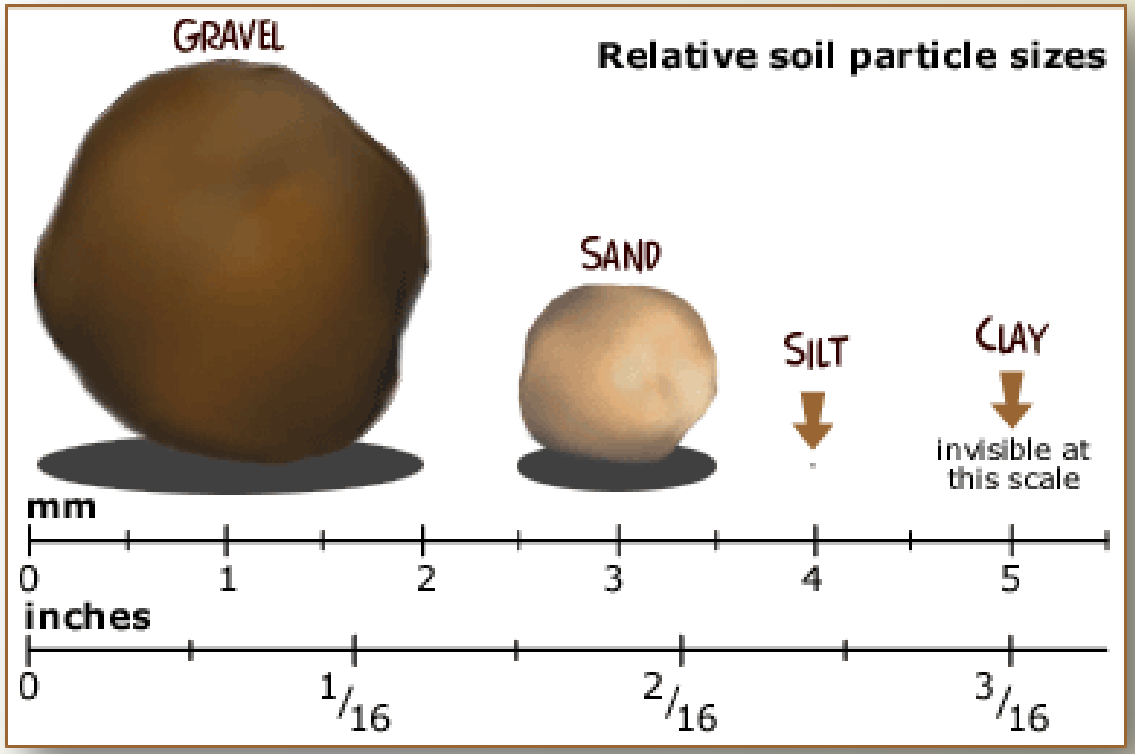
This course covers

1. Soil Factors:
   - Pore space



This course covers

1. Soil Factors:
   - Pore space
   - Texture

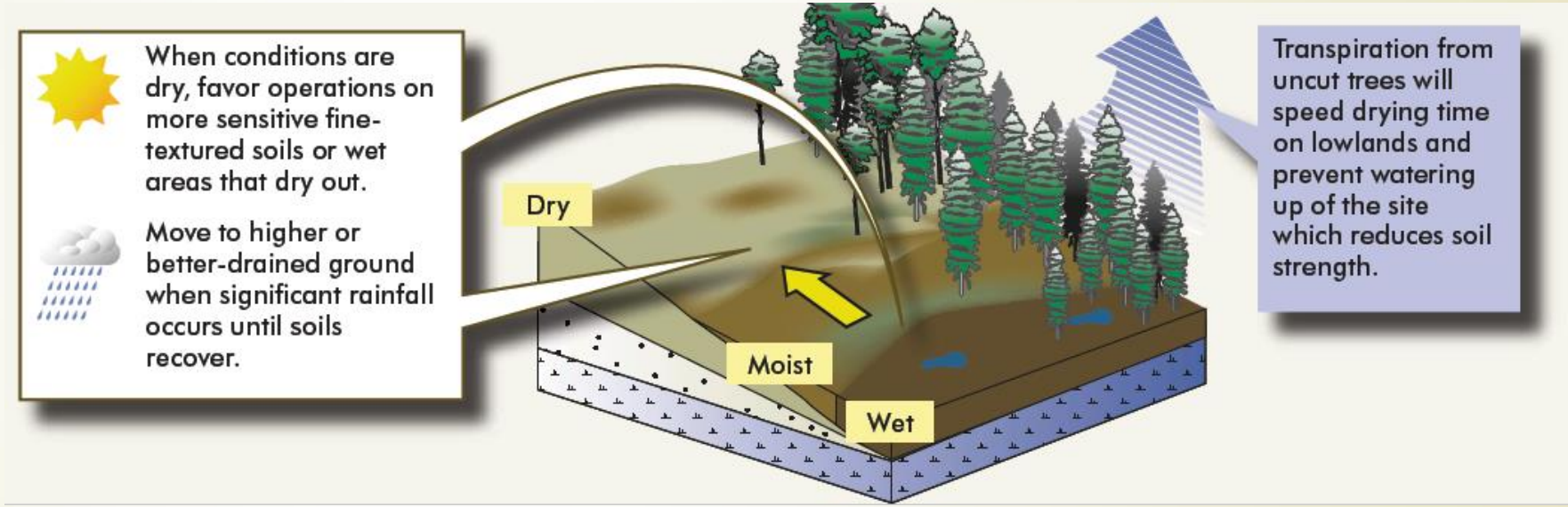


WOODLAND SOILS

INTRODUCTION

This course covers

1. Soil Factors:
   - Pore space
   - Texture
   - Strength

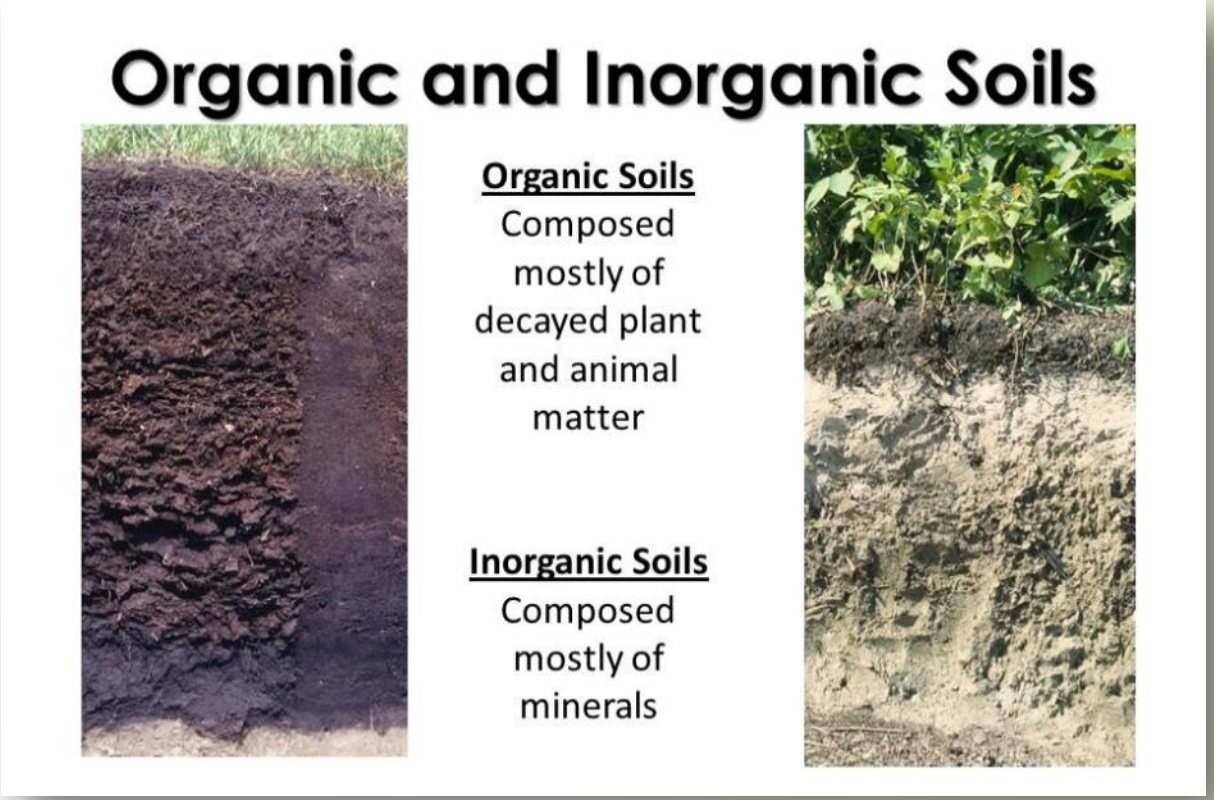


WOODLAND SOILS

INTRODUCTION

This course covers

1. Soil Factors:
   - Pore space
   - Texture
   - Strength
   - Organic matter

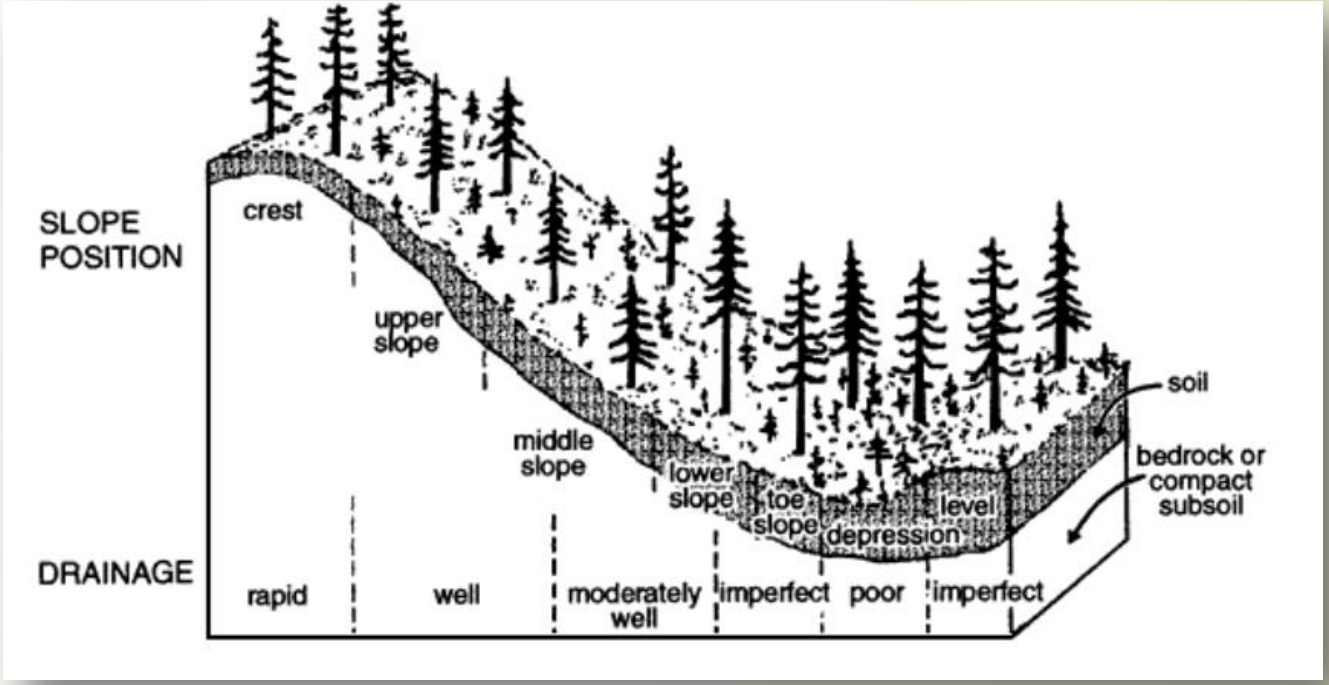


WOODLAND SOILS

INTRODUCTION

This course covers

1. Soil Factors:
   - Pore space
   - Texture
   - Strength
   - Organic matter
   - Water content

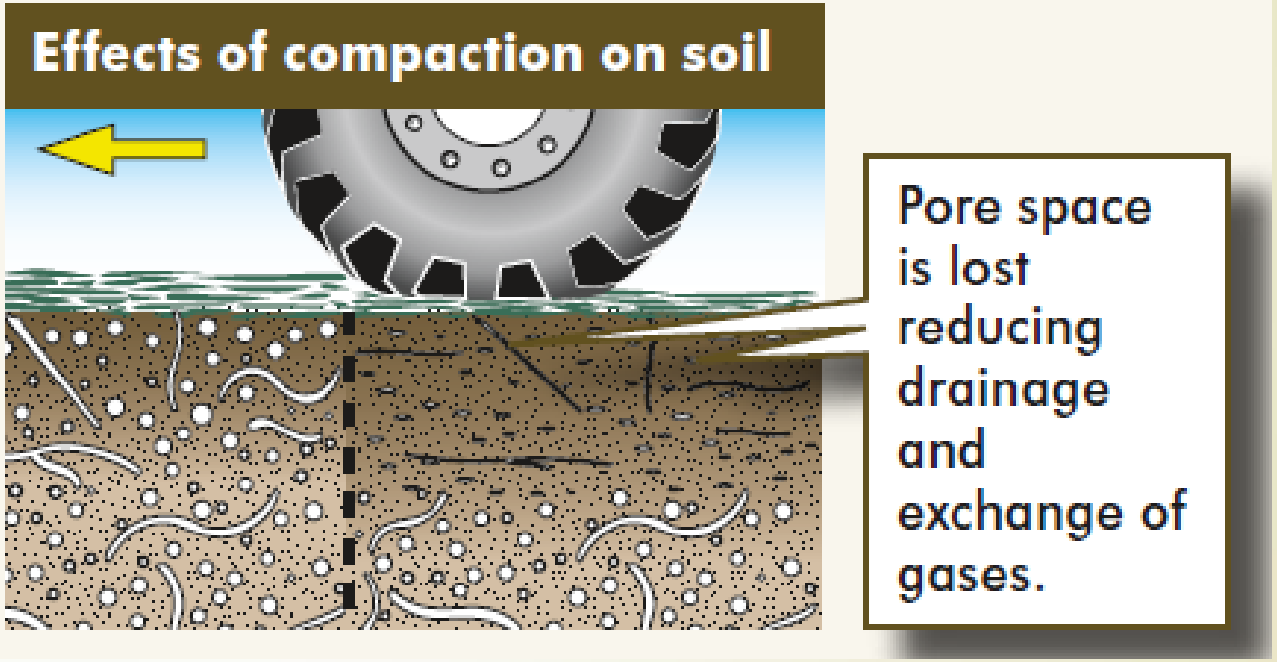


This course covers

2. Planning and team action to avoid damage

This course covers

3. How soil can be damaged through:
   - Compaction
   - Rutting
   - Displacement

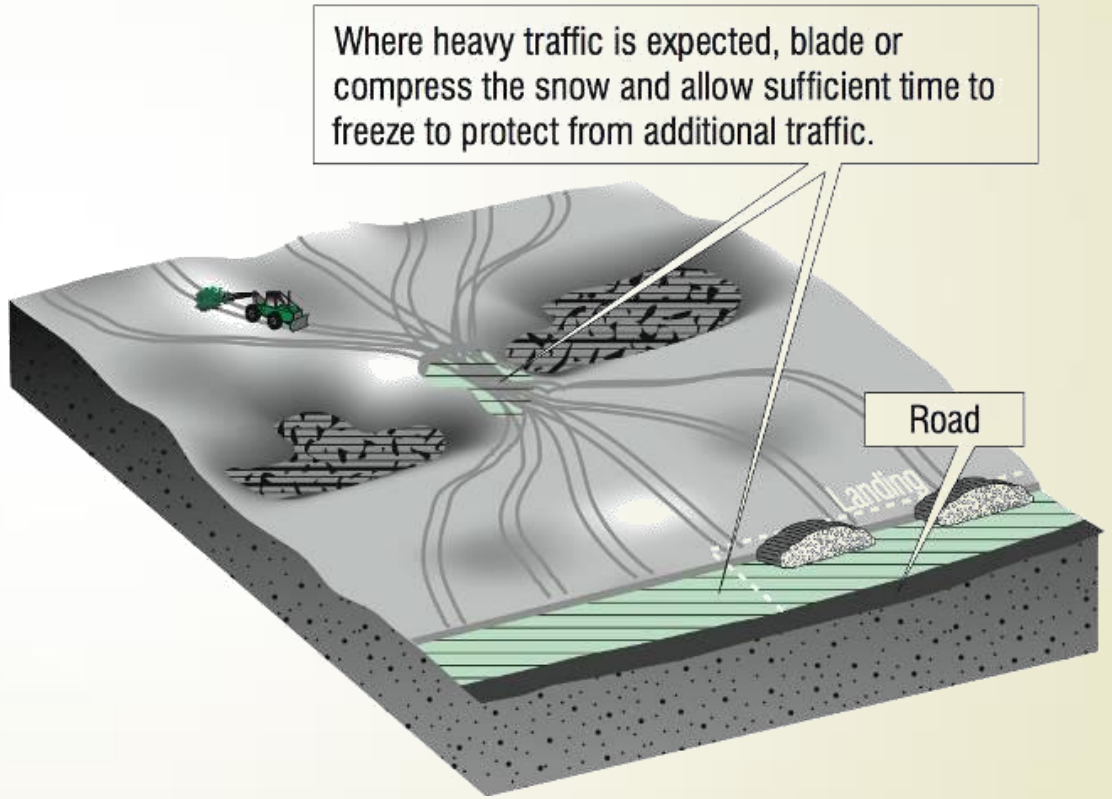


This course covers

4. Legislation & Guidelines

This course covers

5. Operational BMPs to reduce soil damage

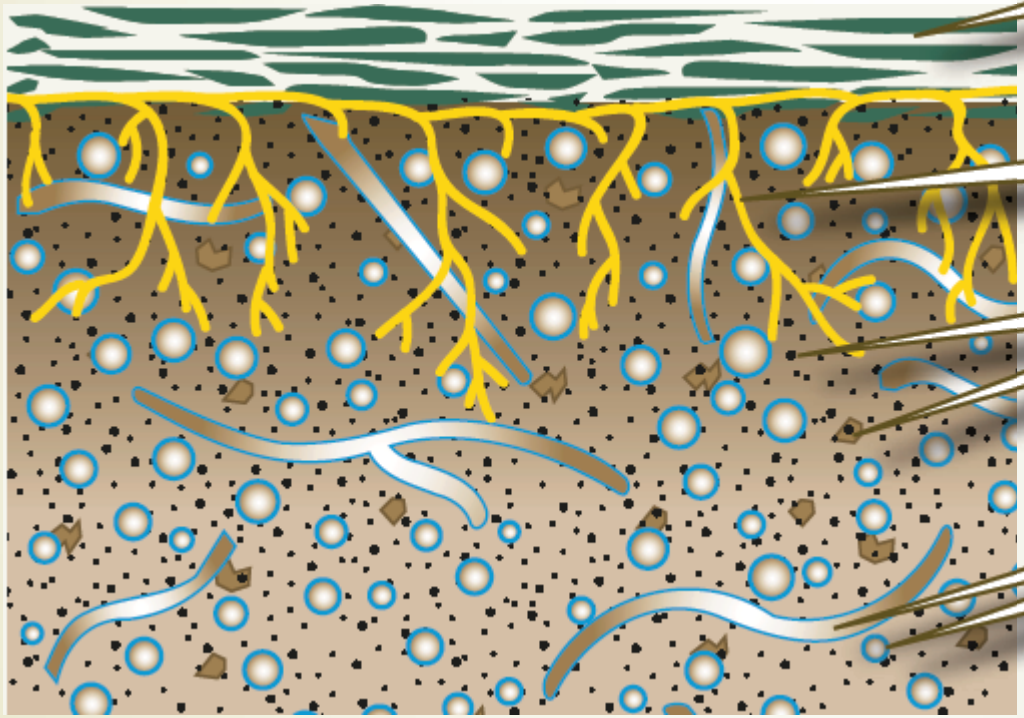


This course covers

5. Operational BMPs to reduce soil damage
6. Road reclamation and site preparation practices

WOODLAND SOILS

Soil Pore Space



Forest floor or organic layer consisting of dead vegetation including leaf litter and unincorporated humus.

Roots

Mineral particles - Clay, silt and sand, plus larger coarse fragments, combine together to form aggregates that define soil structure.

Pore space (soil porosity) - Small and large openings created by the burrowing of small animals and organisms, plant roots, and the freeze/thaw cycle. Pore space is important for water infiltration, drainage and exchange of gases.

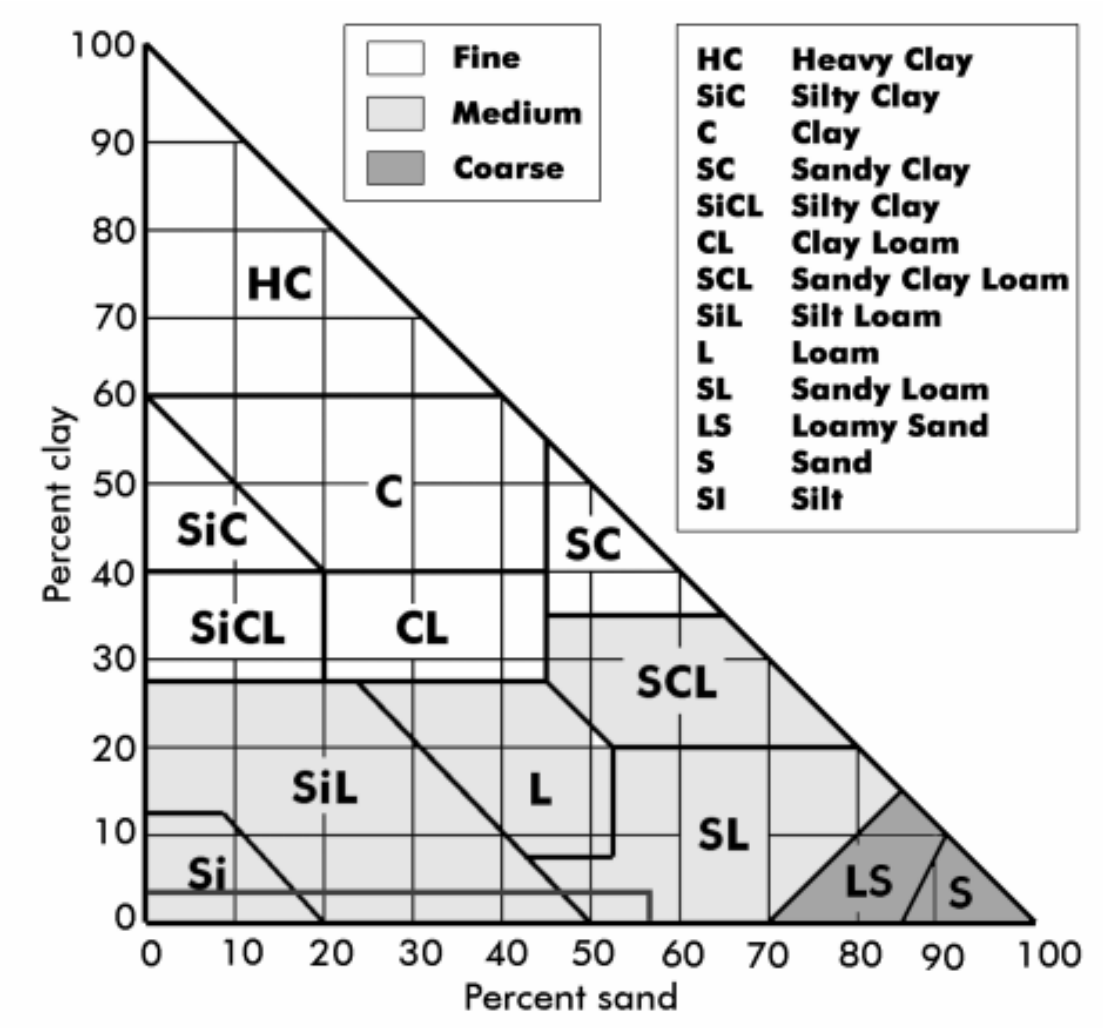
Soil Biodiversity & Ecological Function

- Habitat for plants and animals
- Nutrients for plants
- Breakdown of harmful compounds

- Movement of water & gases

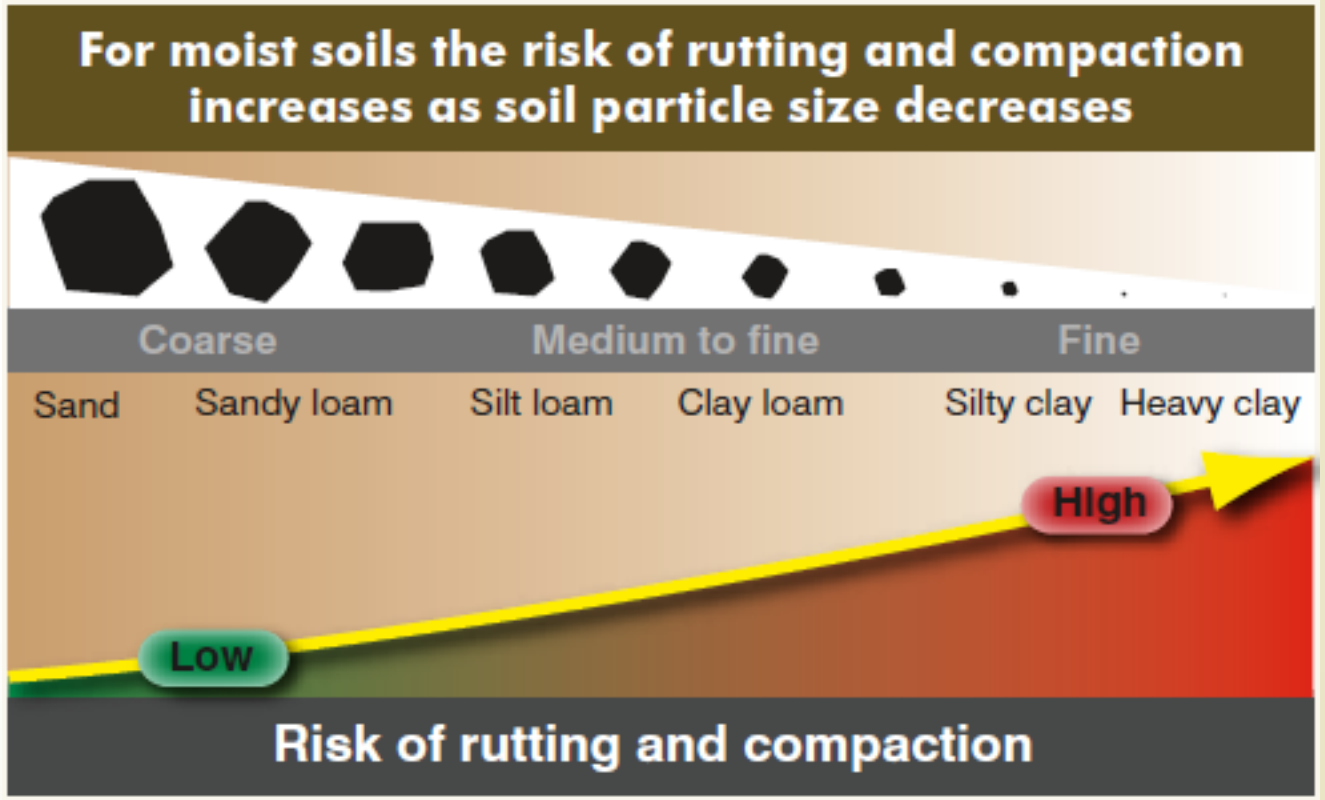
Soil Texture

- Refers to the size of the mineral soil components that are less than 2.0 mm in diameter
- Is determined by the percentage of sand, silt and clay particles

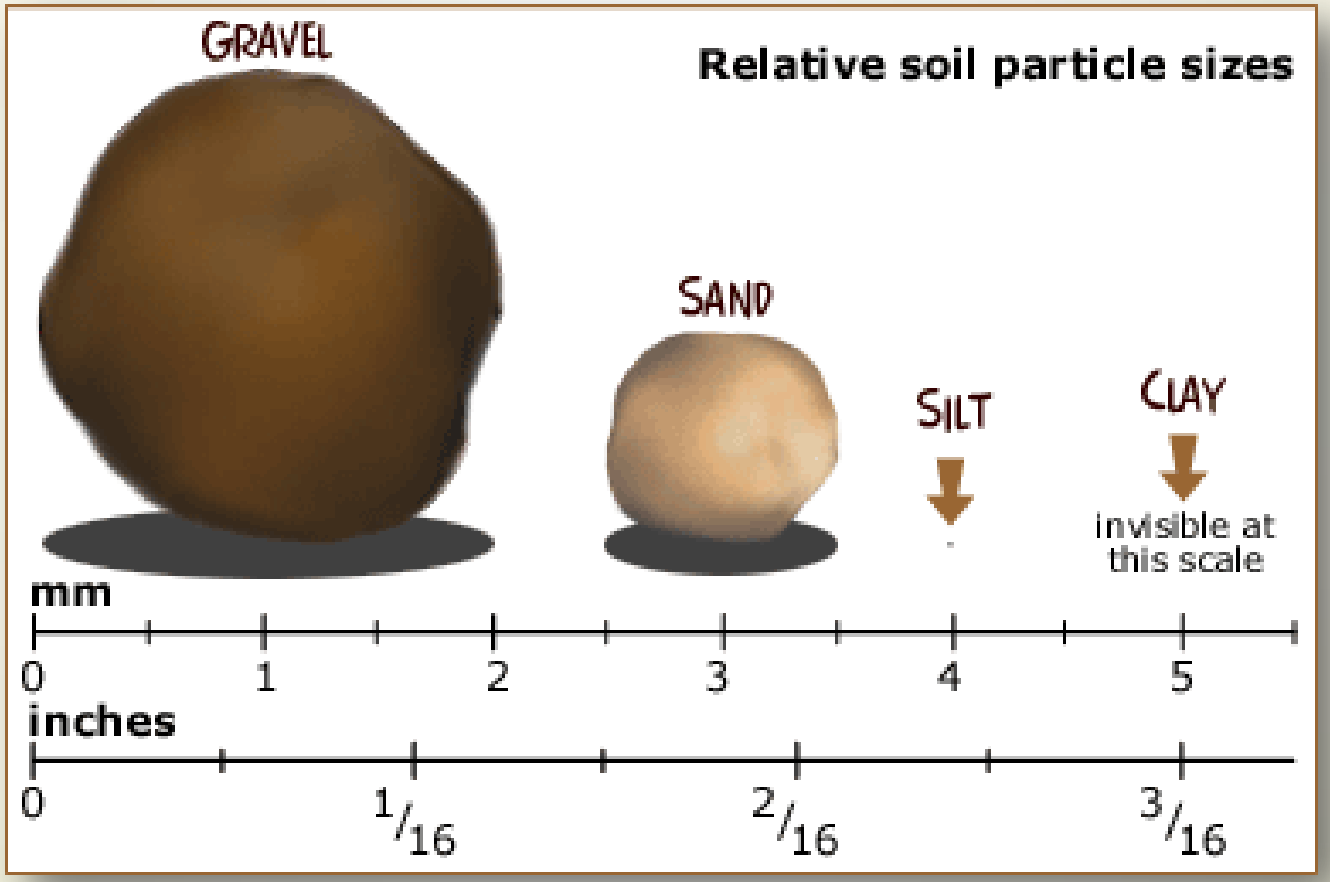


Soil Texture

- Texture is an important factor when determining soil disturbance risk

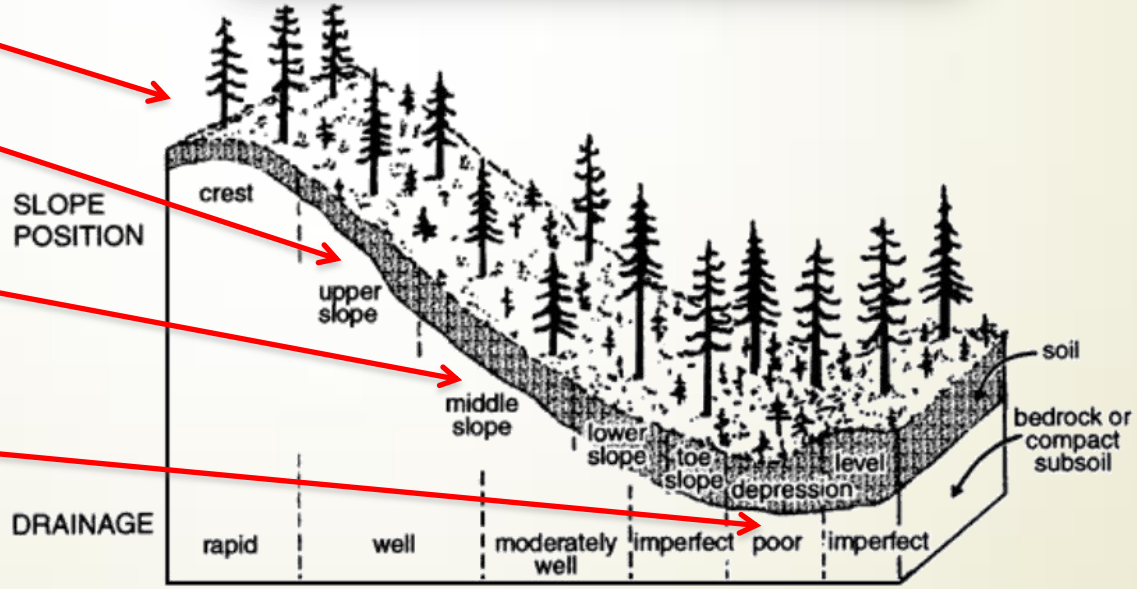


Soil Texture



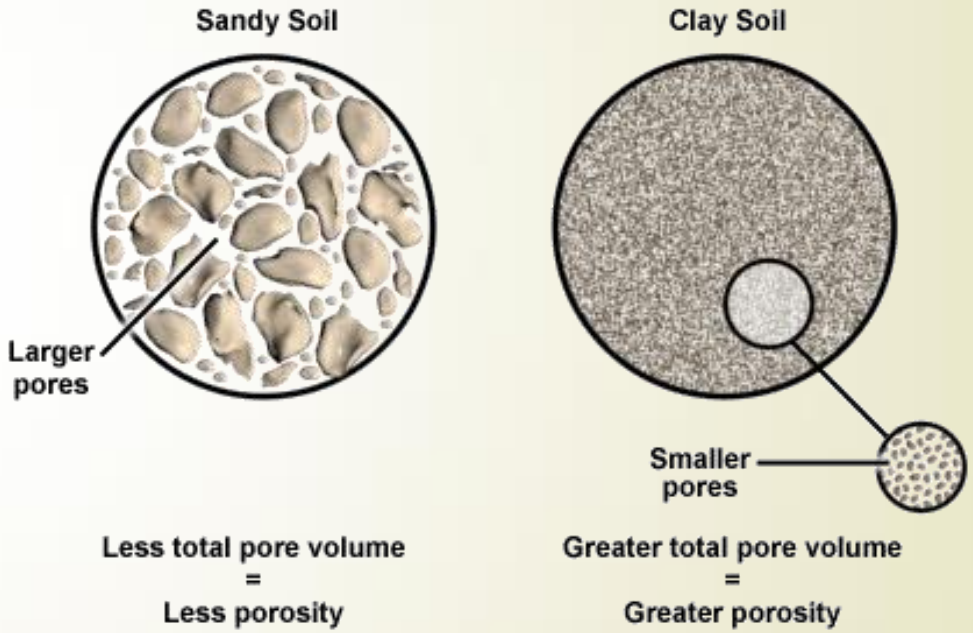
Soil Drainage

- Very rapid
- Rapid
- Well Drained
- Moderately Well Drained
- Poor
- Very Poor

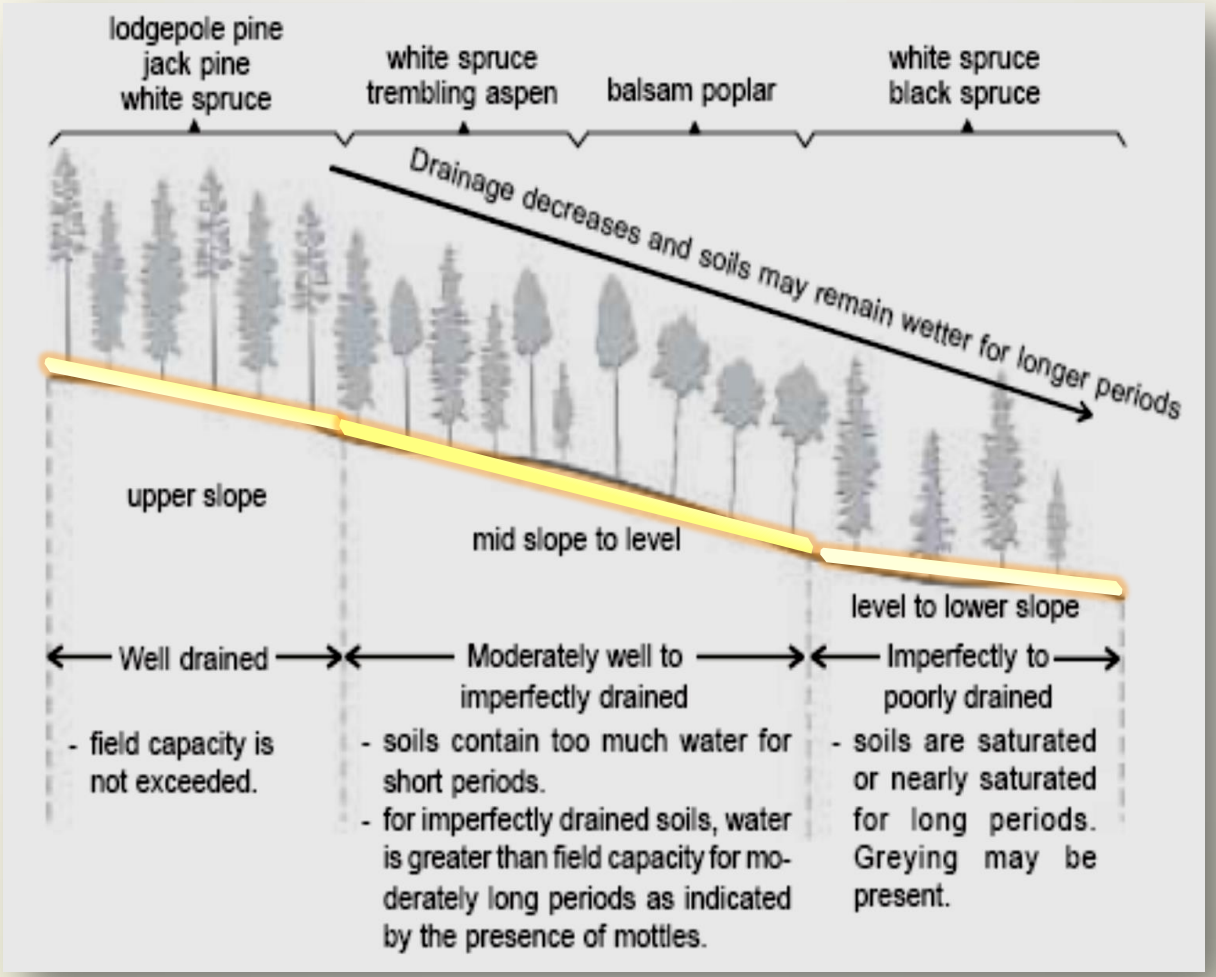


Soil Drainage

Type of Soil Particle	Water-Holding Capacity
Sand	➢ Low
Silt	➢ Medium
Clay	➢ High
Organic	➢ High



Soil Drainage



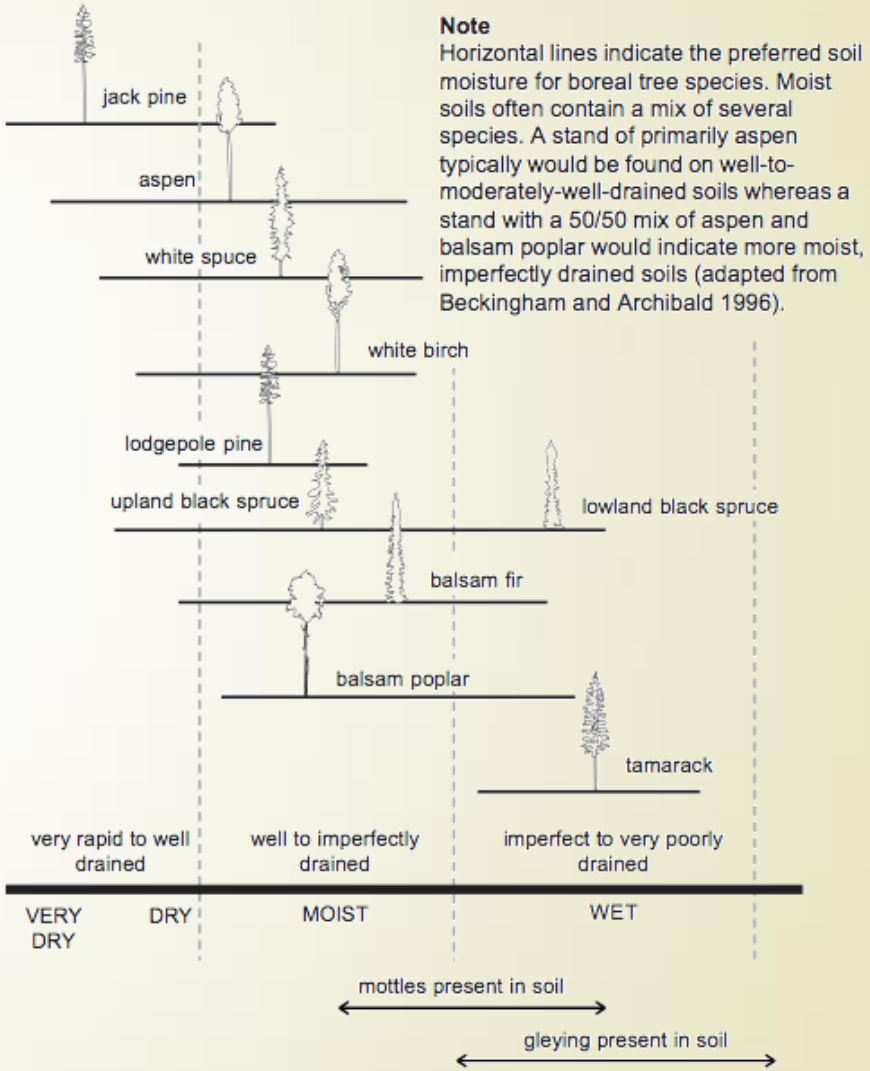
Recognize vegetation as an indicator of soil moisture conditions

Red Osier Dogwood - Rich, Moist Soil

Willow or Black Poplar - Soft, Wet Soil

Labrador Tea - High Water Table, Wet Soil

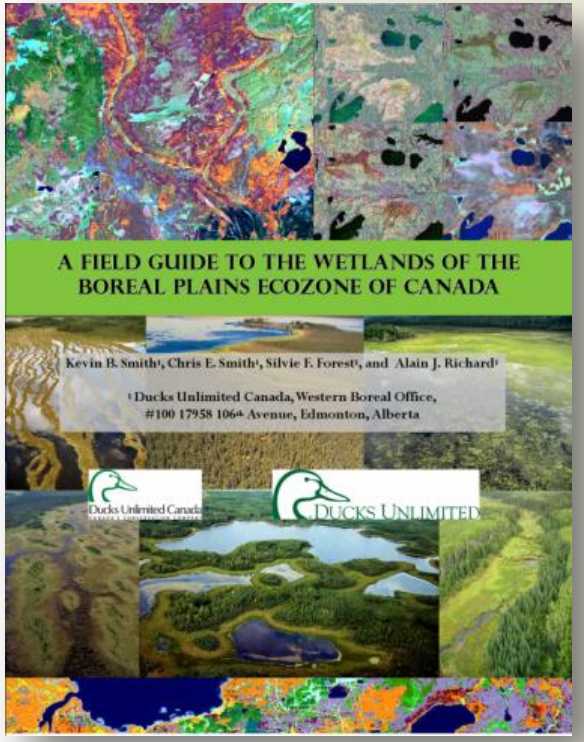
Tree Species Moisture Preferences

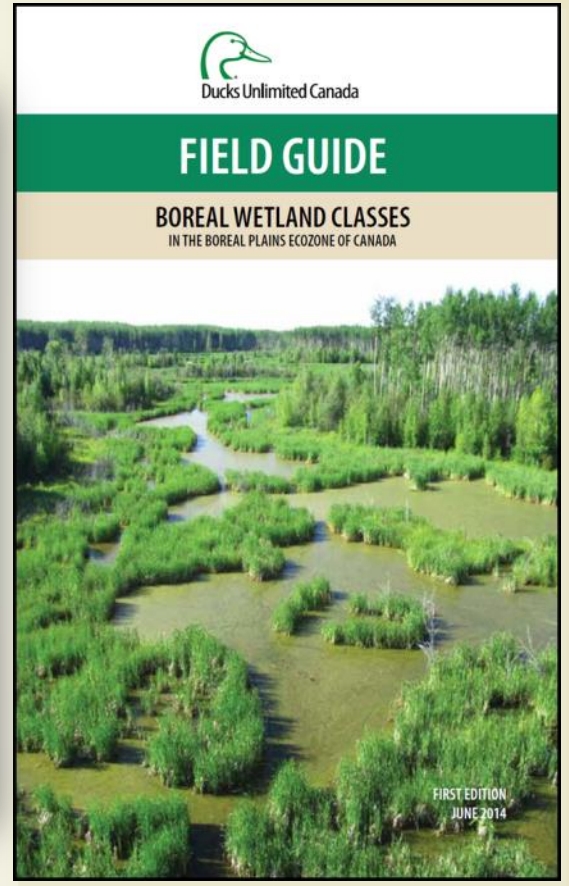


Note
Horizontal lines indicate the preferred soil moisture for boreal tree species. Moist soils often contain a mix of several species. A stand of primarily aspen typically would be found on well-to-moderately-well-drained soils whereas a stand with a 50/50 mix of aspen and balsam poplar would indicate more moist, imperfectly drained soils (adapted from Beckingham and Archibald 1996).

Know your wetlands

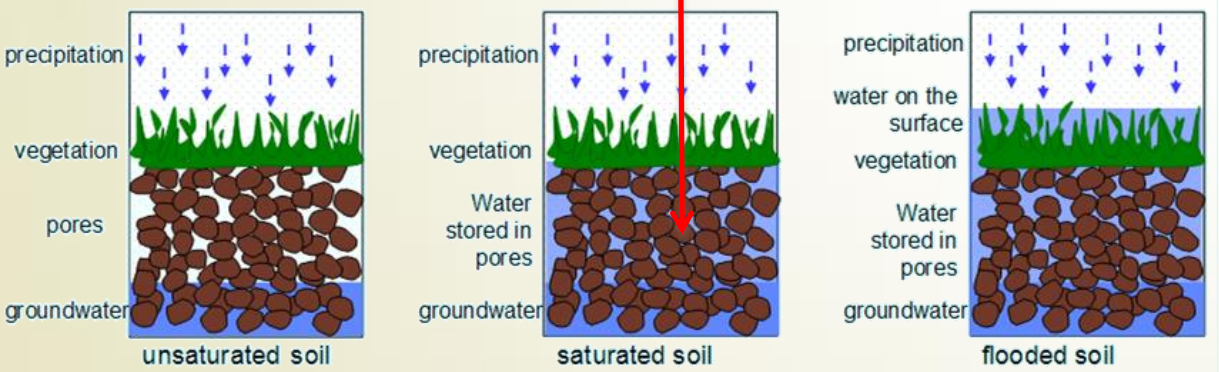
- Swamps in particular may have a closed canopy with merchantable trees
- Understanding of wetlands (soil, vegetation, hydrology) can provide valuable knowledge in planning your forest operation



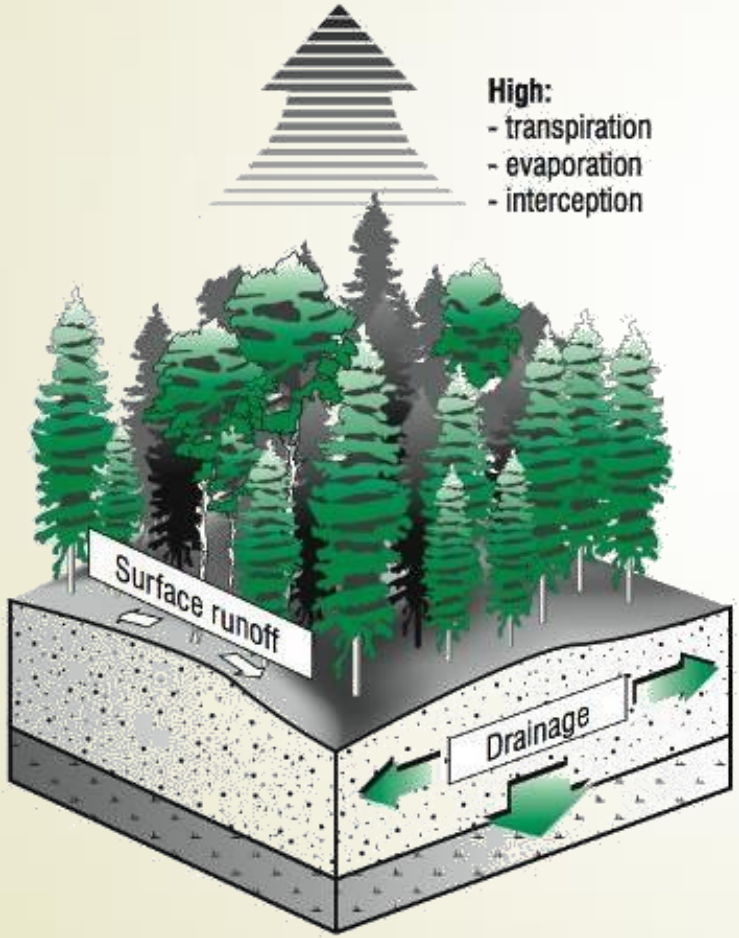


Saturated Soil

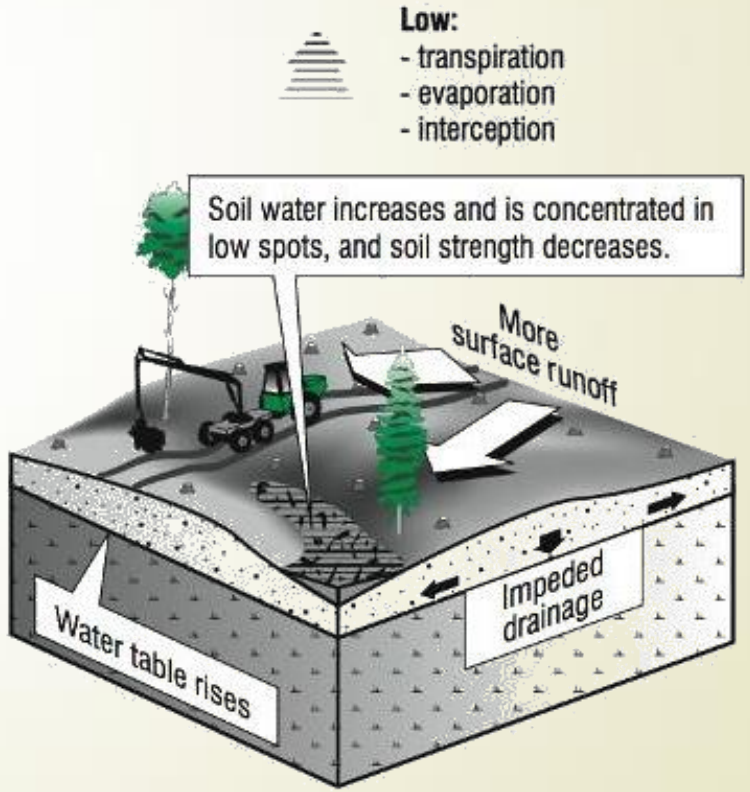
- All pore space is filled with water
- Mottles indicate a soil that is regularly saturated



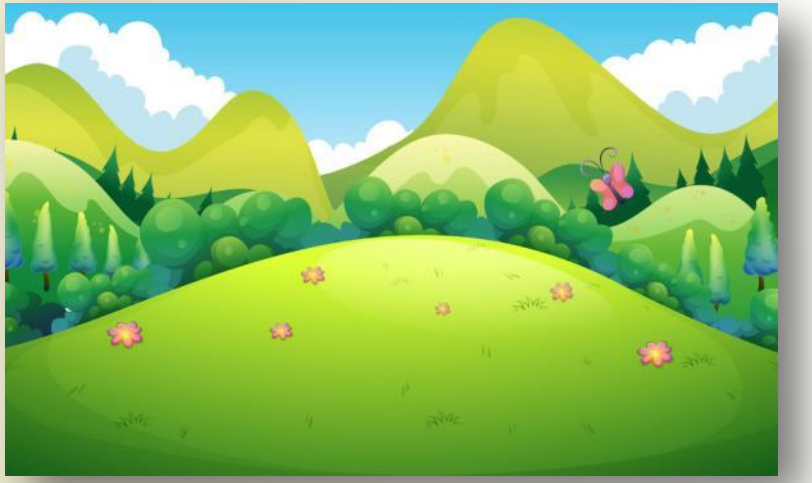
Soil Moisture before Harvesting



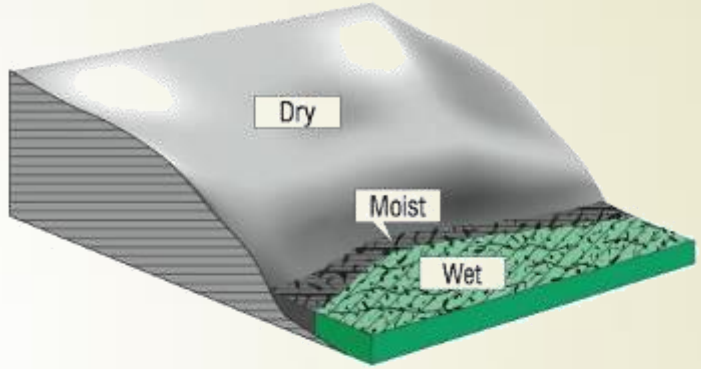
Soil Moisture after Harvesting



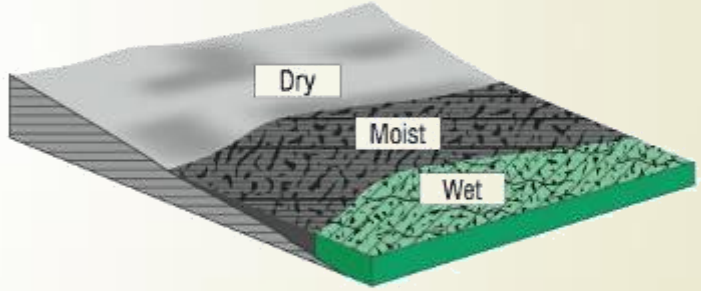
Soil Strength – Slope Position



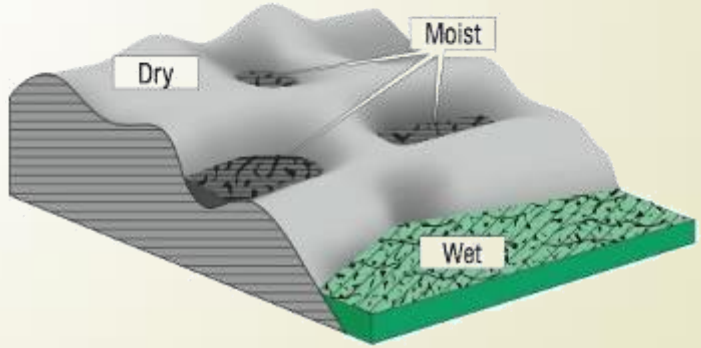
Moderate to steep slope
Moist and wet soils are often confined to narrow bands at the foot of steep hills.



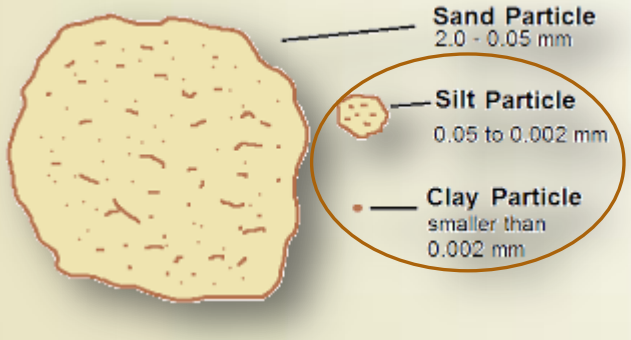
Gentle slope
On gentle slopes, moist soils can occupy larger areas and the change in soil strength can be more gradual.



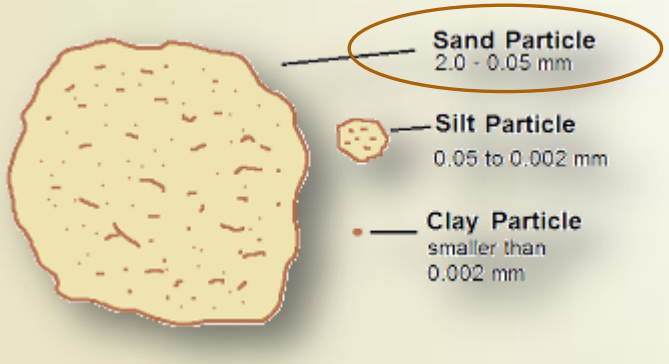
Rolling slopes
On rolling or complex slopes, moist and wet soils can occur in depressions in the slope.



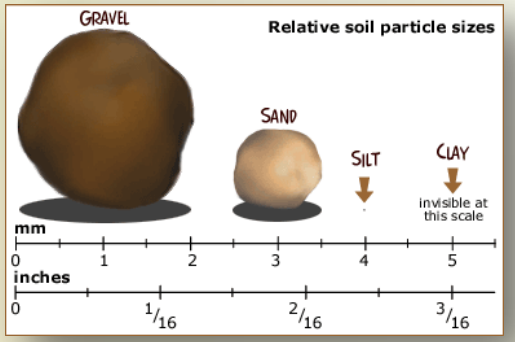
Soil Strength – Fine Texture



Soil Strength – Coarse Texture



Soil Strength – Cobbles



Chapter Summary

- Soils consist of particles and spaces between them
- Texture affects how fast the soil drains after a rain
- Tree and shrub species can be used to spot areas of soft soil
- Soil strength is affected by soil moisture

WOODLAND SOILS

Chapter 1

Soil Factors

Chapter 2

Planning & Teamwork

Chapter 3

How Soils can be Damaged

Chapter 4

Legislation & Guidelines

Chapter 5

Operational BMPs to Reduce Soil Damage

Chapter 6

Reclaiming Disturbed Soils

Working together to protect soils

- Operators, contractors and supervisors work together to protect soils

Consider soils at each stage

- Before harvest
- During road building and harvesting
- After the logs are hauled

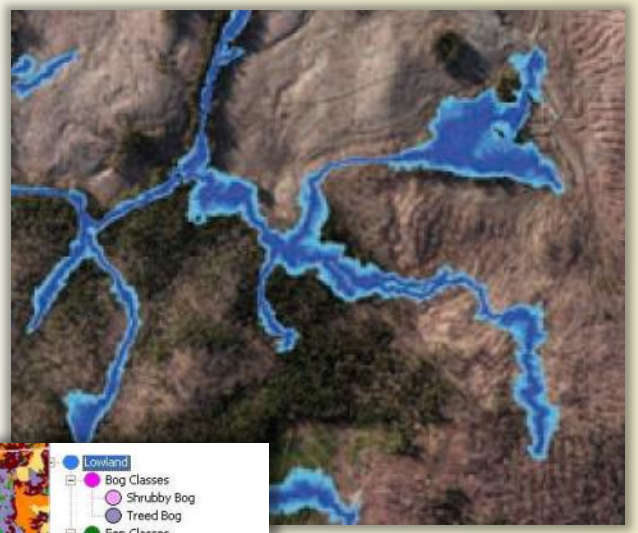
Pre-harvest planning & layout

Consider soil *"before"* harvest

- Decide if it must be frozen or not
- Prepare accurate block maps
- Layout avoids springs, riparian zones etc.
- Road location

Consider soil *"before"* harvest

- Integrate GIS based planning tools, such as a wetland inventory or hydrology mapping (wet areas mapping)



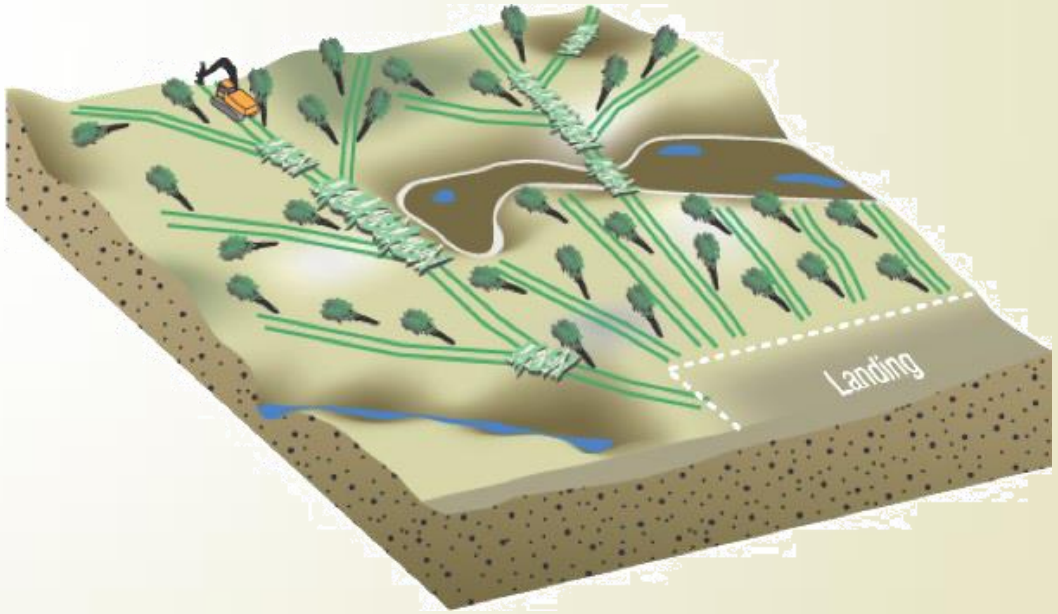
Consider soil *"during"* road building

- Be aware of changing conditions
- Supply geotextiles & structures in advance
- Stockpile road strippings
- Ensure stream crossing function
- Prevent & stop erosion

Consider soil *"during"* falling & skidding

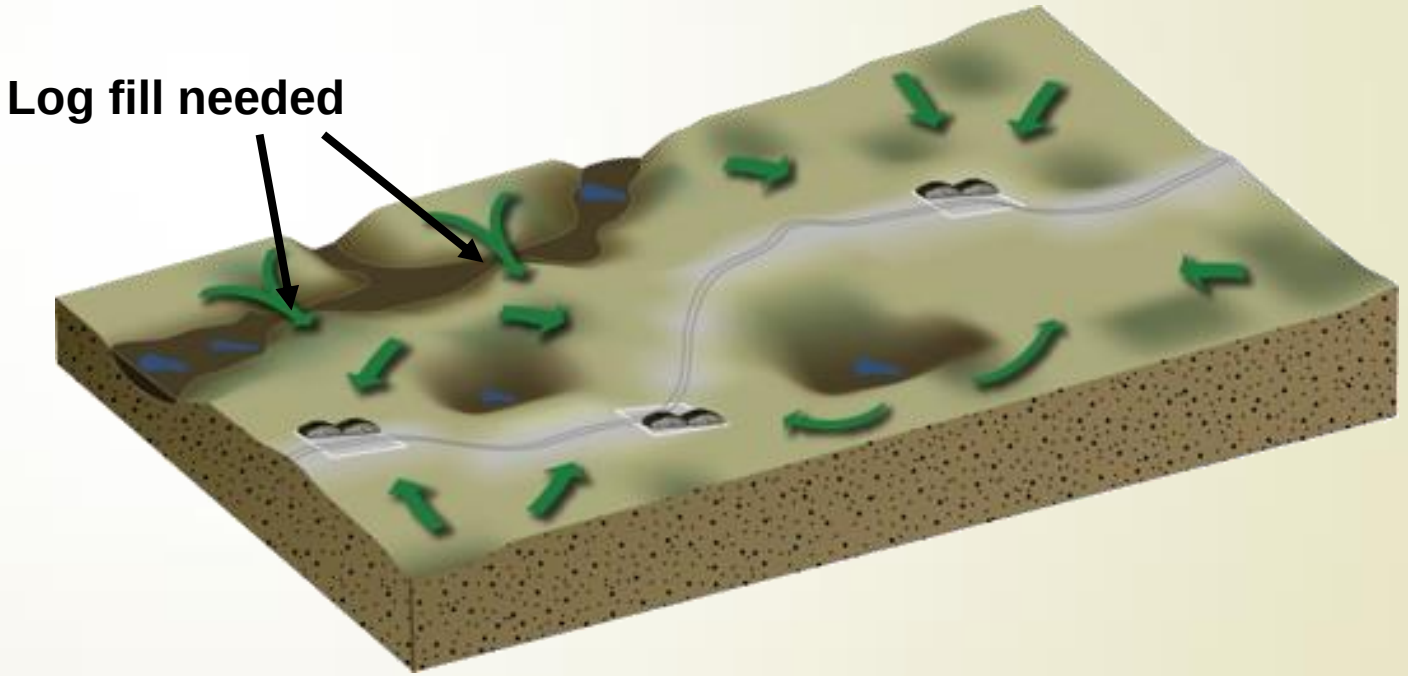
If in doubt about operating conditions:

- Move to better ground until conditions improve.
- Change your operating technique to avoid damage.
- Check with your supervisor about options.



Consider soil *"during"* falling & skidding

- Coordinate equipment to prevent travel over the same ground
- Provide equipment suited to the site



Consider soil *"during"* processing & falling

- Keep to the road as much as possible

Carefully prepare soil for planting

- Work on frost

Carefully prepare soil for planting

- Use low ground pressure in summer

Note: *Site preparation does not fix soil damage made during falling and skidding*

Chapter Summary

Operators, contractors and supervisors work together to protect soils:

- Before harvest
  - through assessing the site & preparing the required maps
- During road building & harvesting
  - by using the right equipment and proven techniques
- After the logs are hauled
  - Through reclamation & reforestation

WOODLAND SOILS

Chapter 1
Soil Factors

Chapter 2
Planning & Teamwork

Chapter 3
How Soils can be Damaged

Chapter 4
Legislation & Guidelines

Chapter 5
Operational BMPs to Reduce Soil Damage

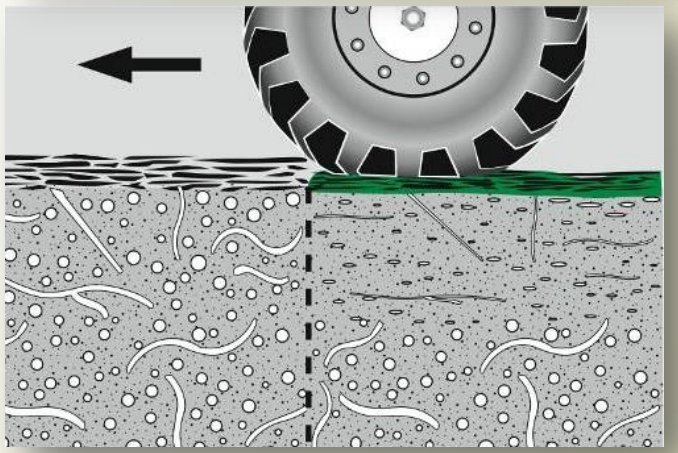
Chapter 6
Reclaiming Disturbed Soils

How soil can be damaged

- Compaction
- Rutting
- Displacement

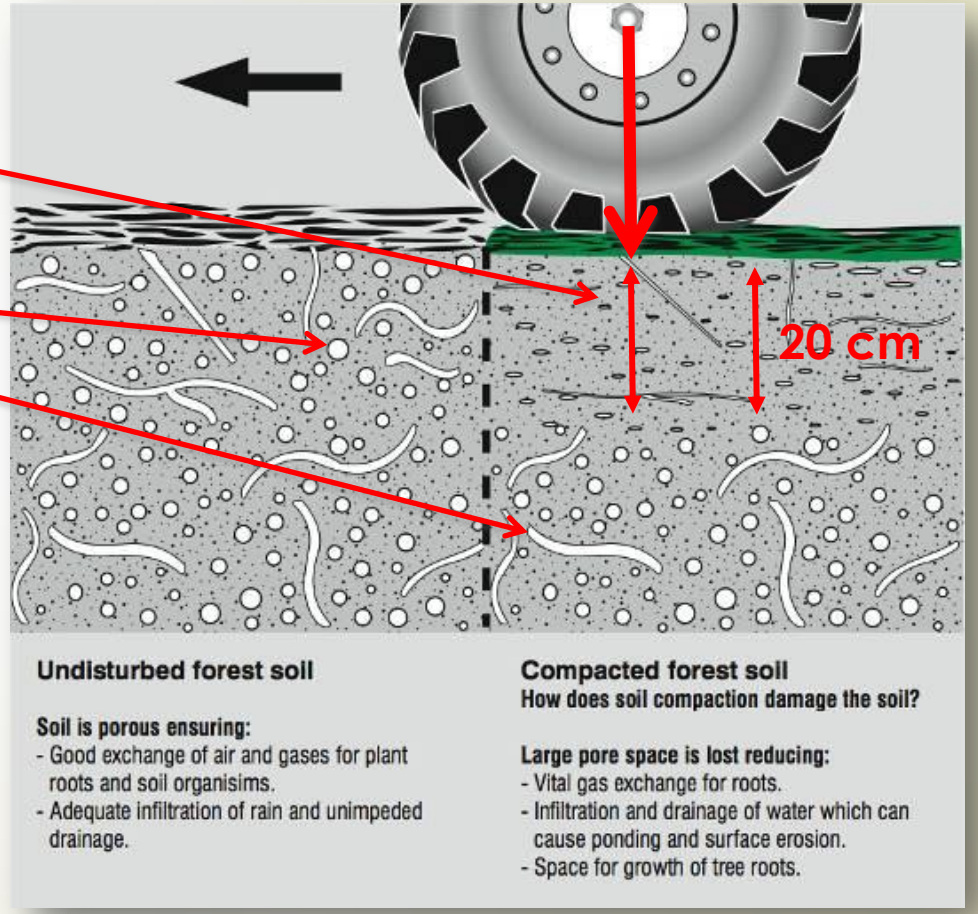
How soil can be damaged

- Soils supply plants with nutrients, gases, moisture, & support
- Helps maintain a healthy ecosystem
- Soil formation takes 1000's of years
- Damaged soil may take years to repair itself
- Erosion can lead to sediment in streams
- Damage results from compaction, rutting, disturbance, erosion



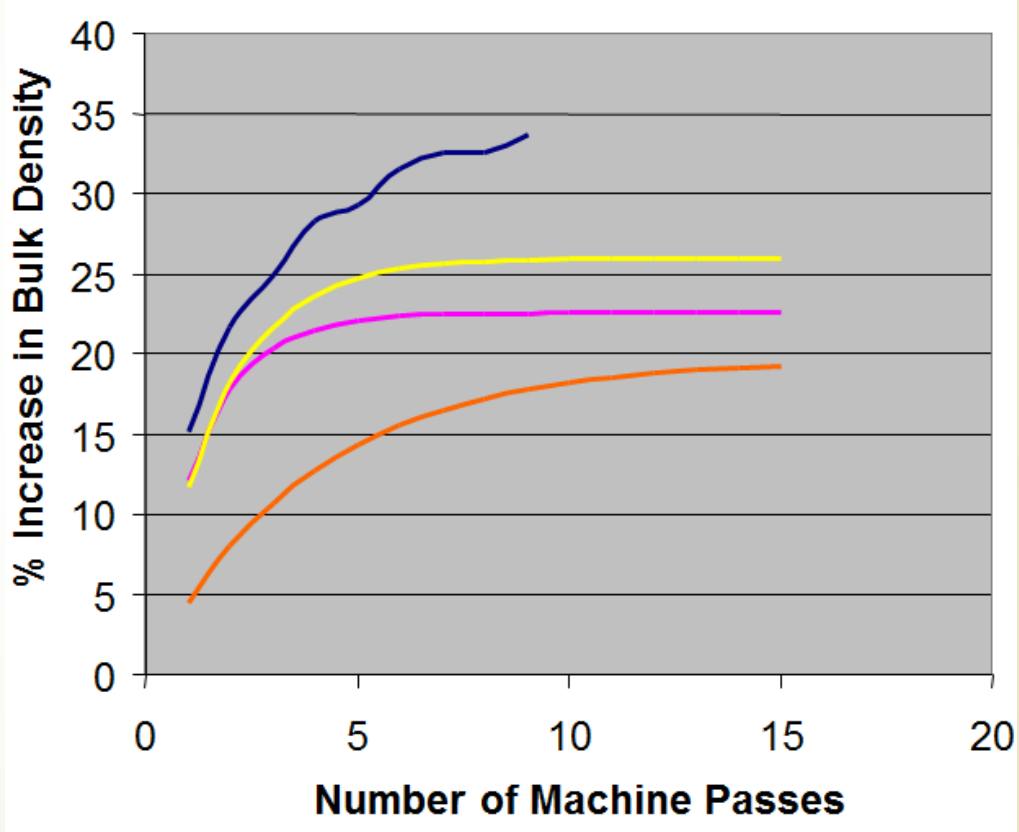
Soil compaction

- Compaction = compression of soil
- Non-compacted soils
  - Large pores
  - Drains freely & absorbs aerated water
- How does compaction occur?
  - Compression reduces pore space



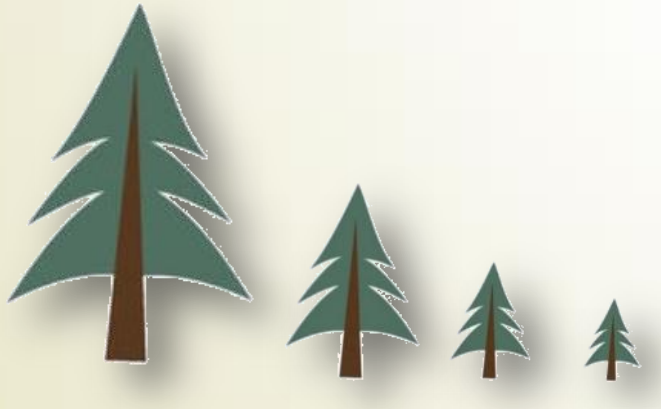
Soil compaction

- Compaction = compression of soil
- Non-compacted soils
  - Large pores
  - Drains freely & absorbs aerated water
- How does compaction occur?
  - Compression reduces pore space
  - In many soils, compaction occurs after relatively few passes of the machine
  - Subsequent passes add to the damage



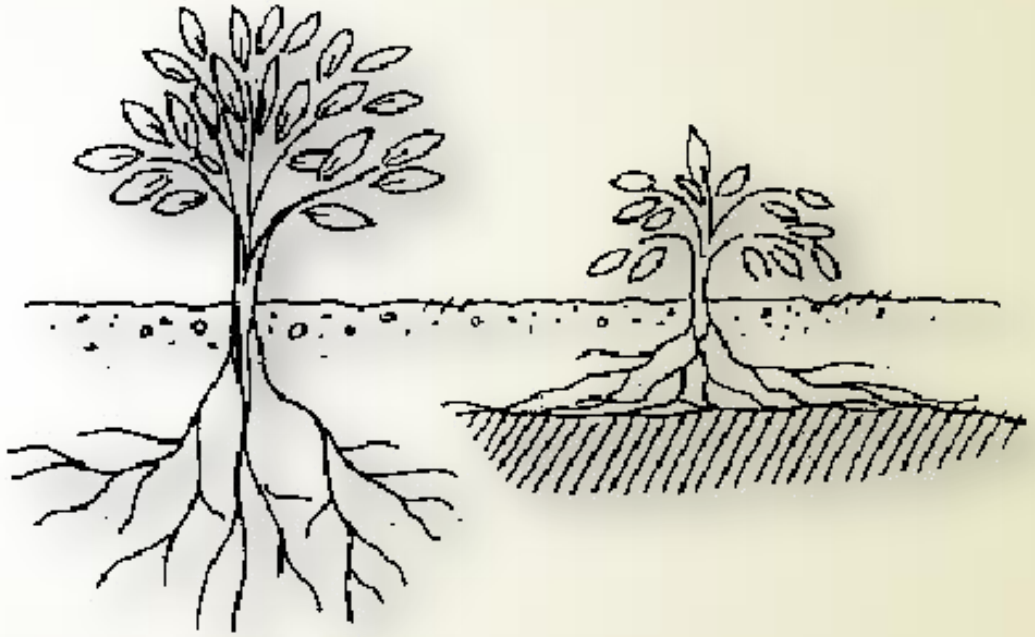
Soil compaction affects tree growth

- Less oxygen to roots
- Reduced drainage
- Increased surface runoff
- Root growth is hampered



Soil compaction can…

- Reduce growth rate by up to 30%

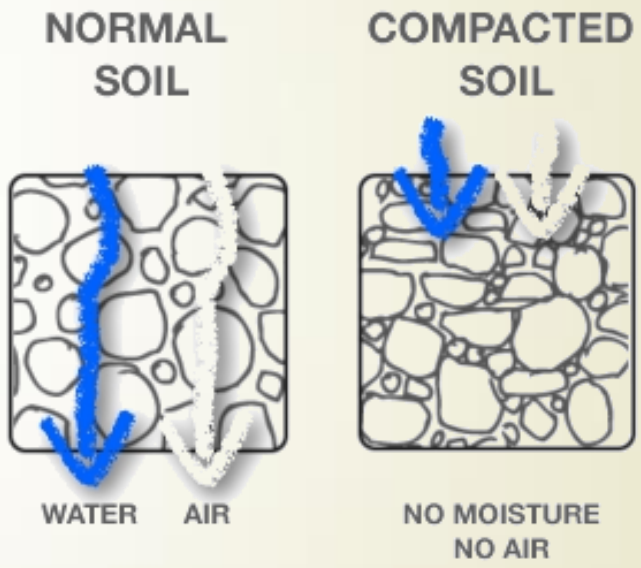


Soil compaction can…

- Reduce growth rate by up to 30%
- Affect a small spot, a block or a watershed

Soil compaction can…

- Reduce growth rate by up to 30%
- Affect a small spot, a block or a watershed
- Reduce air filled pore space

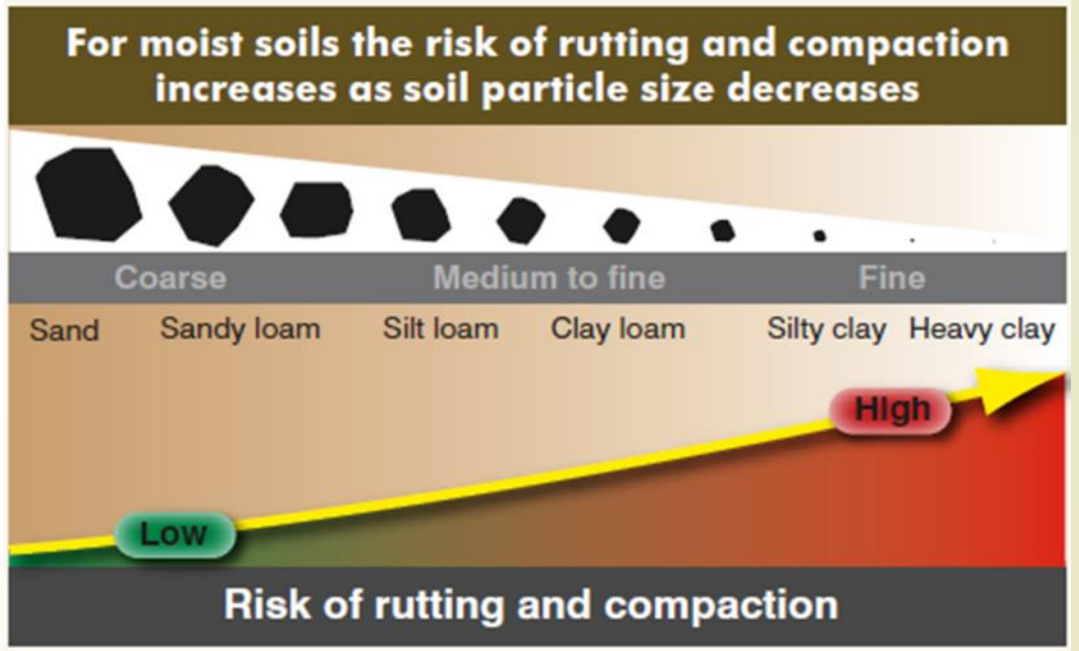


Soil compaction can…

- Reduce growth rate by up to 30%
- Affect a small spot, a block or a watershed
- Reduce air filled pore space
- Reduce aspen suckering

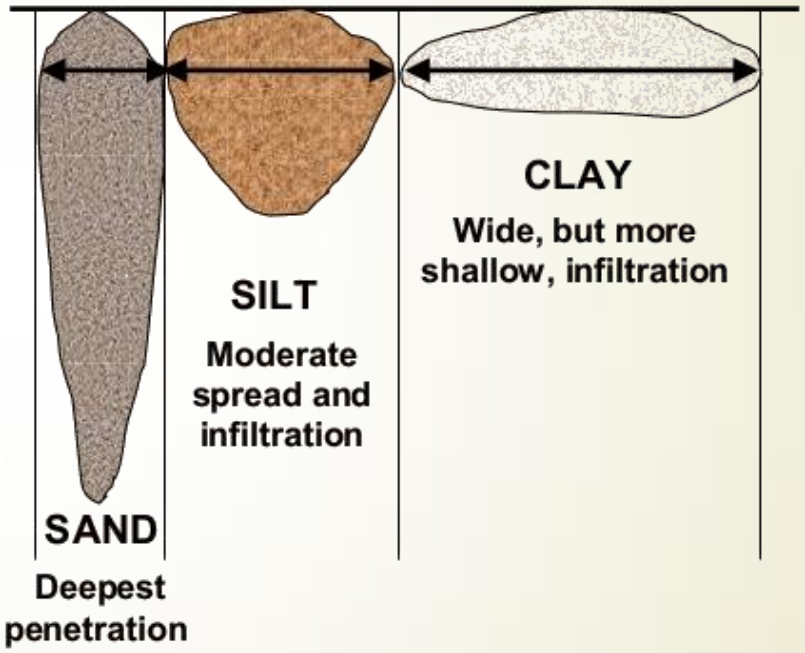
Which soils are most easily compacted?

- Medium-to-fine textured soils with a moisture content at or near field capacity
- Soils with moderate to imperfect drainage



Which soils are most easily compacted?

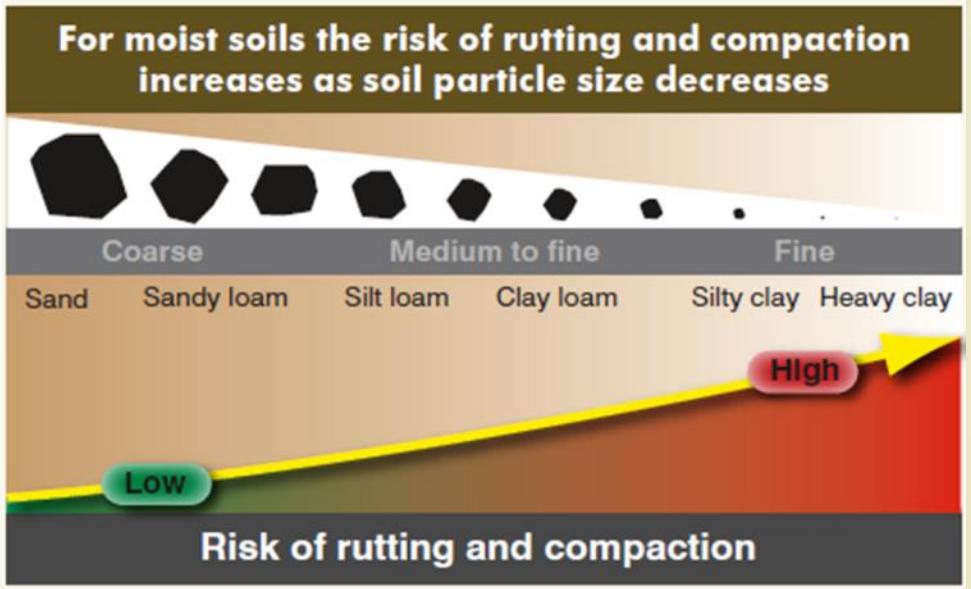
- Medium-to-fine textured soils with a moisture content at or near field capacity
- Soils with moderate to imperfect drainage



Water spreads differently in different soil textures

Which soils resist compaction?

- Dry soils
- Soils that have a lot of coarse fragments in the upper soil layers



Rutting damages roots & soil structure

- What is a Rut?
  - Trench or furrow that damages soil & roots through soil displacement and compaction

What is a Rut?

- Trenches or furrows that damage soil & roots

Definition

- **4**m long & **20**cm deep (in humus >= 30cm deep)
- **4**m long & **10**cm deep (in humus < 30cm deep)

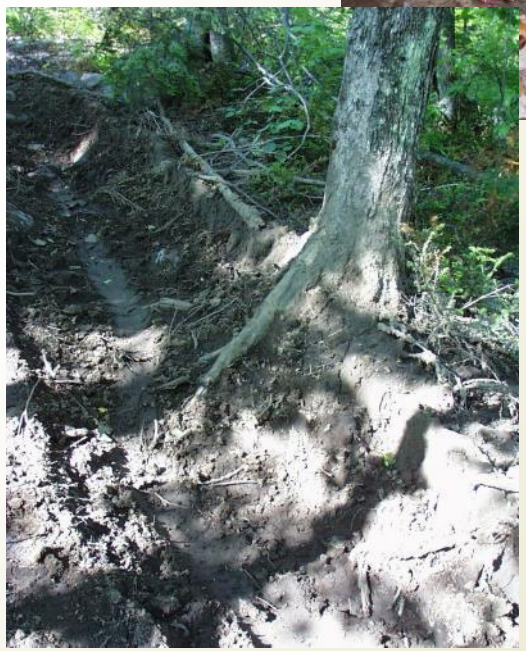
Rutting damages roots & soil structure

- What is a Rut?
  - Trench or furrow that damages soil & roots through soil displacement and compaction
- How is a rut defined?
  - Typically by depth and length
  - Varies by regulatory authority

- BC
  - >5 cm or >15 cm deep and 2 m long
- SK
  - >15 cm deep and 5 long
- ON
  - >30 cm deep and 4 m long
- NS
  - Government focus on compaction
  - Industry sets rutting

Rutting “cause & effect”

- Can occur after just one pass
- Roots near surface can’t penetrate
- Shallow ruts can cause damage
- Root damage makes trees more susceptible to disease & blow-down
- Impacts plantable sites or productive areas



Impact of rutting on soil drainage

- Lateral water flow is blocked
- Increase in water = lower soil temp.
- Surface flow can cause soil erosion & sedimentation

Weak soils are prone to rutting

- Well-decomposed organic soil
- Wet soils
- Non-frozen
- Fine textured

Loss or displacement of organic matter

- Less microbes
- Prone to extreme drying or flooding
- Prone to temperature extremes
- Erosion potential

Loss or displacement of organic matter

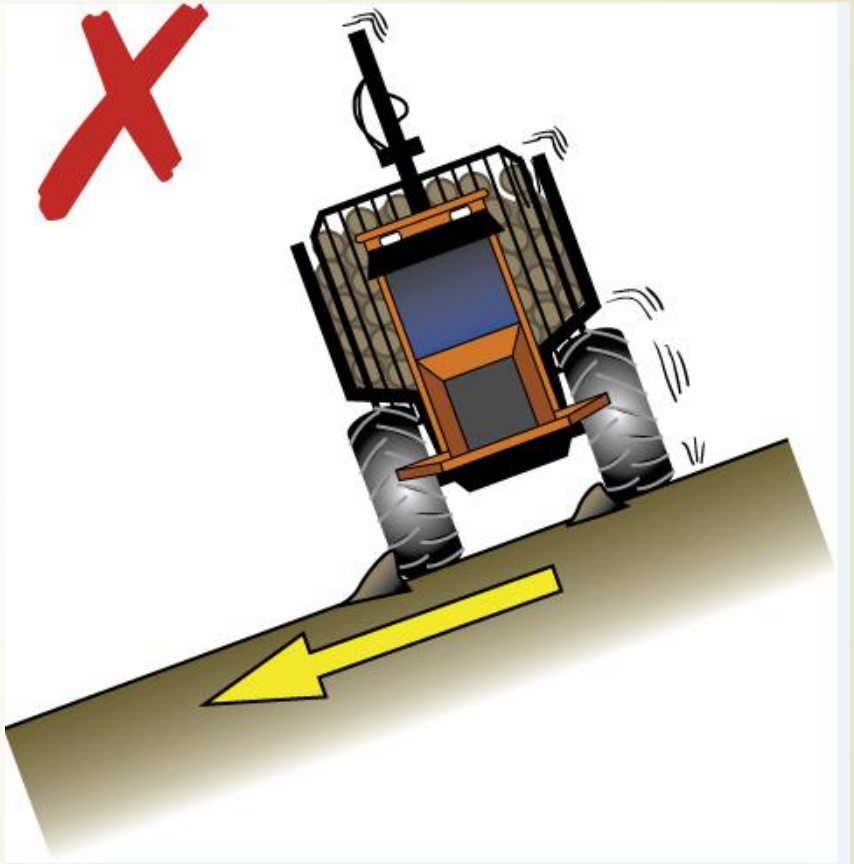
- Displaced when piled at roadside
- Nutrients not available to trees growing on road
- Always replace stripped organic matter

Loss or displacement of organic matter

- Loss during silviculture operations
- Poor planning may cause loss due to soil erosion
- Usually local on a small scale
- Not always a big problem

Loss or displacement of organic matter

- Slippage can shear the organic matter off the surface, leaving it at risk to erosion



Review

What natural feature of soil is lost when soil is compacted?

a) The pore space
b) The soil particles
c) The soil nutrients
d) None of the above

Review

What natural feature of soil is lost when soil is compacted?

a) **The pore space**
b) The soil particles
c) The soil nutrients
d) None of the above

Review

A soil is “saturated” when…

a) it rains for more than an hour

b) it stops raining and the soil water drains away

c) erosion begins to move soil away

d) it no longer has empty pore space, as the pores are filled with water

Review

A soil is “saturated” when…

a) it rains for more than an hour

b) it stops raining and the soil water drains away

c) erosion begins to move soil away

d) it no longer has empty pore space, as the pores are filled with water

Chapter Summary

The 3 main ways soil can be damaged during operations are:

- Compaction
- Rutting
- Organic matter displacement

WOODLAND SOILS

Chapter 1
Soil Factors

Chapter 2
Planning & Teamwork

Chapter 3
How Soils can be Damaged

Chapter 4
Legislation & Guidelines

Chapter 5
Operational BMPs to Reduce Soil Damage

Chapter 6
Reclaiming Disturbed Soils

Legislation

The 4 pieces of legislation that cover soil protection during operations are:

1. Forest and Prairie Protection Act
2. Forests Act
3. Public Lands Act
4. Provincial Parks Act

Operating Ground Rules

The ground rules serve 3 main purposes:

1. Minimize potential for soil erosion
2. Prevent substances from entering watercourses
3. Ensure tree growth is maintained

2016

Pre-Harvest Planning

9.1 Areas susceptible to rutting, puddling or compaction shall be avoided when planning temporary roads, decks, landings and skidding patterns.

9.1.1 Areas susceptible to rutting, puddling or compaction shall be harvested during dry or frozen conditions (when soil condition is not susceptible to degradation e.g. blocks with predominantly imperfectly-poorly drained soils, soils exceeding field capacity).

2016

Harvesting

9.2 The total area covered by temporary roads, processing areas, and displaced soil, created by timber harvesting operations shall not exceed five percent of each harvest area unless the company has an approved silvicultural strategy for their roads.

9.3 Operations shall not occur during heavy rainfall or when soil conditions are above field capacity (saturated).

2016

Harvesting

9.4 Minimize the machine traffic on sensitive areas, depending on soil susceptibility to disturbance according to the results of a hand test.

9.5 Operations shall cease when instances of multiple ruts in a limited area are created that are clearly related to operations during unfavourable ground conditions.

9.6 Erosion and soil disturbance must be limited, with effort made to retain organic matter and soil nutrients.

2016

Post-Harvest Reclamation/Reforestation

9.7 Roads within harvest areas that are no longer required shall be reclaimed and reforested. Treatments acceptable to Alberta are required on compacted soils. Acceptable treatments may be decompaction if required, roll back of debris, and planting.

2016

Alberta Forest Soils Conservation Guidelines

Contains guidelines for in-block disturbances…

1. Roads & Decking
2. Skidding
3. Reforestation

What is a Rut?

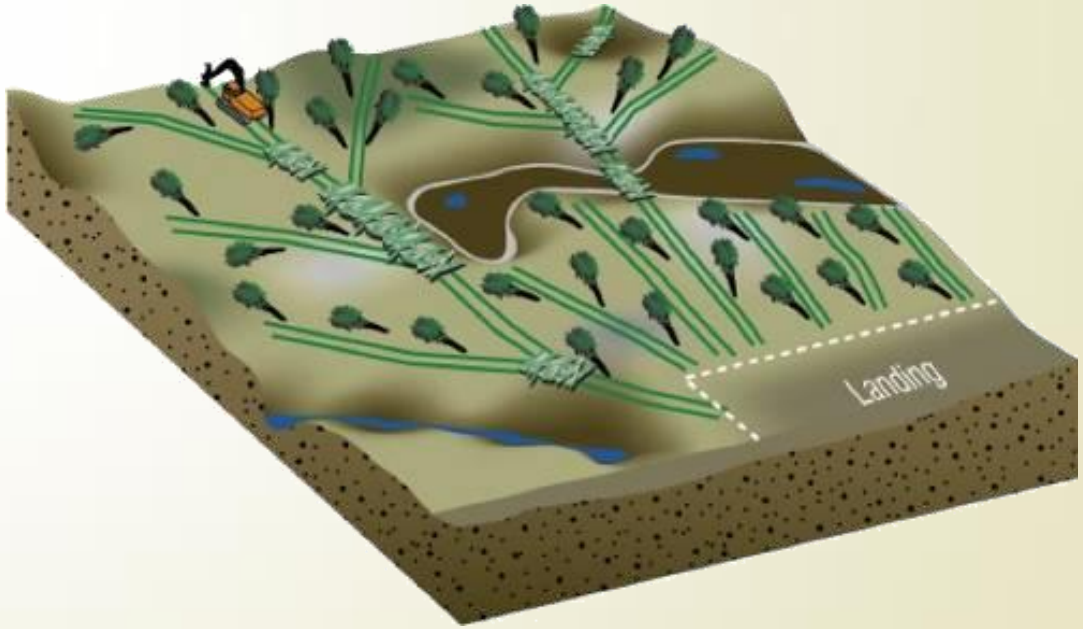
- Trenches or furrows that damage soil & roots

Definition

- **4**m long & **20**cm deep (in humus >= 30cm deep)
- **4**m long & **10**cm deep (in humus < 30cm deep)

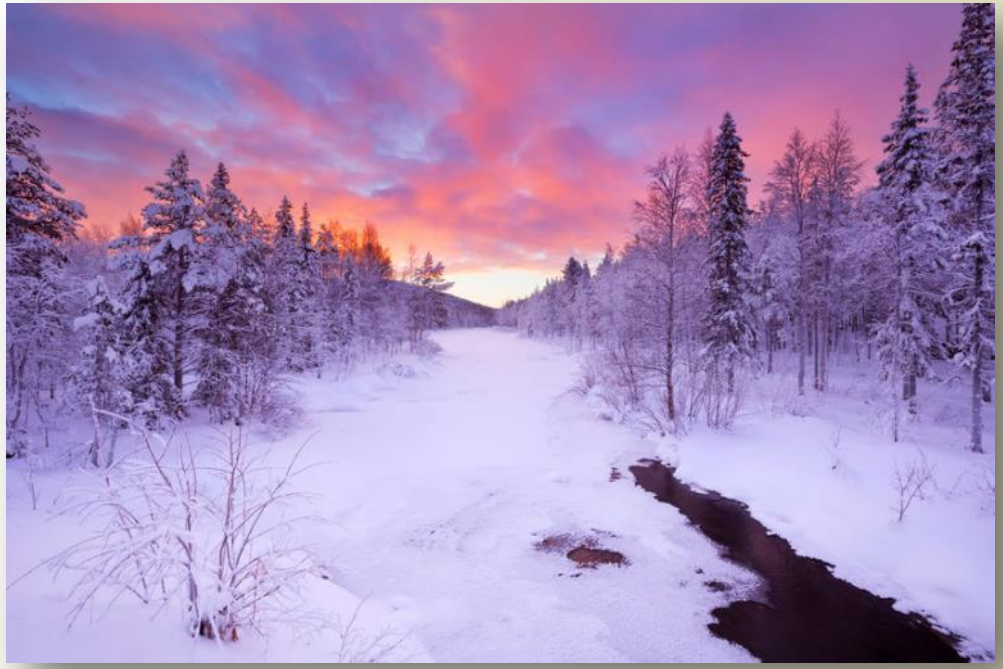
Highlights of the guidelines…

1. Minimize amount of in-block roads
   a) Optimize economical skidding distances
   b) Keep road widths down
   c) Use seismic lines where practical



Highlights of the guidelines…

1. Minimize amount of in-block roads
2. Season of Harvest



Highlights of the guidelines…

1. Minimize amount of in-block roads
2. Season of Harvest
3. Reclamation Tactics

Highlights of the guidelines…

1. Minimize amount of in-block roads
2. Season of Harvest
3. Reclamation Tactics
4. Minimize Road Impacts

Create guidelines for skidding…

1. Rating system for risk of soil damage
2. Number of blocks open at once
3. Operator expectations

Risk of ruts forming:		
•	Low 1-4	No machine or forest operation should cause ruts at a low potential.
•	Moderate 5-11	Wide-tired skidders or other control of skidding is likely to prevent ruts.
•	High 12-27	Only the most careful operations will prevent ruts, harvesting should temporarily cease, or the site should be logged when the soil is frozen.

Planning - risk

Risk of Rutting

	Category	Class Rating
Soil		
•	Coarse-texture mineral soil (less than 20% silt and clay)	1
•	Fine-textured mineral soil (greater than 20% silt and clay)	2
•	Organic soil	3
Soil Water Content		
•	Frozen soil with high water content	0
•	Dry (soil crumbles when crushed)	1
•	Moist (loose soil forms weak clod when compressed)	2
•	Wet (soil deforms when compressed)	3
Landscape		
•	Gentle slopes and convex slope positions	1
•	Flat and concave slope positions	2
•	Steep slopes (greater than 30%)	3

Planning - risk

Risk of Rutting

Block 100	Category	Class Rating
Soil		
•	Coarse-texture mineral soil (less than 20% silt and clay)	1
•	Fine-textured mineral soil (greater than 20% silt and clay)	2
•	Organic soil	3
Soil Water Content		
•	Frozen soil with high water content	0
•	Dry (soil crumbles when crushed)	1
•	Moist (loose soil forms weak clod when compressed)	2
•	Wet (soil deforms when compressed)	3
Landscape		
•	Gentle slopes and convex slope positions	1
•	Flat and concave slope positions	2
•	Steep slopes (greater than 30%)	3

Risk Rating

1- 4 Low Risk

5 -11 Moderate

12 - 27 High

Risk Rating

1 X 2 X 3 = 6

Moderate

Planning - risk

Risk of Rutting

Risk Rating	
1- 4	Low Risk
5 -11	Moderate
12 - 27	High

Block	Soil texture	Soil moisture	Landscape	Rating
100	Sandy loam **1**	Moist **2**	Steep **3**	6 - Moderate
120	Organic **3**	Wet **3**	Flat **2**	18 - High
130	Silty clay **2**	Moist **2**	Gentle **1**	4 - Low
140	Gravelly **1**	Dry **1**	Flat **2**	2 - Low

WOODLAND SOILS

Chapter 1

Soil Factors

Chapter 2

Planning & Teamwork

Chapter 3

How Soils can be Damaged

Chapter 4

Legislation & Guidelines

Chapter 5

Operational BMPs to Reduce Soil Damage

Chapter 6

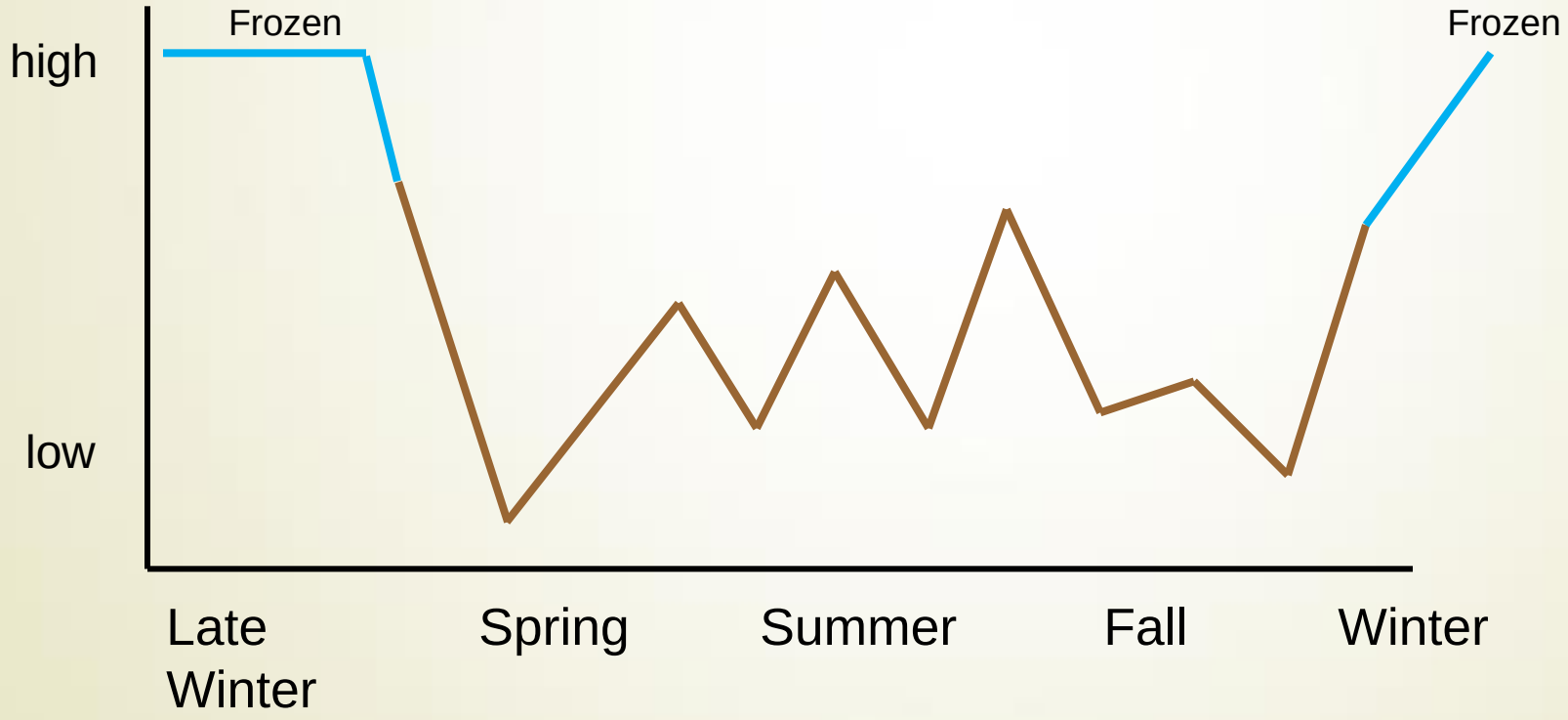
Reclaiming Disturbed Soils

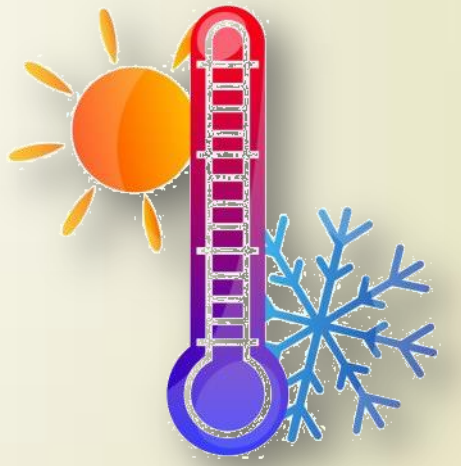
Operational BMPs to reduce soil damage

1. Operate when soils are strongest
2. Avoid moist/wet soils
3. Operate on frozen soil
4. Use appropriate … equipment
5. Use appropriate … felling techniques
6. Use appropriate … skidding techniques
7. Use appropriate … roadside techniques
8. Use appropriate … site preparation techniques

1 Operate when soil strength is highest

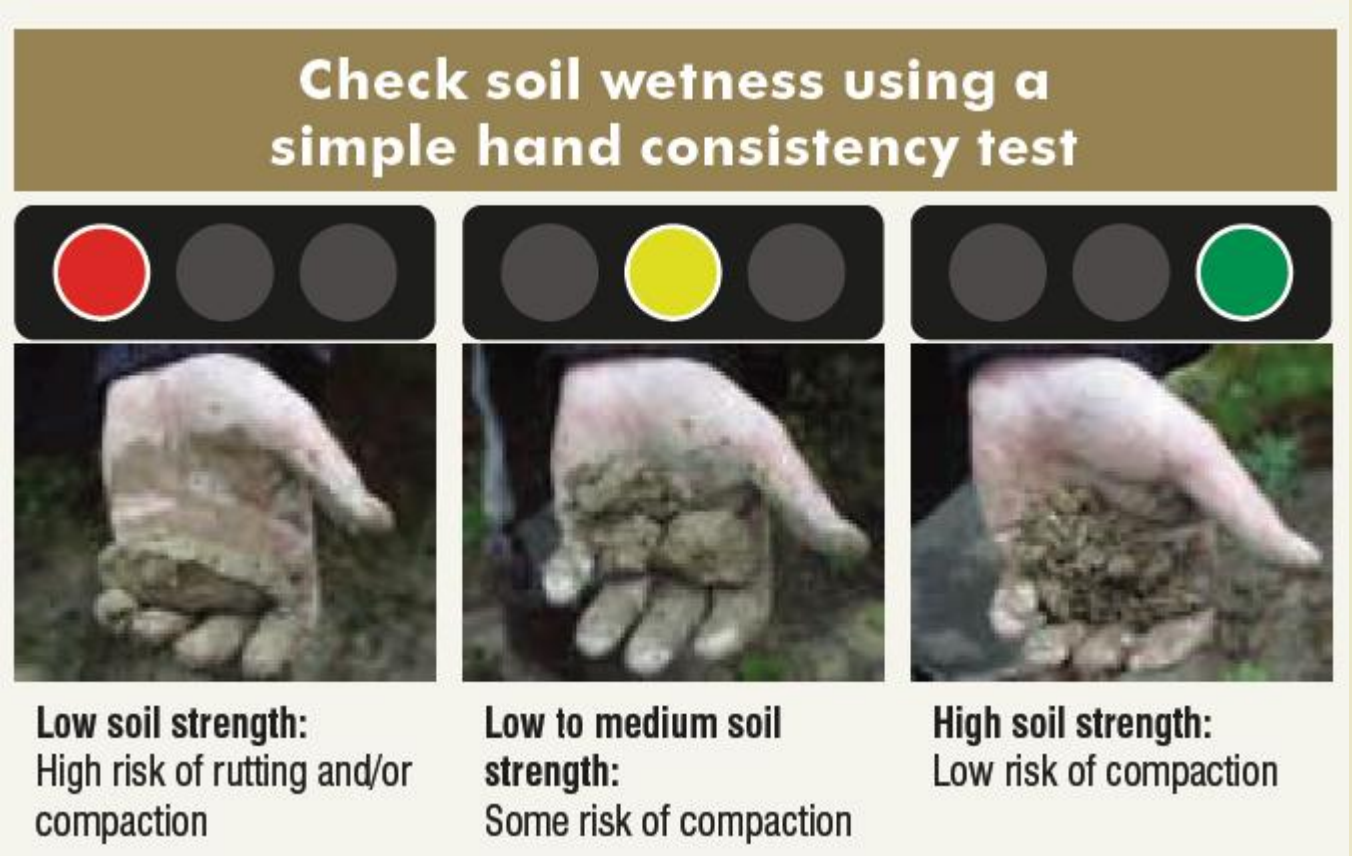
- Seasonal Strength





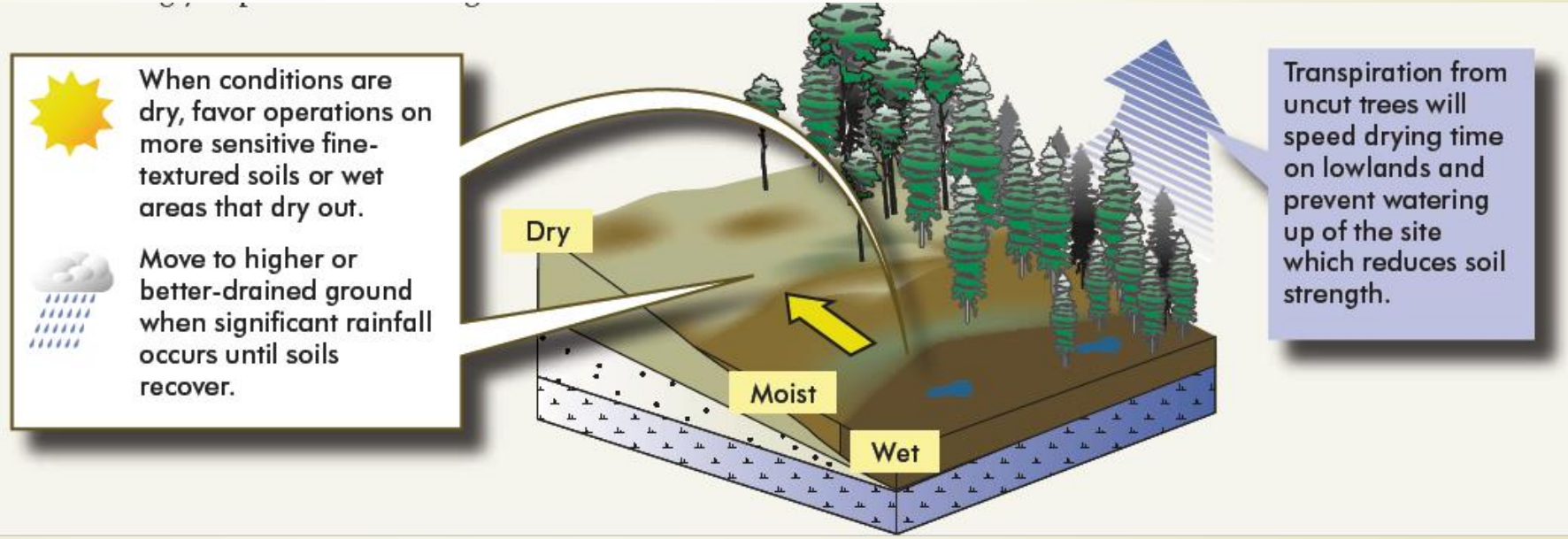
2 Avoid moist/wet soils

- Test for soil moisture
- Disturbance risk is highest when soil moisture increases



2 Avoid moist/wet soils

- Operate on low lying areas when dry
- Be prepared to move to drier ground



2 Avoid moist/wet soils

- Harvest blocks will have variable conditions
- Utilize planning tools, recognize vegetation indicators etc.

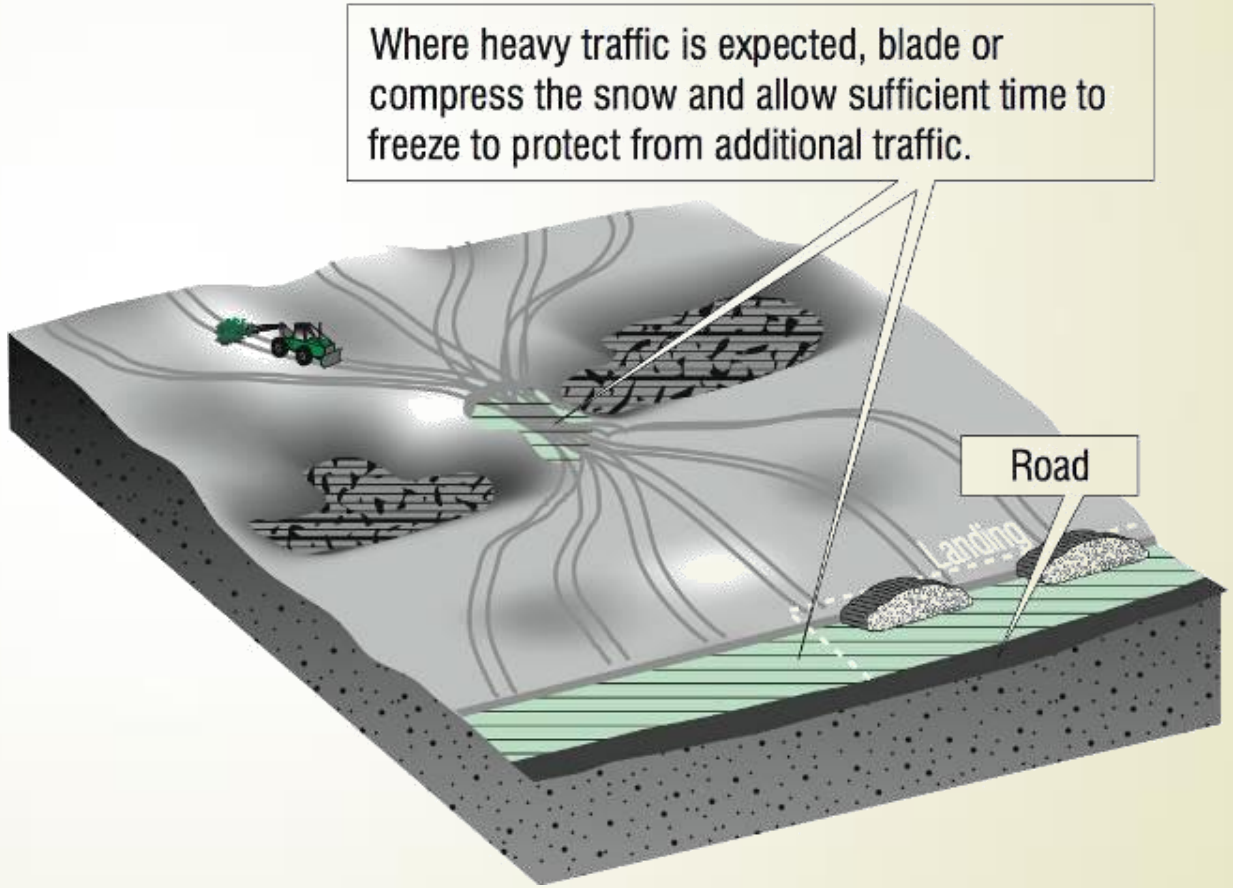
3 Operate on frozen soils

- Encourage deep frost penetration

3 Operate on frozen soils

- Encourage deep frost penetration

Depth of frost required for protection		
Soil type	Compaction	Rutting
Mineral	> 15 cm	7 – 15 cm
Organic		50 cm if wet 70 cm if dry

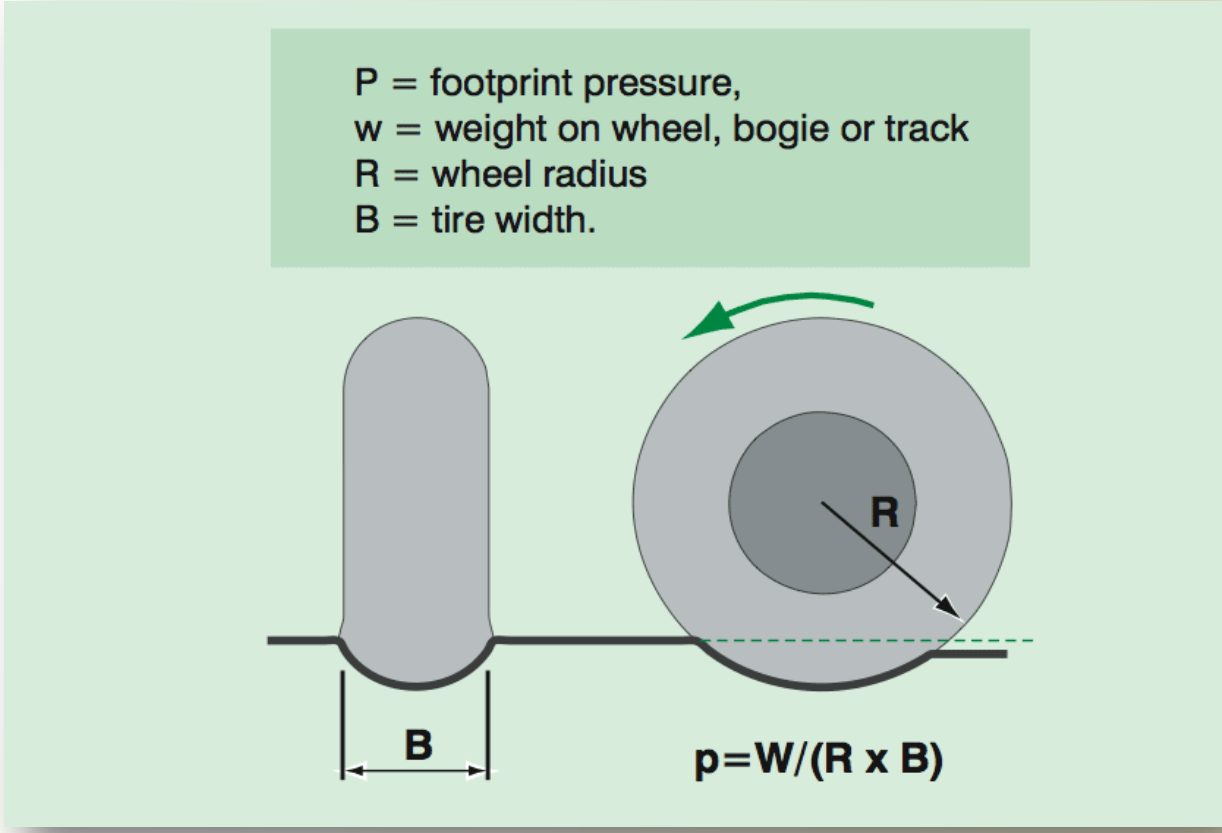


4 Use appropriate equipment

- When needed, reduce machine loads
- Overloading the machines can create an imbalance in load distribution

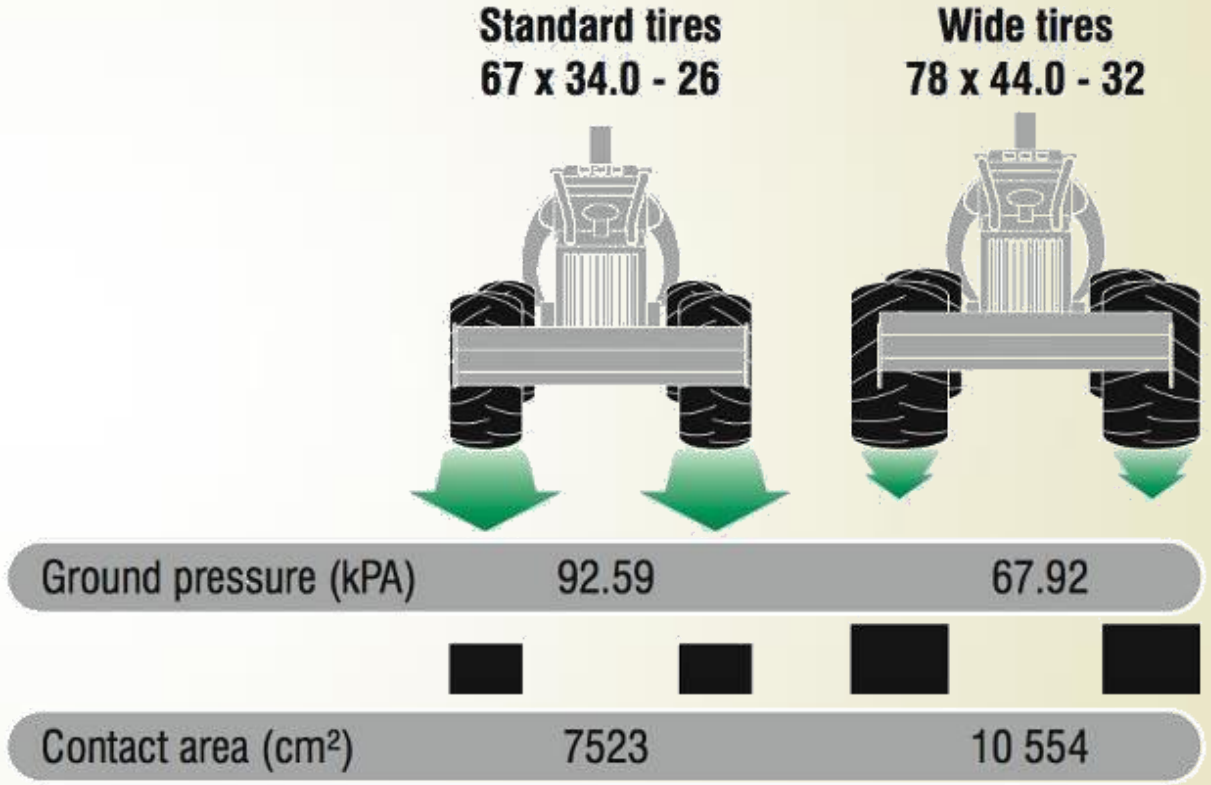
4 Use appropriate equipment

- Machine ground pressure is a **static** measurement that provides an **indication** of soil disturbance risk
- Values should be used as broad indicators of risk, not for direct comparison



4 Use appropriate equipment

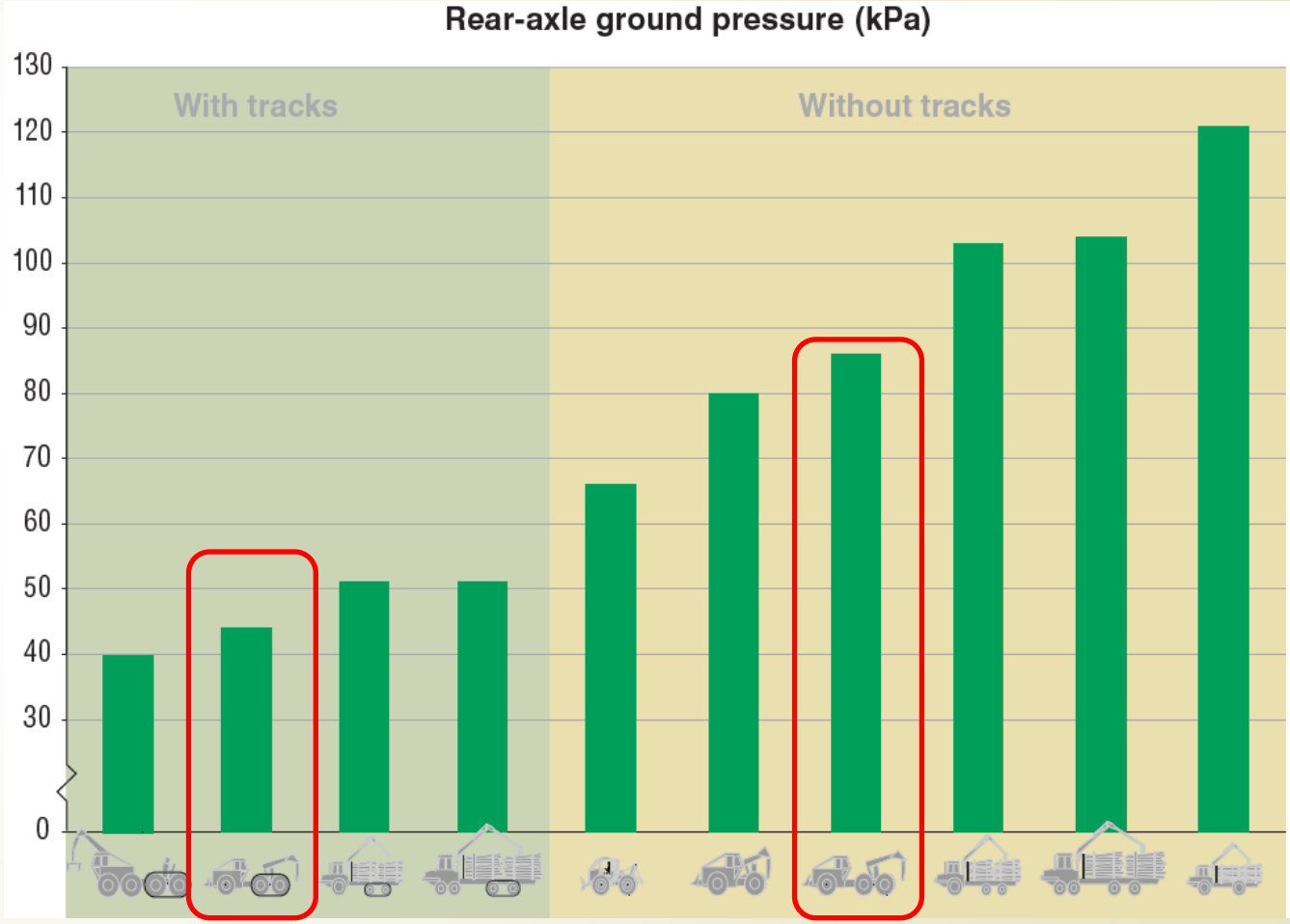
- Ground pressure values are greatly impacted by the tire/track contact area
- Useful when making broad comparisons



Note: Example is for four-wheeled 14-tonne skidder.

4 Use appropriate equipment

- Ground pressure values are greatly impacted by the tire/track contact area
- Useful when making broad comparisons
- No detailed link between machine ground pressure and disturbance



4 Use appropriate equipment

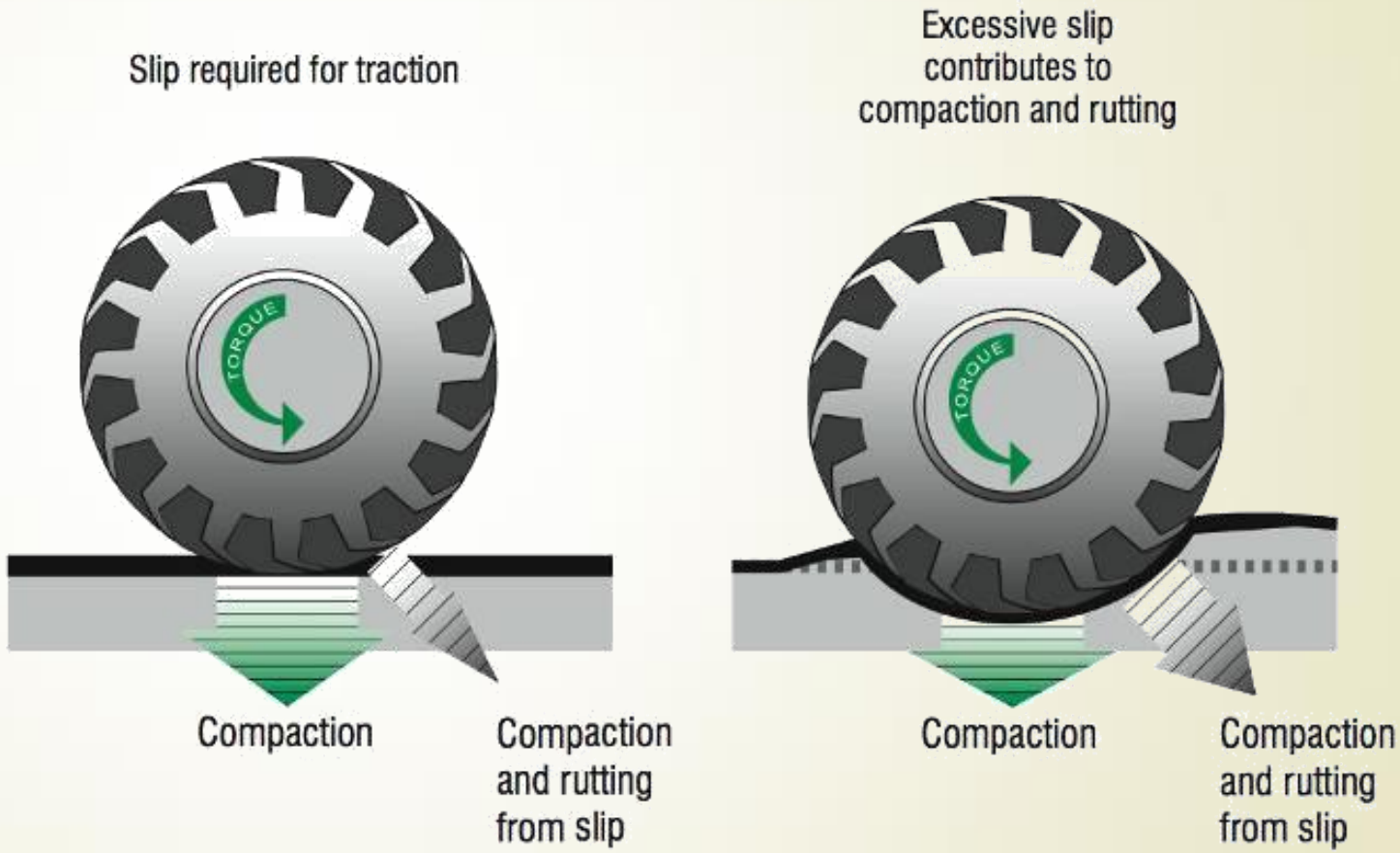
- Tracks added to a bogie axle can reduce ground pressure by up to 50%

4 Use appropriate equipment

- Tracks added to a bogie axle can reduce ground pressure by up to 50%
- Important to maintain proper track tension

4 Use appropriate equipment

- Tire or Track Slip

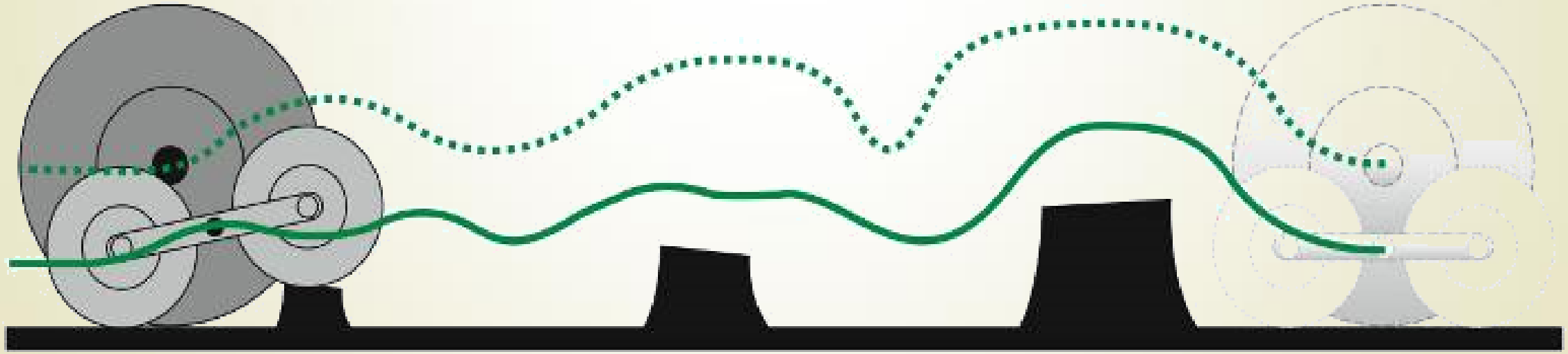


4 Use appropriate equipment

- Tire or Track Slip
- Chains increase traction, reduce wheel slippage and decrease tire wear
- The increased traction can result in lower fuel consumption

4 Use appropriate equipment

- Bogie or Single Axle
- Bogie axles allow more tire surface to be in contact with the ground
- Bogies have a lower lift over obstacles, this can reduce pressure to the ground



4 Use appropriate equipment

- Fuel consumption can be negatively impacted by:
  - Excessive slip or wheel spin
  - Wider tires
- Higher tire pressures can result in lower travel speeds and reduced productivity if operator comfort is compromised
- Bogie tracks provide ability to climb out of ruts, resulting in shorter rut lengths

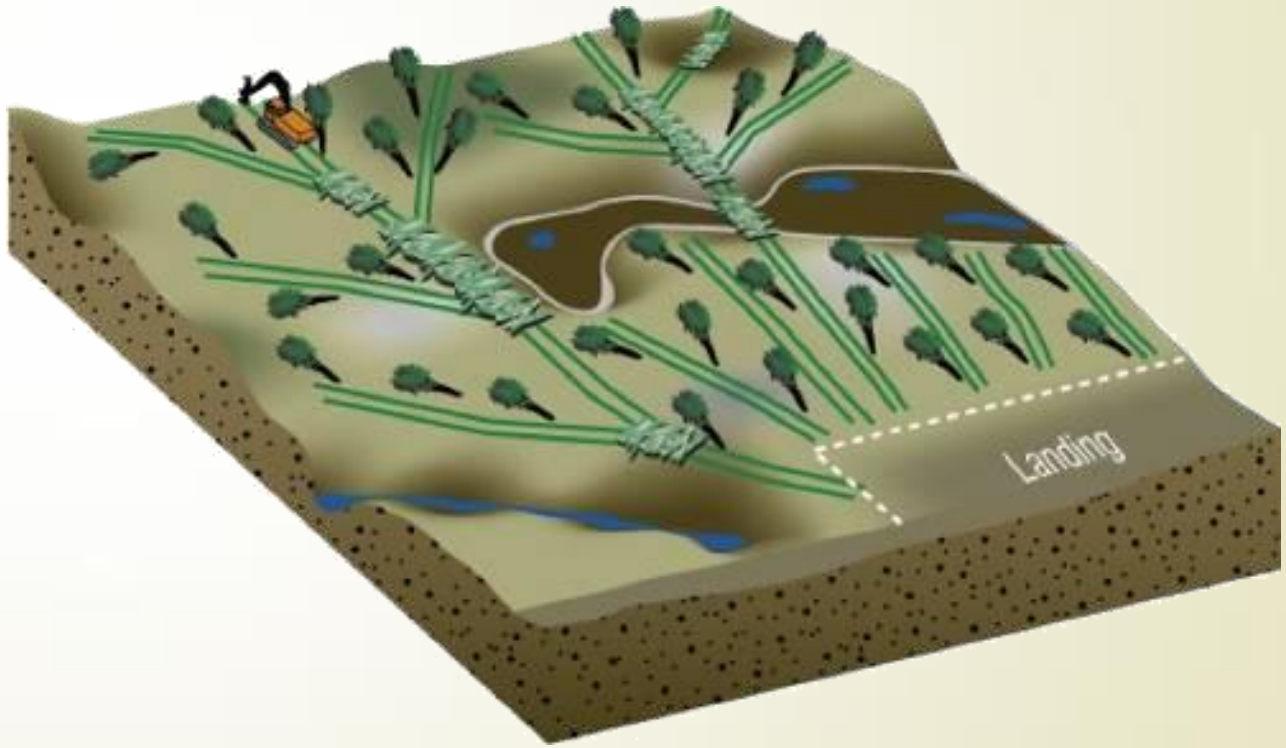
5 Use appropriate felling techniques

The felling phase is the first opportunity to prevent soil damage:

- The buncher operator can affect the skidding or forwarding phase
- As the first to traverse the block, buncher operators can let the skidder operators know about soil conditions

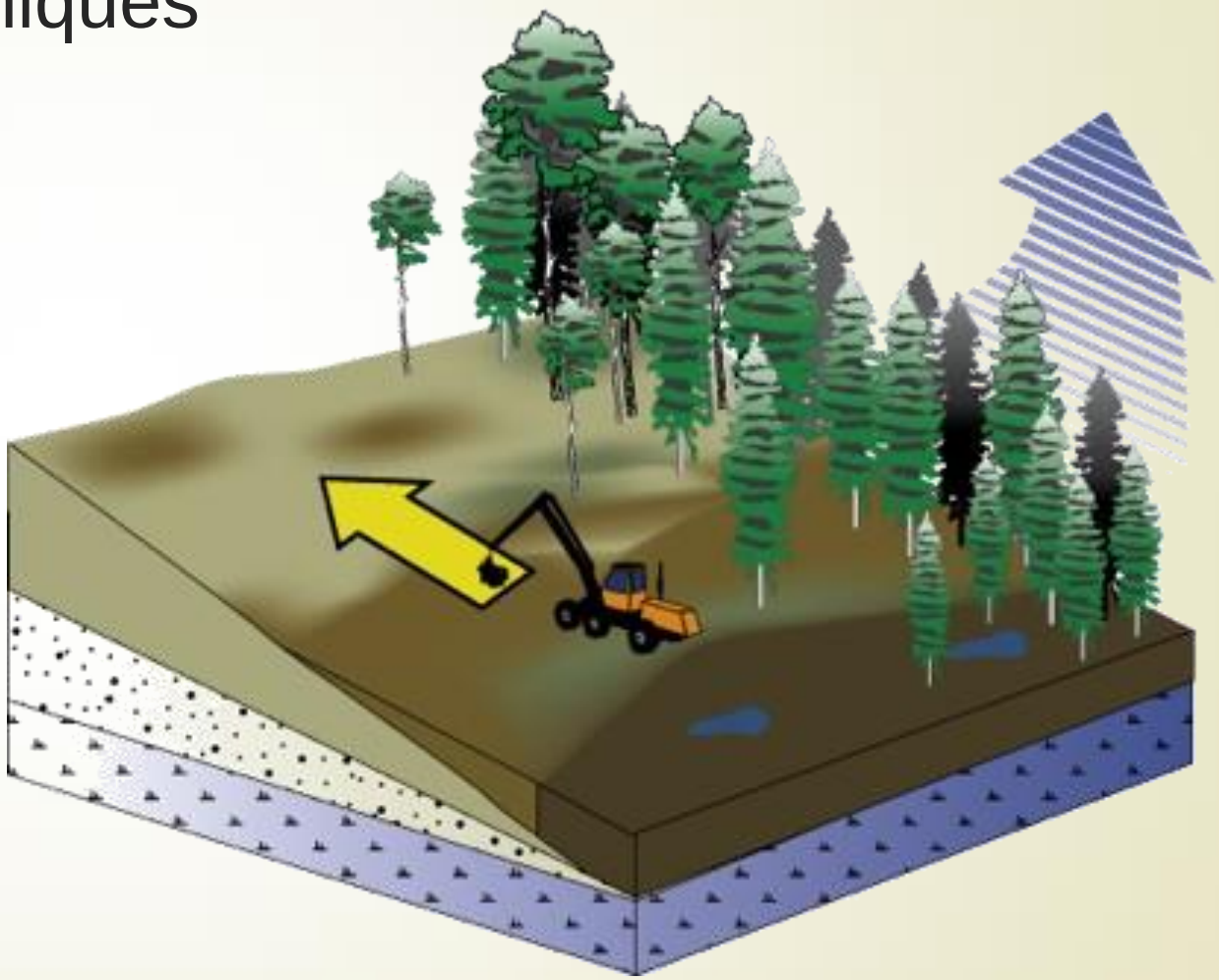
5 Use appropriate felling techniques

- Space passes widely and make neat bunches
- Cut perpendicular to the road/landing
- Optimize bunch size



5 Use appropriate felling techniques

- Adjust to sudden changes in soil strength
- Fall trees under dry conditions
- Don’t get too far ahead of skidding



5 Use appropriate felling techniques

- Alert skidder operators about wet areas

5 Use appropriate felling techniques

- Alert skidder operators about wet areas
- Distribute woody debris to create brush mats

6 Use appropriate skidding techniques

Dispersed Skidding Pattern:

- Pros ✓
  - Light impact over a large area
- Cons ✗
  - Widespread compaction
  - Advanced regen is damaged
  - Only good for dry conditions

6 Use appropriate skidding techniques

Designated Skid Trails:

- Pros ✓
  - Can avoid widespread compaction
  - Damage is confined to trails
- Cons ✗
  - Significant compaction on trail
  - Can lead to rutting in wet, fine-textured soils

6 Use appropriate skidding techniques

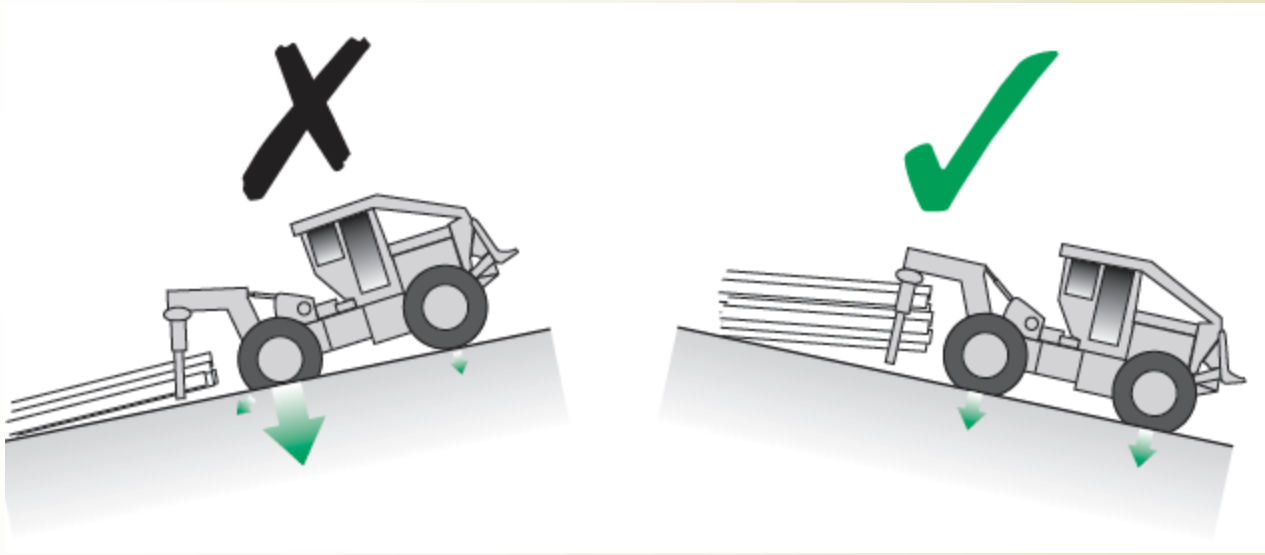
Designated Skid Trails:

- Pros ✓
  - Can avoid widespread compaction
  - Damage is confined to trails
- Cons ✗
  - Significant compaction on trail
  - Can lead to rutting in wet, fine-textured soils

6 Use appropriate skidding techniques

Match techniques to conditions

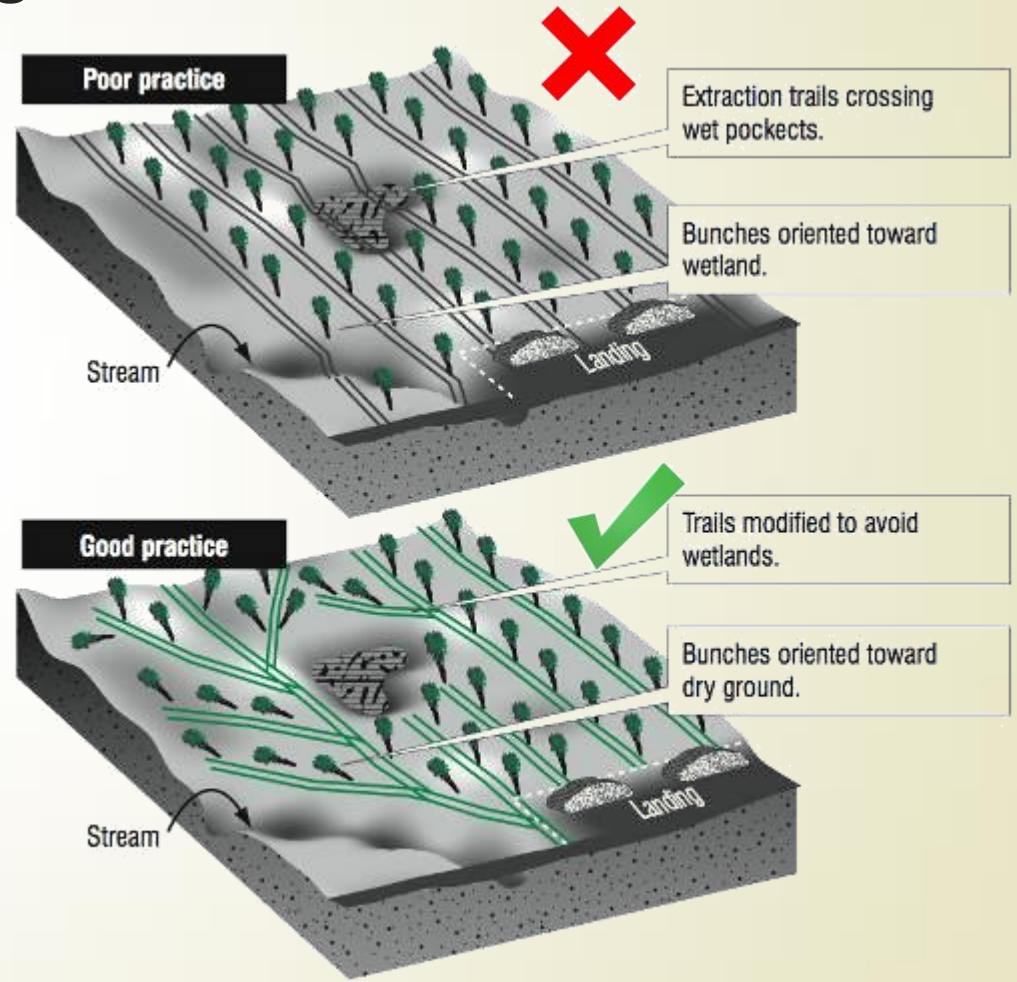
- Skid downhill where possible
- Avoid skidding on side slopes
- Skid with optimal load size



6 Use appropriate skidding techniques

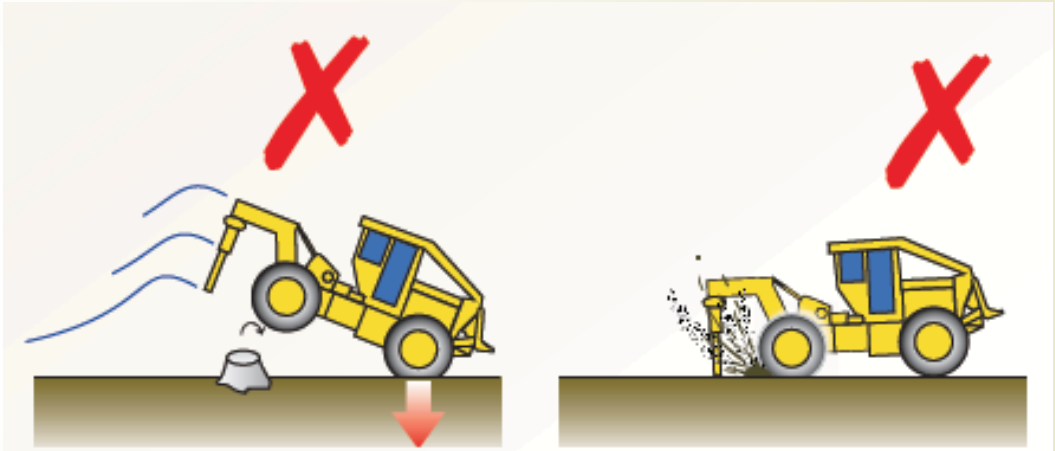
Match techniques to conditions

- Skid downhill where possible
- Avoid skidding on side slopes
- Skid with optimal load size
- Avoid skidding through wet patches



6 Use appropriate skidding techniques

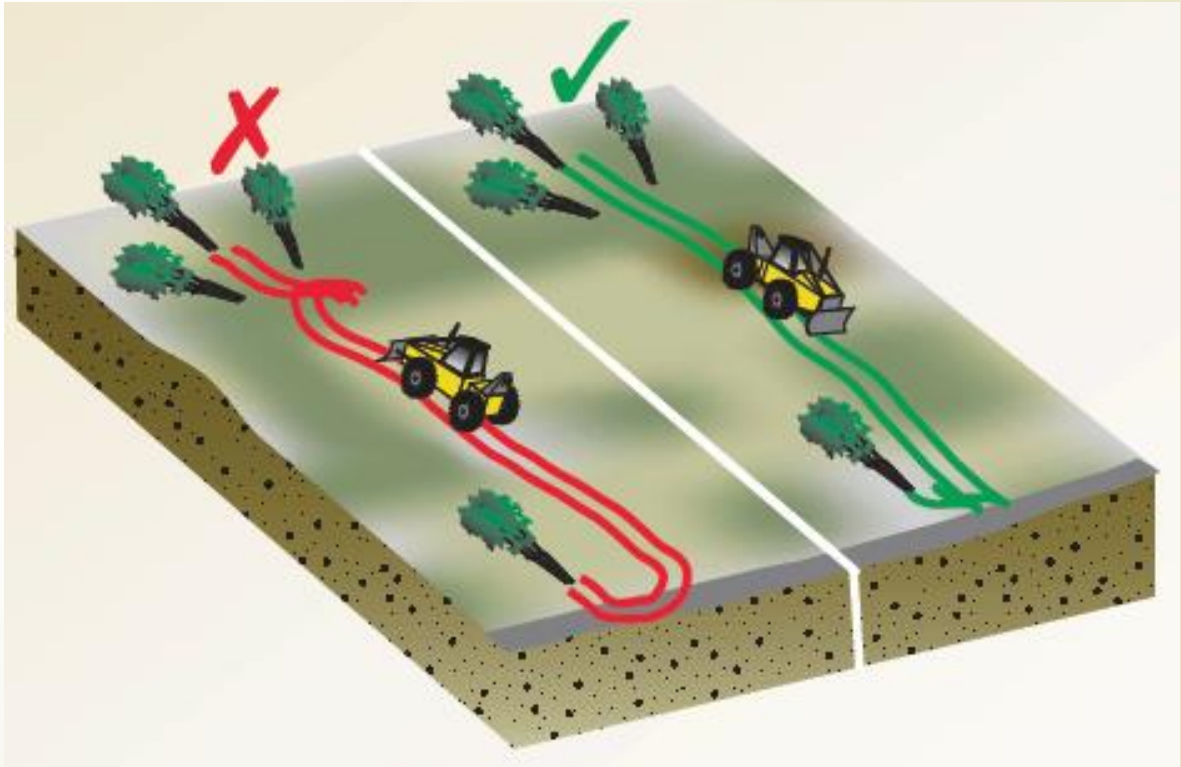
- Keep a constant travel speed



Travel at a lower speed and avoid rapid speed changes. This reduces bouncing and helps prevent soil compaction and tearing of the forest floor.

6 Use appropriate skidding techniques

- Keep a constant travel speed
- Minimize turning



6 Use appropriate skidding techniques

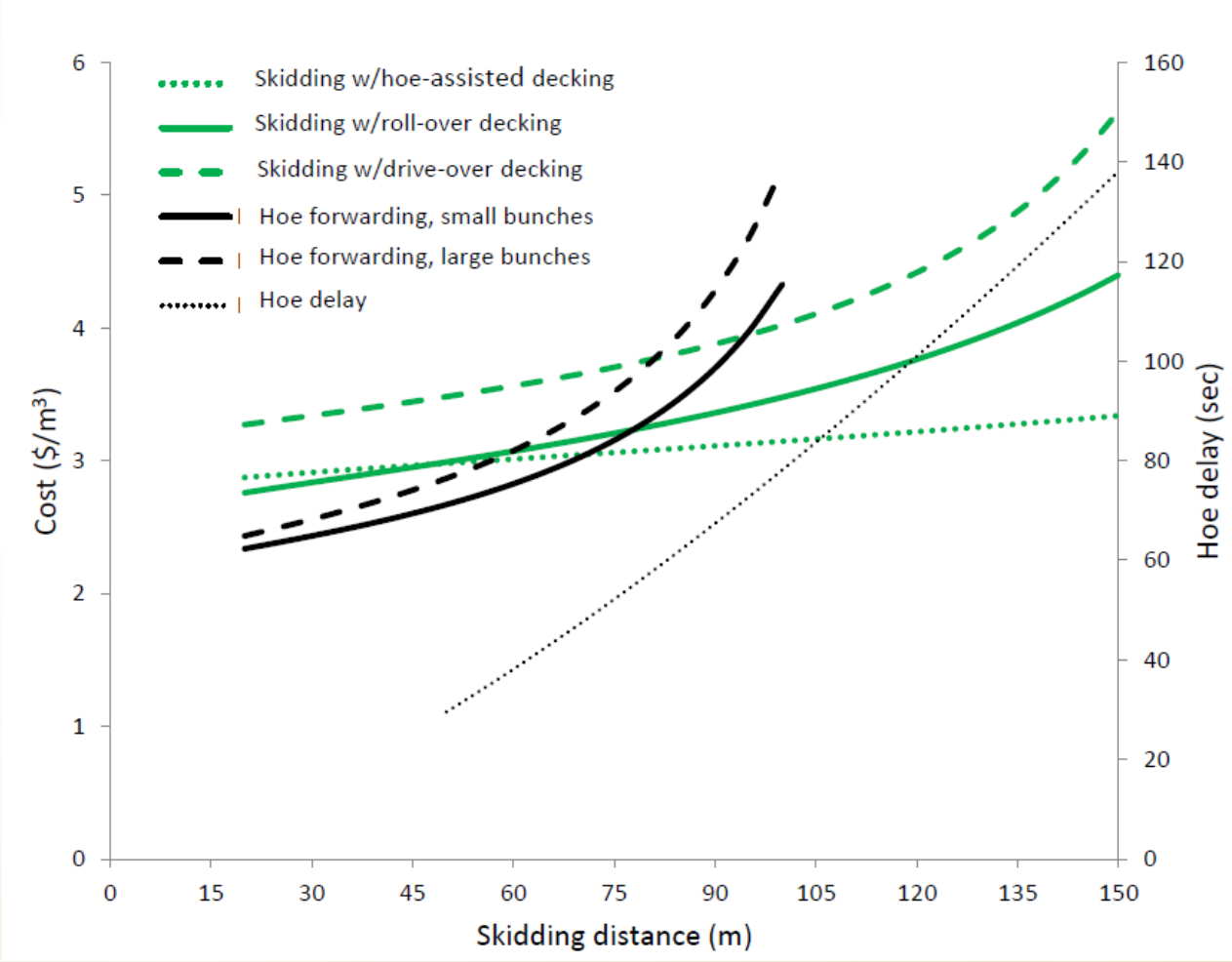
Match equipment to conditions:

Be ready to shut down & wait for frost/dry weather

6 Use appropriate skidding techniques

Consider alternative extraction techniques:

- Hoe-assisted decking or hoe-forwarding near roadside or in soft soil areas
- Can reduce skidder movements in high-risk areas



6 Use appropriate skidding techniques

Consider alternative extraction techniques:

- 3-in-1 trail consolidation (Quebec)
- Modified buncher layout to concentrated extraction trails
- 6% production loss
- Allows for possible improved soil disturbance compliance

7 Use appropriate roadside techniques

Place decks on a firm bench:

7 Use appropriate roadside techniques

Roadside Handling:

- Deck with skidder and loader-forwarder & operate equipment from the road
- Turn skidder on road
- Deck logs on high ground
- Pile debris with an excavator or loader

8 Use appropriate site preparation equipment & methods

Review

Soil moisture and soil strength will be the same anywhere in the block.

- True
- False

Review

Soil moisture and soil strength will be the same anywhere in the block.

- True
- **False**

Review

A tire requires a small bit of slip to provide traction, but excessive slip can cause compaction and rutting.

- True
- False

Review

A tire requires a small bit of slip to provide traction, but excessive slip can cause compaction and rutting.

- **True**
- False

Review

The feller-buncher operator can reduce soil damage by:

a. Orienting bunches in the direction of skidding

b. Working the lower, wetter areas during dry weather and moving to higher ground when it rains

c. Letting skidder operators know where the soft spots are

d. All of the above

Review

The feller-buncher operator can reduce soil damage by:

a. Orienting bunches in the direction of skidding

b. Working the lower, wetter areas during dry weather and moving to higher ground when it rains

c. Letting skidder operators know where the soft spots are

d. All of the above

WOODLAND SOILS

Reclaiming Disturbed Soils

- Roads can be good growing sites when decompacted

Reforesting in-block roads

Accessible Upland Roads

1. Decompaction
2. Rollback strippings
3. Plant or seed
4. Check for mortality
5. Fill plant if necessary

Reforesting in-block roads

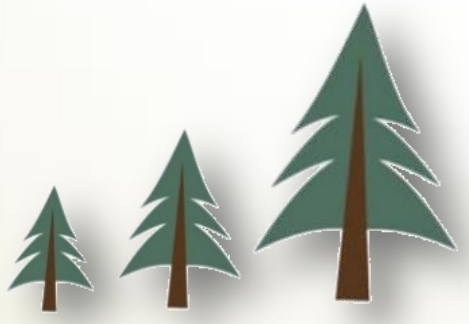
Inaccessible Upland Roads

1. Ripper plow across the road (winter)
2. Drag chains to spread slash
3. Plant or seed

Reforesting in-block roads

Reclaiming Lowland Roads

1. Shear stumps during road construction
2. Roll back strippings
3. Mound if necessary
4. Plant spruce
5. Fill plant if necessary



Chapter Summary

- Operations will cause some damage, some of which can be repaired
- In-block roads can become very productive growing sites when decompacted
- All land is important, and every hectare that supports trees should be reforested

SUMMARY

Course Summary

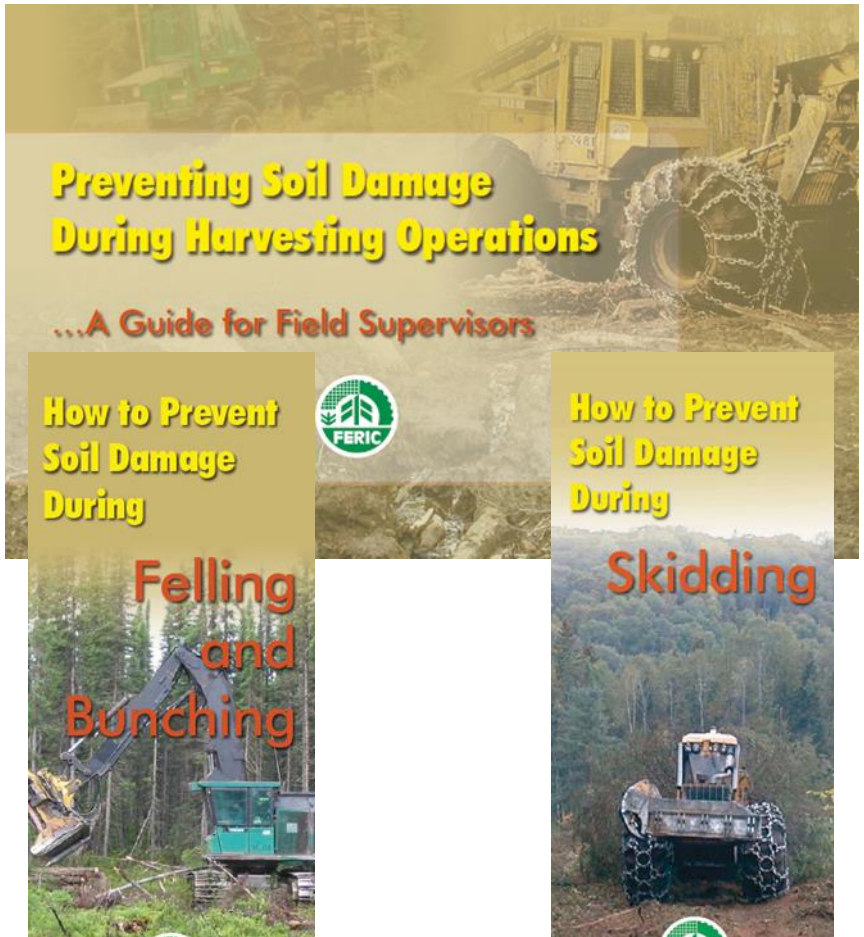
1. Soil factors: pore space, texture, strength organic matter, water content
2. Planning and team action will reduce damage
3. Soil can be damaged through compaction, rutting and displacement
4. Legislation and guidelines apply
5. Operational BMPs to reduce soil damage
6. Road reclamation and site preparation practices

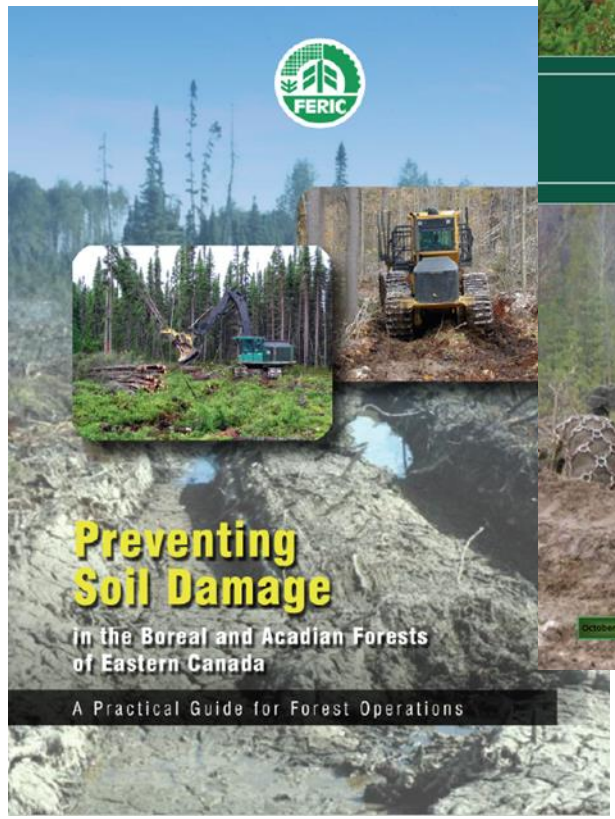
Key learnings

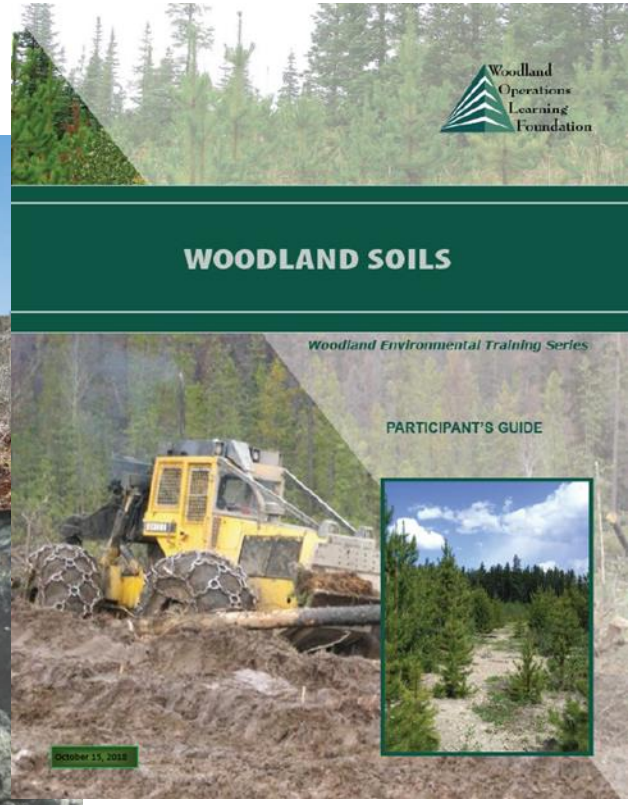
1. Know your soils
2. Plan for changing conditions
3. Ensure everyone is knowledgeable with the basic BMPs
4. Work as a team, communicate issues and adapt as problems arise

RESOURCES

GOOGLE DRIVE LINK FOR DOCUMENTS: DOWNLOAD







FPInnovations

GET IN TOUCH

Mark Partington
mark.partington@fpinnovations.ca
514-782-4525