Site Damage from Timber Harvesting

- Timber harvest can affect a site and its productivity by impacting:
  - Soil
  - Water
  - Microclimate
  - Flora and fauna
  - Aesthetics and other concerns

What Are We Concerning?

- Even the BEST and most careful timber harvest does have impacts.
- The point is to
  - minimize the detrimental impacts and
  - optimize the beneficial impacts
- What we concern:
  - How do we assess damage to the site?
  - How do we prevent damage?
  - How do we correct or ameliorate damage?

Soil Impacts

- Any access or entry into a stand has the potential to disturb the forest floor and soil.
- This potential is increased with harvesting activities, especially skidding.
- Each time a skidder drives across a site, it alters the soil, generally by
  - compacting and/or
  - rutting the soil

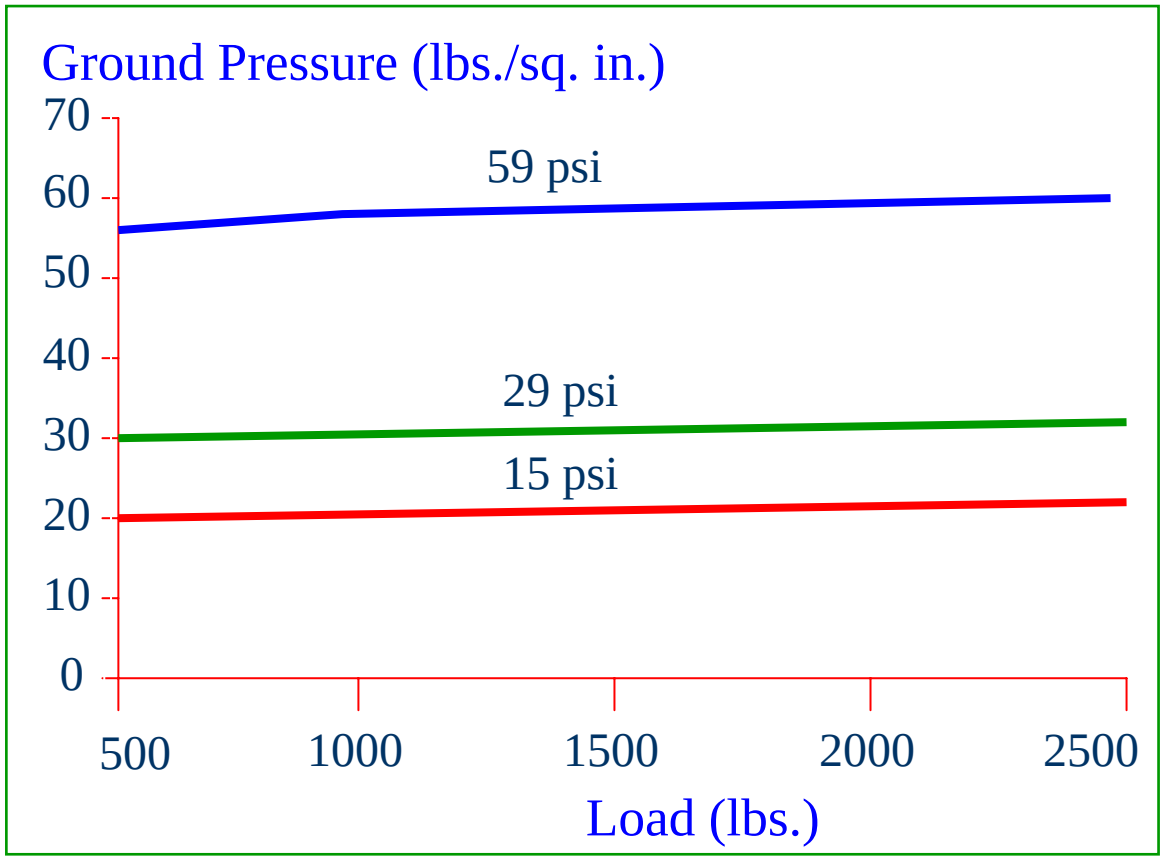
What is Soil Compaction?

- Reduction in soil volume resulting from the application of force.
- Measured in bulk density increase.

Soil Compaction

- Four things to be remembered about compaction:
  - The greater the load, the greater the potential for compaction.
  - Loam-textured soils are more susceptible to compaction.
  - Most compaction occurs during the first several passes across a site.
  - Moist soils are compacted more easily.

Compaction
Ground Pressure vs. Tire Inflation



For pneumatic tires:

- Surface load is closely related to tire pressure.
- Low pressure tires have lower potential for compaction than high pressure tires.

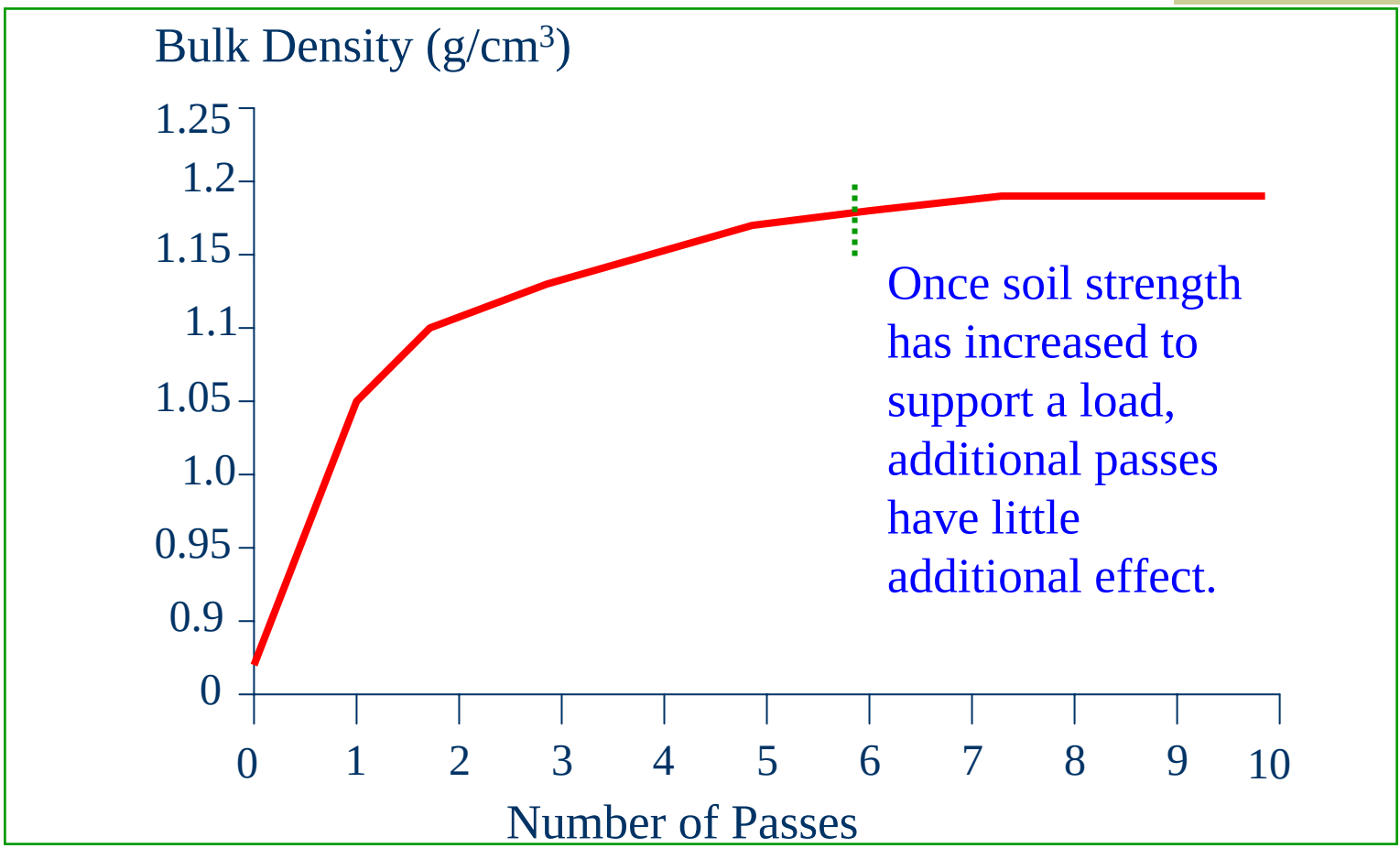
Compaction
Bulk Density

- Compaction potential is the greatest when soils are wet but not saturated because:
  - soil strength is lower, and
  - open pores are available into which finer particles can be packed

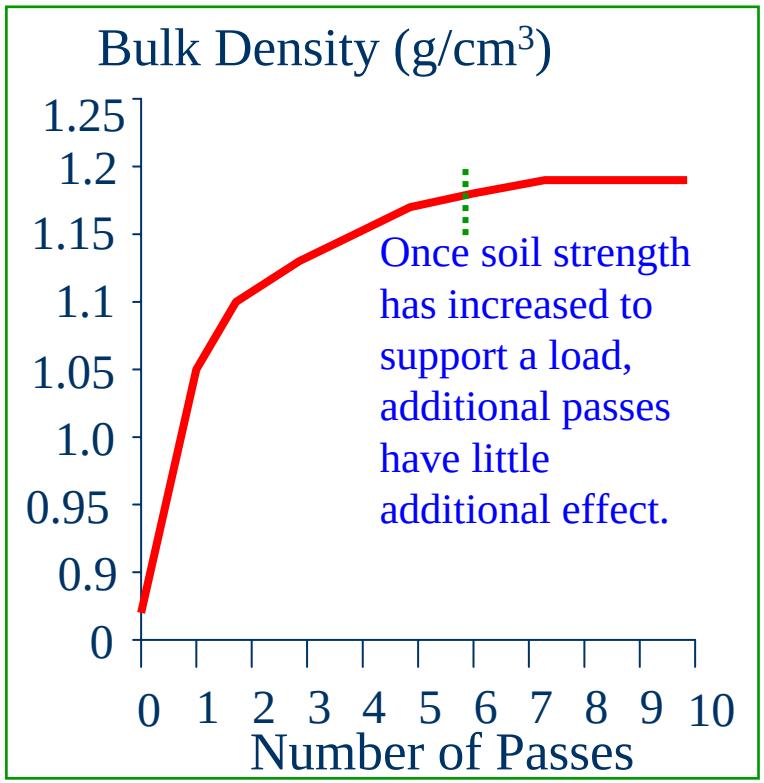
Compaction
Bulk Density (g/cm^3)

Undisturbed	Intermediate	Heavily Disturbed	Soil Type
0.75	0.92	1.14	L. Sand
1.21	1.42	1.55	S. Cl Sand
1.57	1.82	1.86	S. Loam
1.14	1.36	1.52	S. Cl Loam
1.36	1.43	1.55	S. Cl Loam
1.03	1.01	1.17	Loam
1.25	1.5	1.5	Loam

Compaction
Soil Compaction vs. No. of Passes



Compaction



- Most compaction occurs during the first few passes.
- It is usually best to concentrate on skidder activity or use designated skid trails.
- Skid trail can range from about 20% to more than 50% of the harvested area.
- Roads and landings occupied 10.3% on Appalachian logging sites (Kochenderfer 1977).

Compaction
How can we prevent or minimize damage?

Plan ahead! Five key recommendations:

- Know the soil on which you operate and plan accordingly
- Match equipment to site
- Minimize traffic intensity
- Follow BMPs and any restrictions that may apply
- Conserve organic matter and nutrients

Water Impacts

- Timber harvest can affect the hydrology of a site, especially:
  - the quantity,
  - the quality, and
  - the timing of water within or from a watershed

Water
Damage Assessment and Control

- Ongoing silvicultural activities such as timber harvesting are *non-point sources* of pollution rather than point sources.
- Their impacts, dispersed across the landscape, are much tougher to assess and control than impacts from most *point sources*.

Water
Damage Assessment and Control

- In West Virginia, WV DOF assesses compliance with WV's BMPs by:
  - visiting sites,
  - observing operations from the air, and
  - conducting surveys.

Water
Damage Assessment and Control

- Although the BMPs are voluntary guidelines, the loggers should follow them.
- If the sediment is originated from your site, and you have not made a legitimate attempt to protect the water resource, you can be
  - stopped,
  - fined, and
  - prosecuted.

Water

How can we protect the water resource from a harvest?

- Schedule the harvest to avoid the wet season
- Plan access carefully, and minimize traffic intensities on the site
  - Landings, decks, staging and servicing areas need to be considered too.
- If you must cross the stream, what kind crossing will you need?

Methods of Determining Soil Compaction and Disturbance

- Visual estimate
- Visual simulation

Factors Affecting Soil Disturbance/Compaction

Three major factors:

- Soil type
- Logging system
- Moisture condition

Soil Disturbance Category

- SD1 – Little or no disturbance
- SD2 – Compaction likely
- SD3 – Area is rutted, ruts are less than 8” deep
- SD4 – Area is rutted, ruts are 8” deep or more
- SD5 – Area is churned

Source: Carruth and Brown (1996).

Travel Intensity

TI1 - Trees on the plot have been felled.

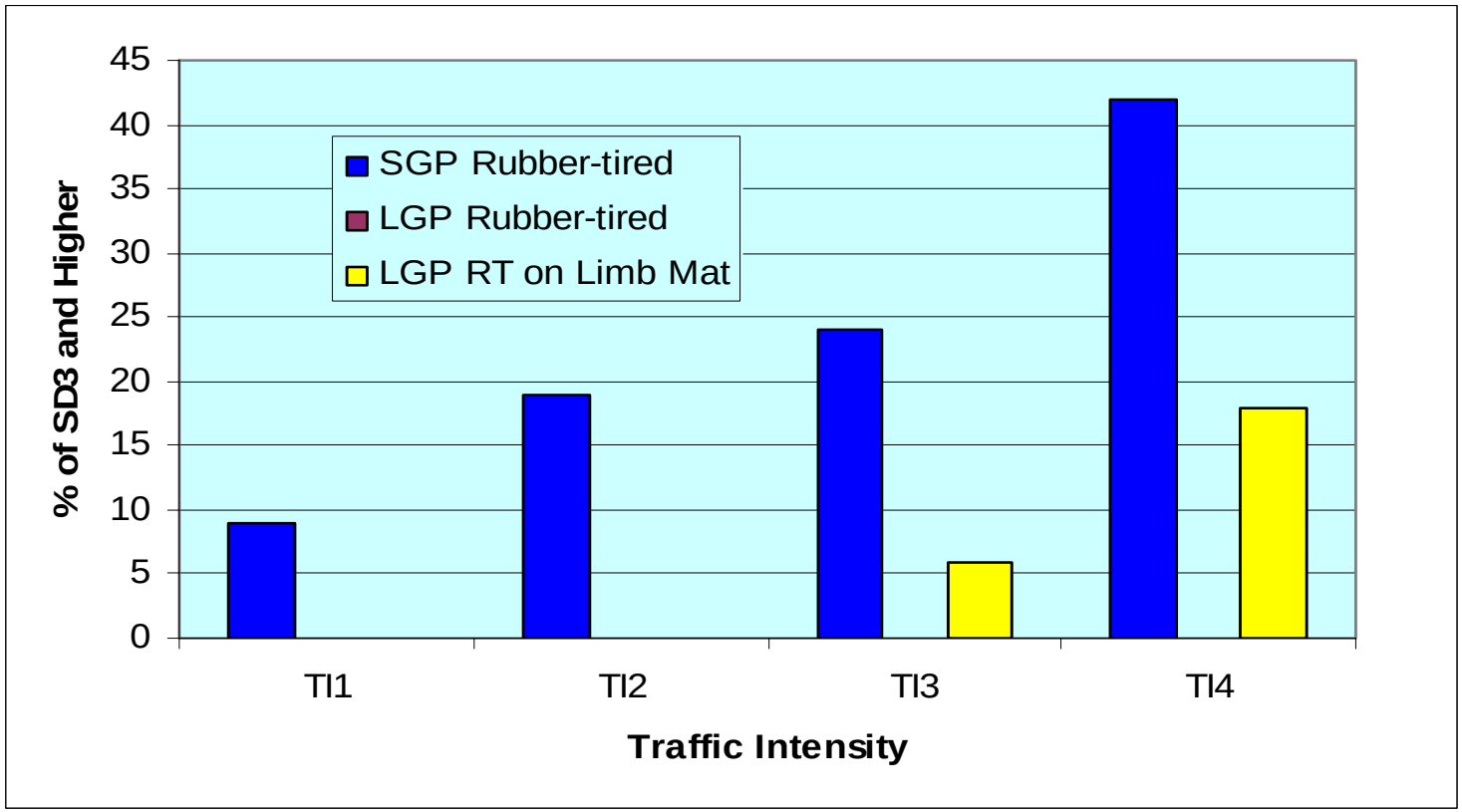
TI2 - Trees which stood on the plot have been removed and no other traffic has passed through the plot.

TI3 - Passes with a loaded machine are between three and ten.

TI4 - More than ten loaded machine passes have been made through the plot.

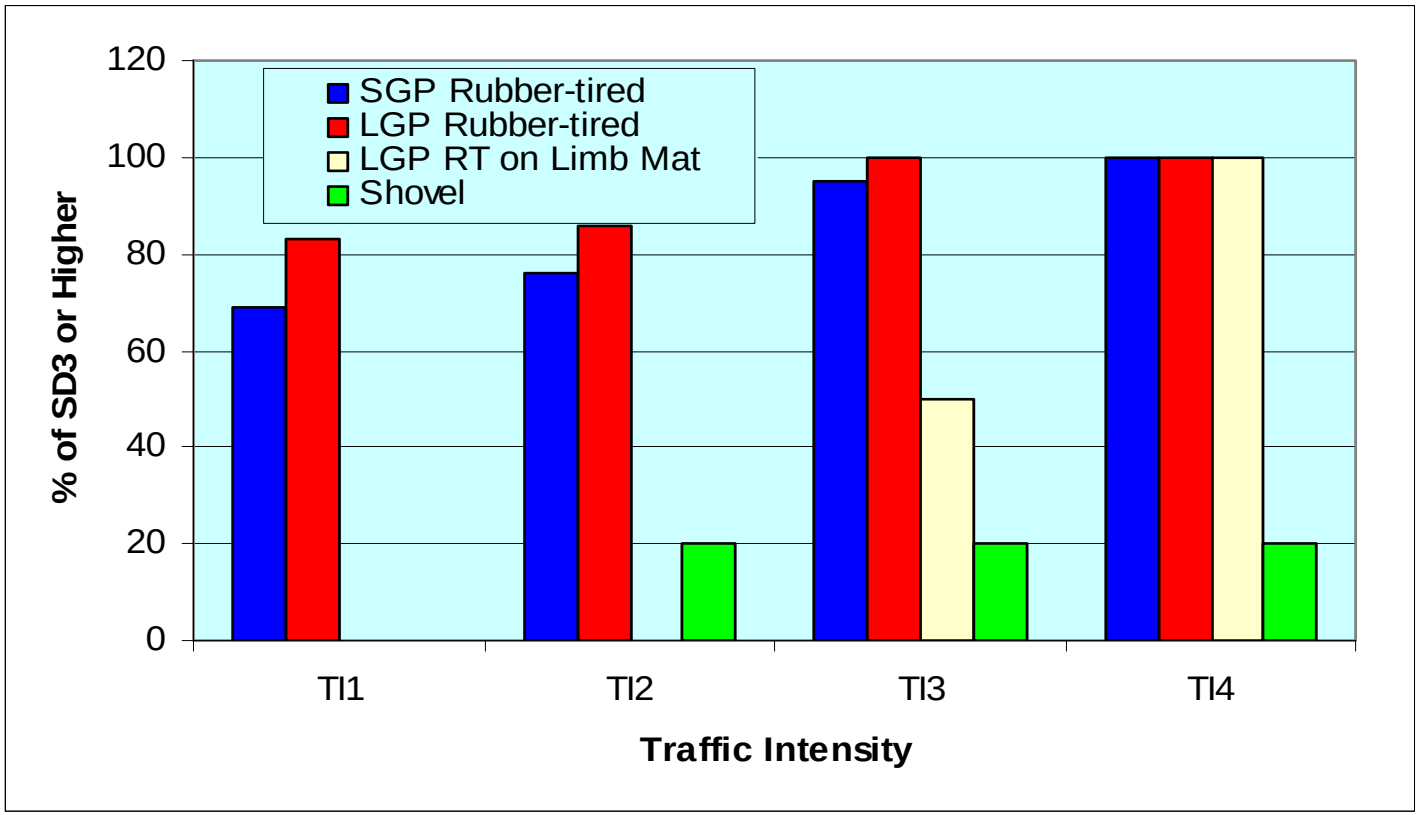
Source: Carruth and Brown (1996).

Percentage of SD3 and Higher
(Soil Moisture < 40%)



Source: Carruth and Brown (1996).

Percentage of SD3 and Higher
(Soil Moisture >= 40%)

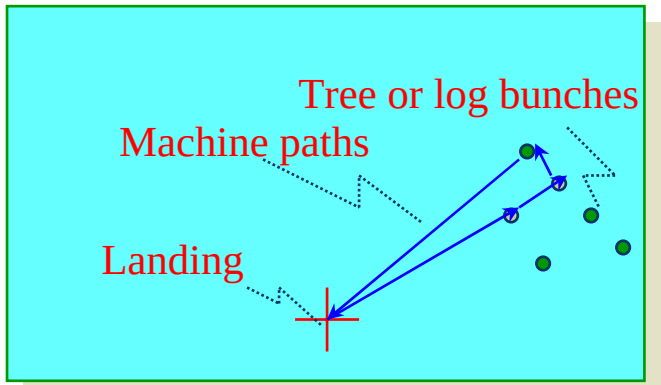


Source: Carruth and Brown (1996).

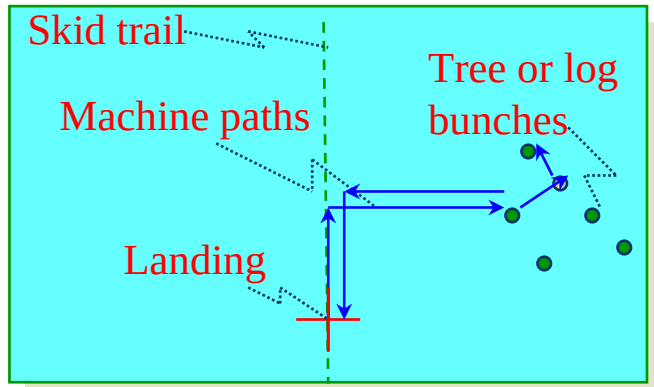
Visual Simulation

- The use of a graphical user interface to provide input on:
  - machine and landing locations, and
  - the size of payload
- The size and location of trees within the stand and the equipment being used are shown to scale on the computer screen.

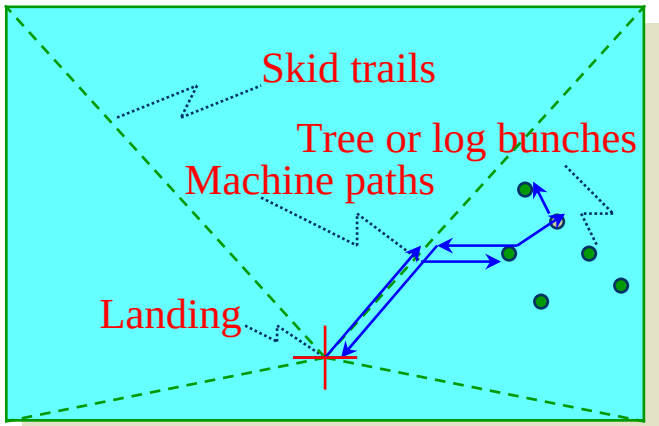
Extraction Patterns



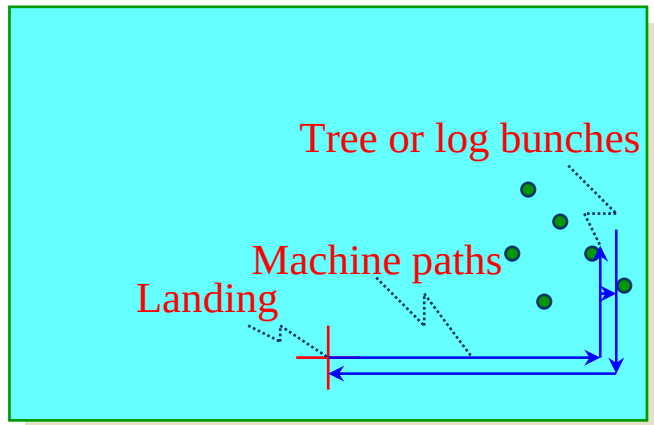
Skidding Pattern 1



Skidding Pattern 2

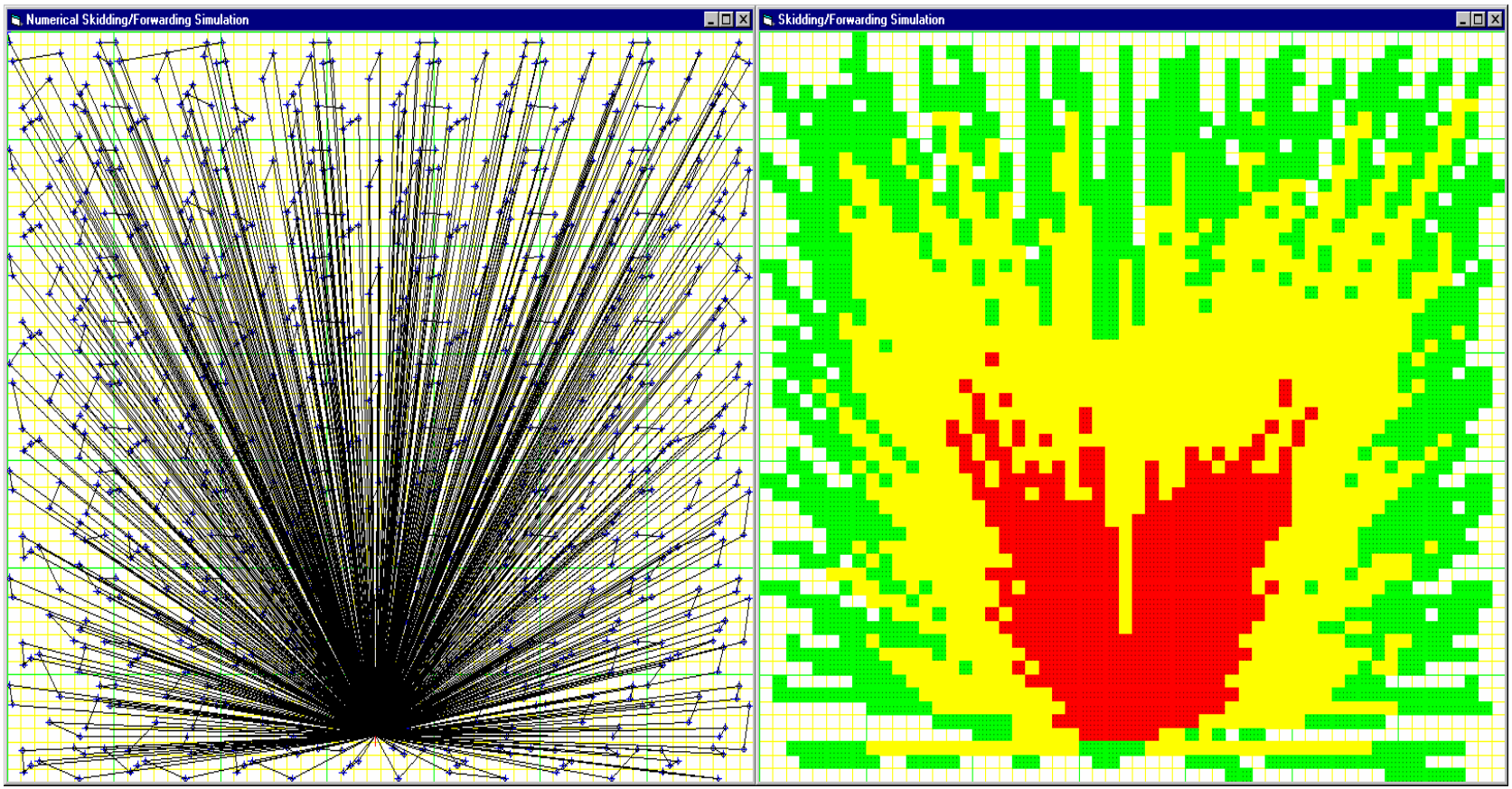


Skidding Pattern 3

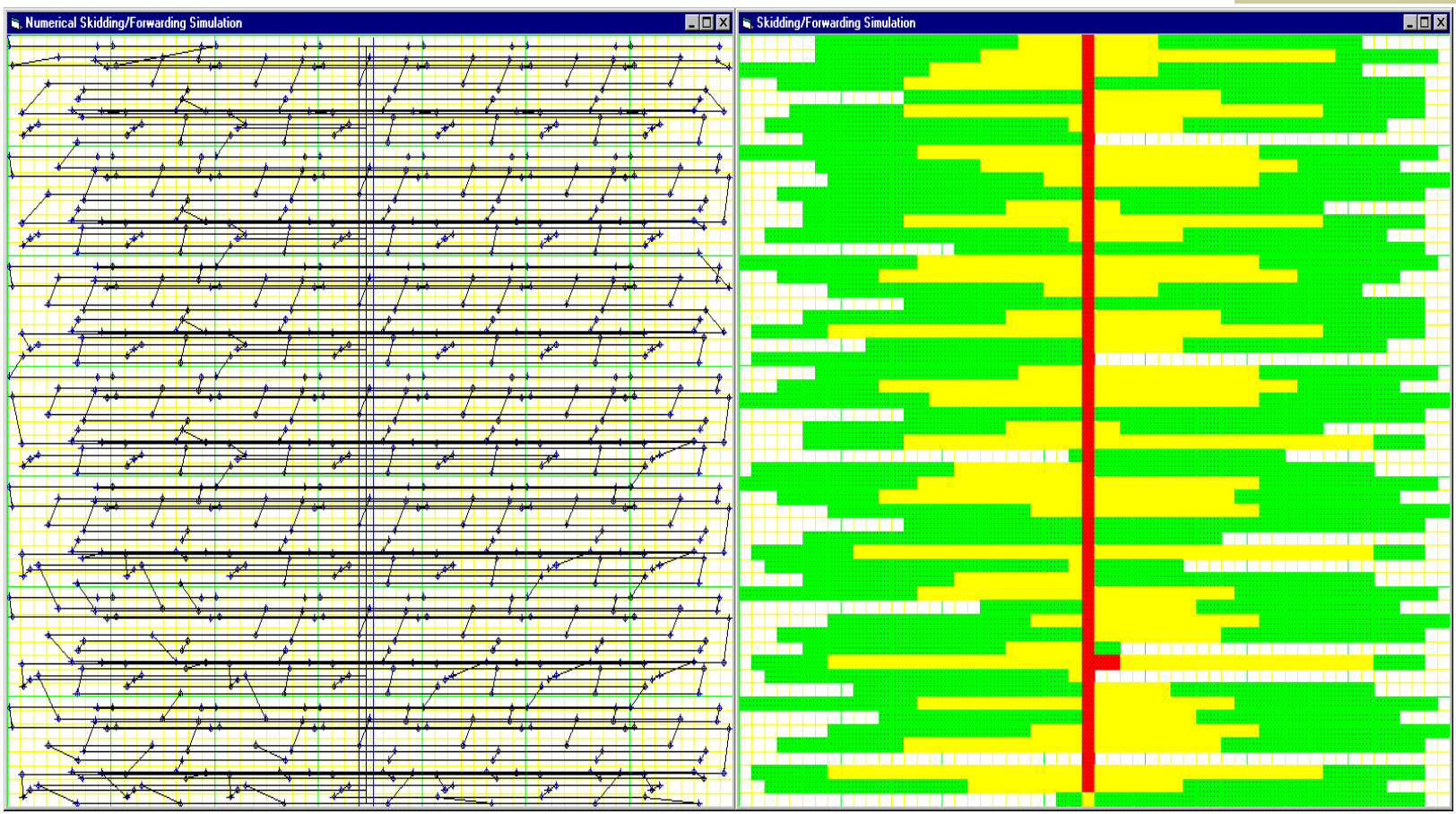


Forwarding Pattern 1

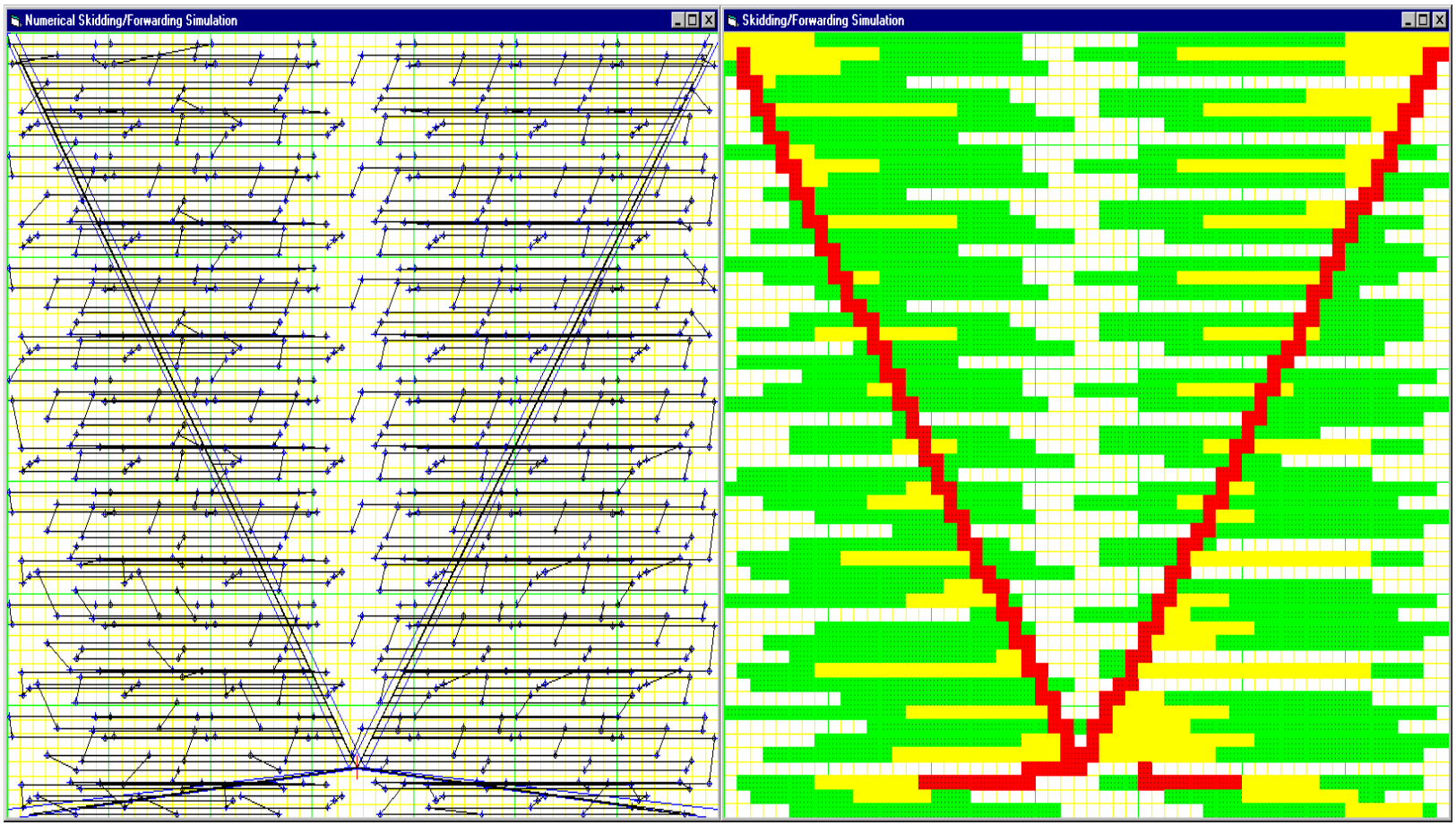
Skidding with No Trails



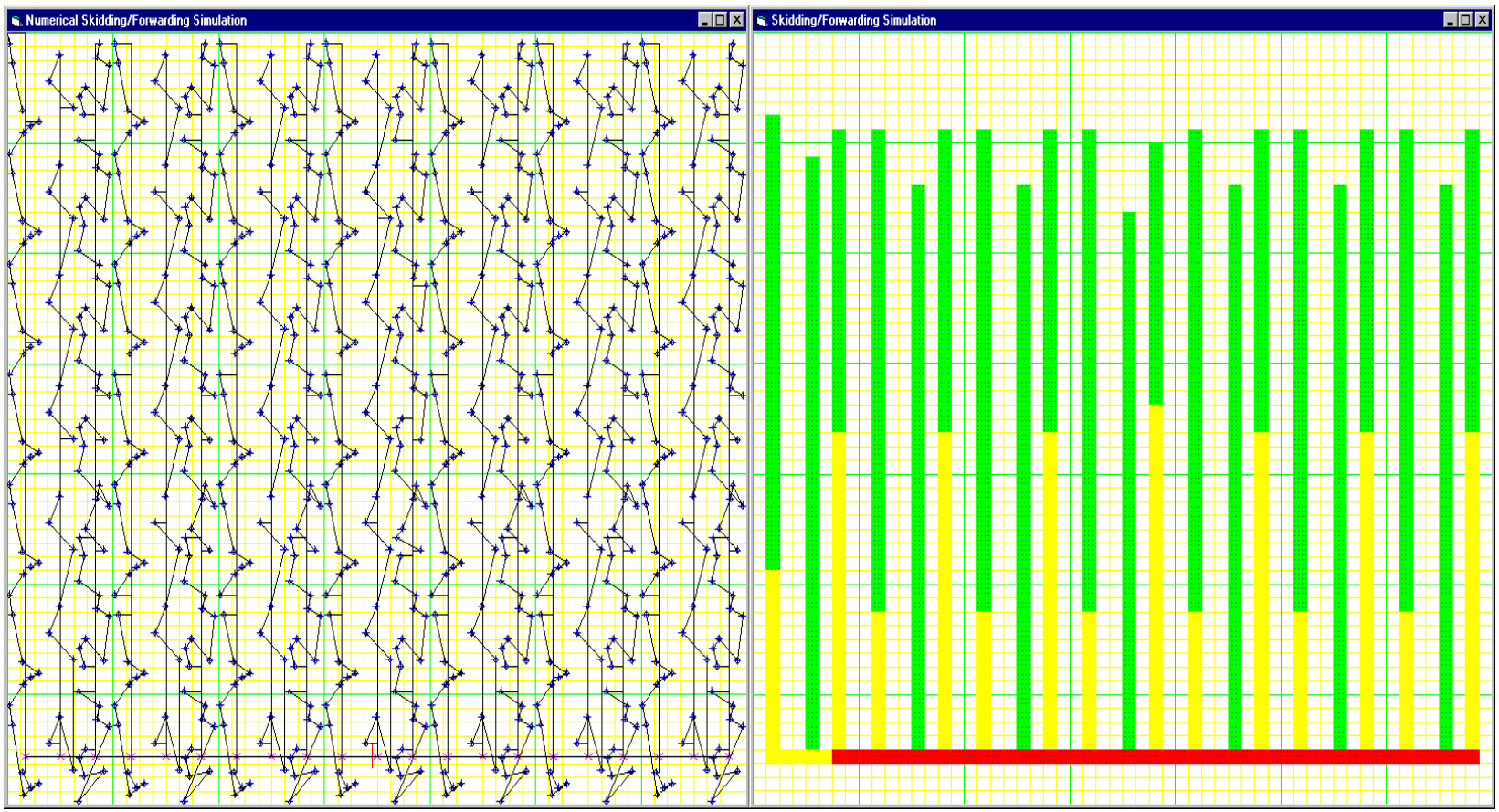
Skidding with One Trail



Skidding with Two Trails



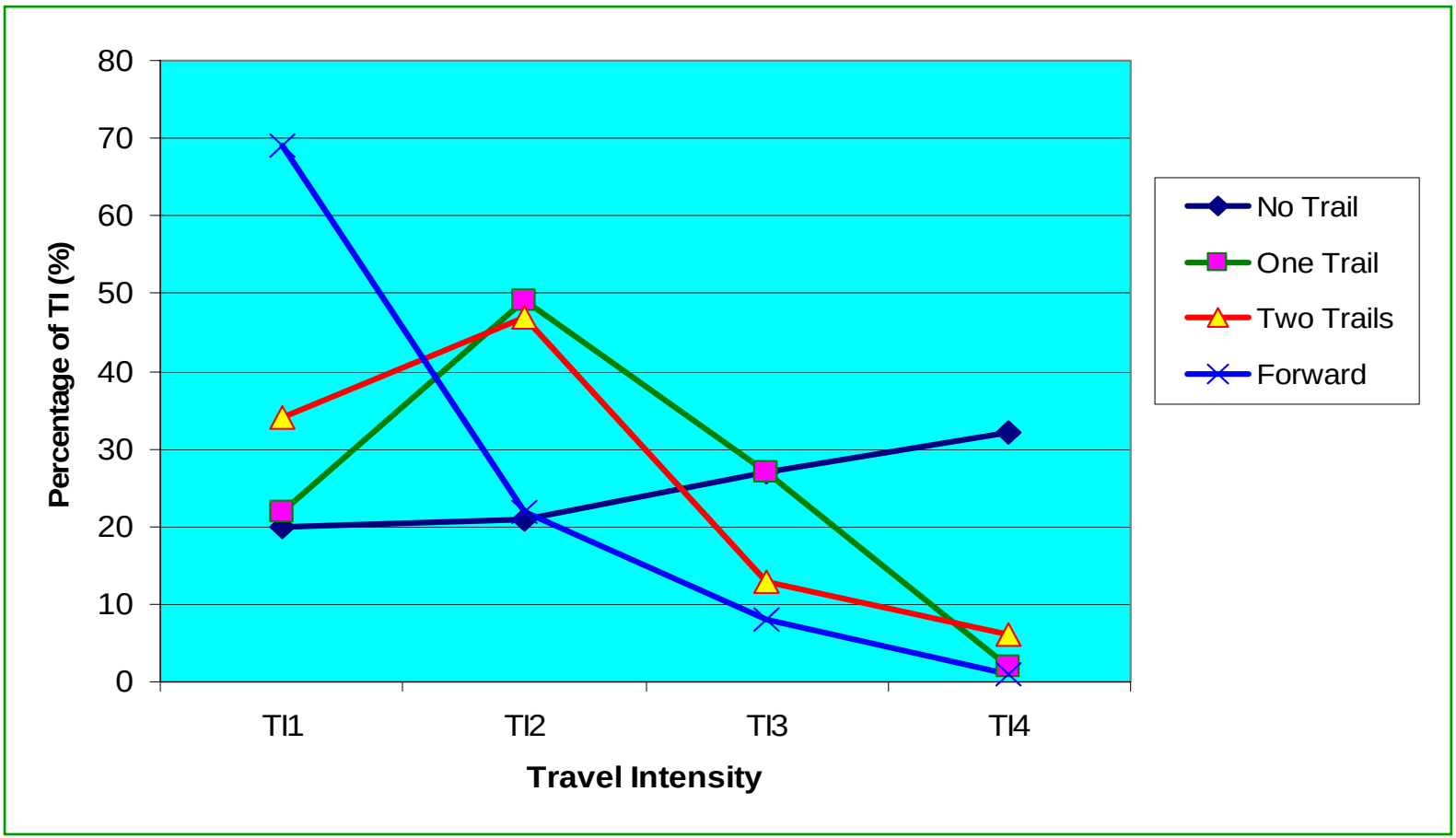
Forwarding Direct to Road



Travel Intensity Levels
by Machine and Method (%)

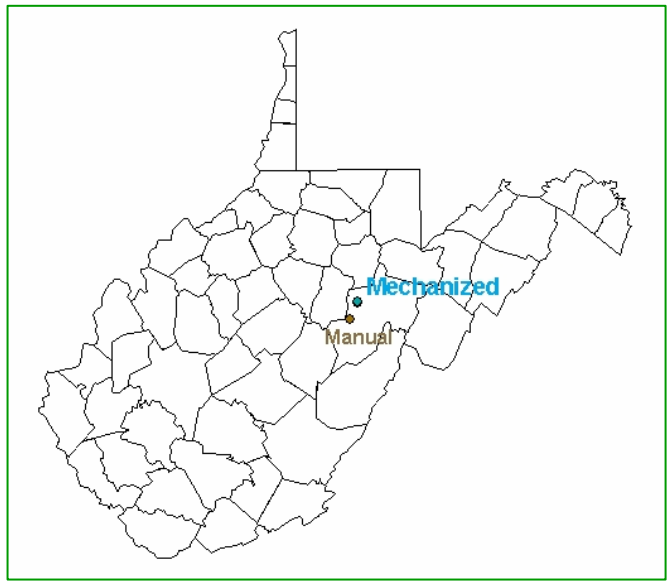
Travel Intensity	No Trail	One Trail	Two Trails	Forward
TI1	20	22	34	69
TI2	21	49	47	22
TI3	27	27	13	8
TI4	32	2	6	1

Travel Intensity Levels
by Machine and Method (%)



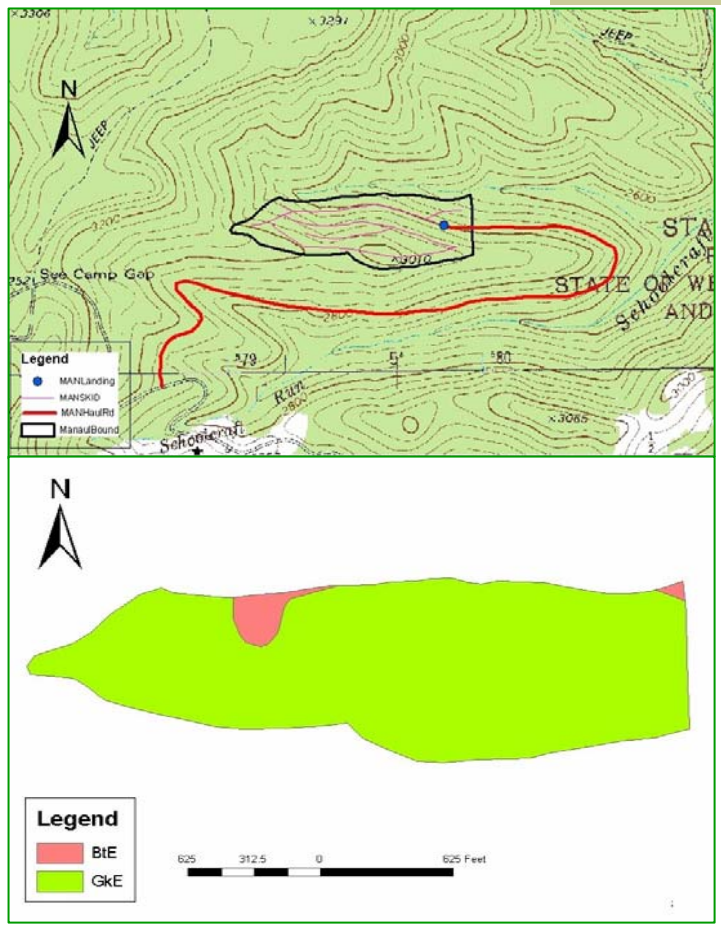
A Recent Study on Soil Compaction in WV

- Document and compare
  - Soil compaction
  - Two systems
- Two sites
- Location
  - Mead-Westvaco
  - Randolph County, WV
- Summer, 2002



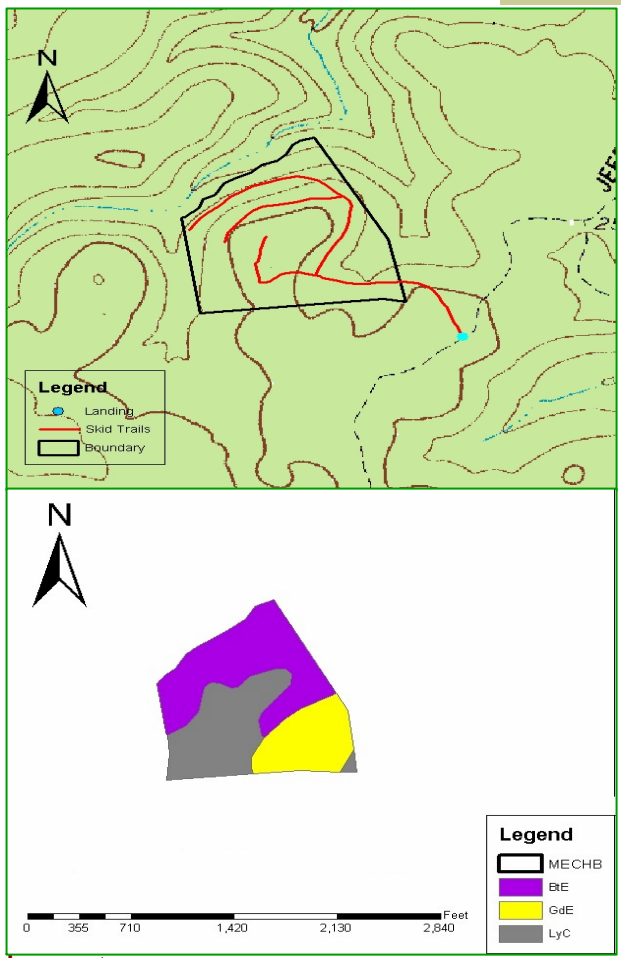
Site Conditions
(Manual Harvesting Site)

- 31 acres
- Selection Cut
- 30-40 % slope
- 3,595 BF/ac
- Mixed Hdwds
- Gilpin series (GkE) and Buchanan (BtE)
- Summer, 2002



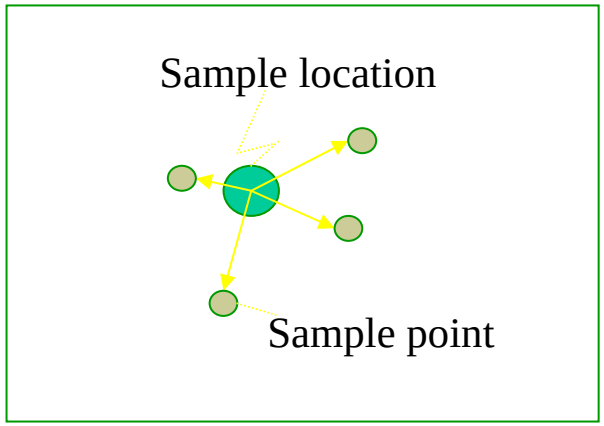
Site Conditions
(Mechanized Harvesting Site)

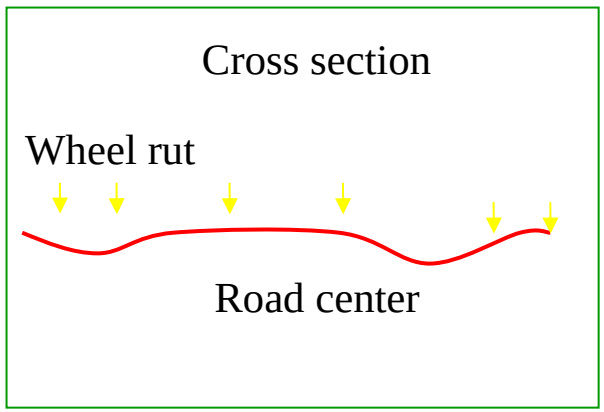
- 34 acres
- Clearcut
- 15-25 % slope
- 5,765 BF/ac
- Mixed Hdwds
- Buchanan (BtE), Gilpin (GdE), and Lily (LyC) series
- Summer, 2002



Sample Plots

- Plots across the site
  - 30 locations installed for each site
  - systematically laid out using a grid of 3 by 3 chains
  - Four samples taken at each location at random direction and distance
- Points in the road
  - Six samples taken at each cross section of the road
  - 10 cross sections on manual site and 14 sections on mechanized site
  - First four cross sections also for compaction vs. the number of loaded machine passes





Harvesting Systems

- Two ground-based systems
- Manual
  - Chainsaw
  - Cable skidder
  - Bulldozer
- Mechanized
  - Feller-buncher
  - Grapple skidder

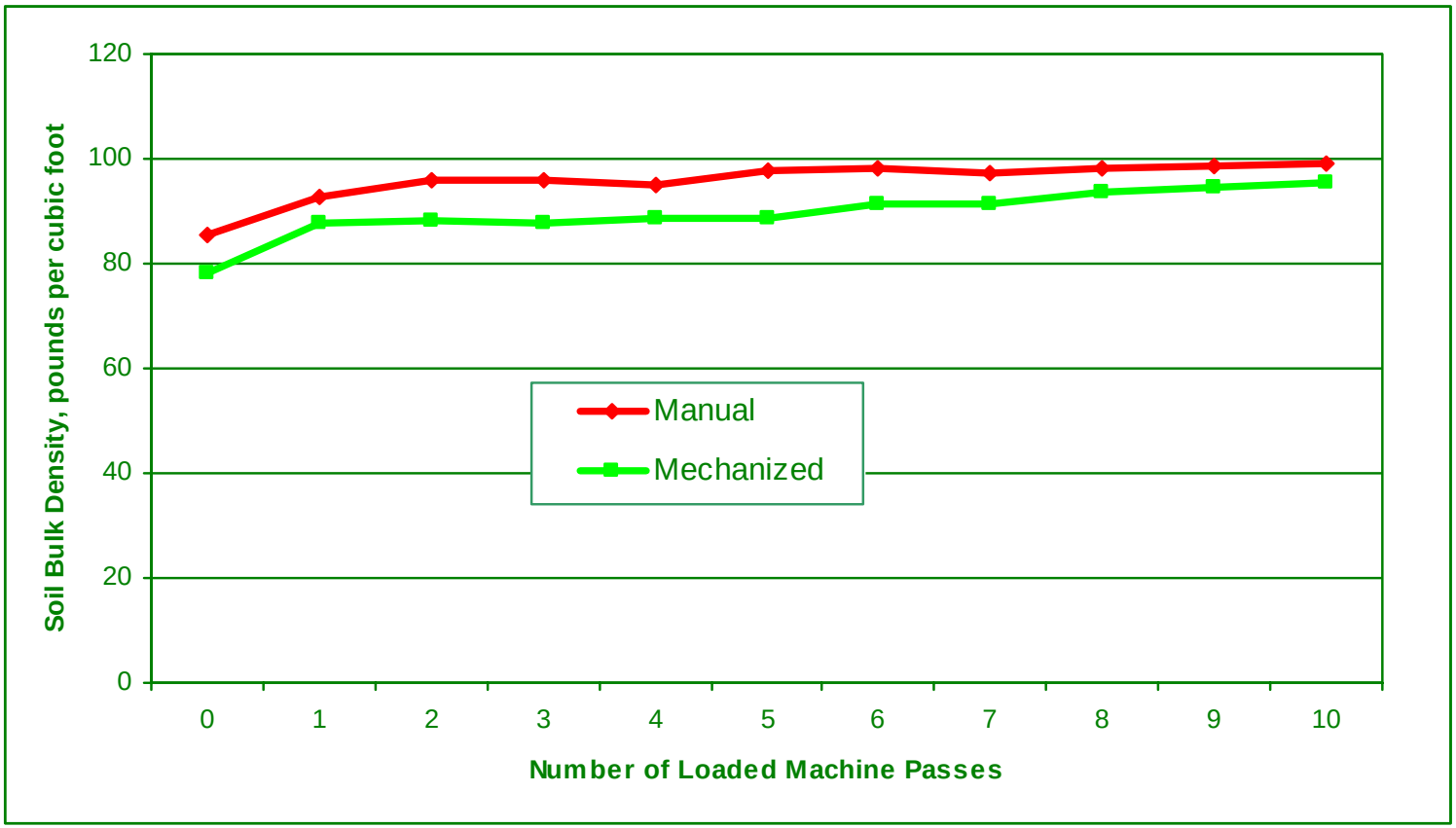
Data Collection

- GPS and wooden poles for locations
- Troxler™ - surface density and moisture gauge
  - Dry density (lbs/ft^3)
  - Wet density (lbs/ft^3)
  - Soil moisture (%)
  - Six inches deep from the top of soil surface
  - www.troxlerlabs.com

Results

- Average compactions of 6.08 lbs/ft^3 across the site and 9.35 lbs/ft^3 in the skid roads were presented on the manual site.
- The average compactions were 1.82 lbs/ft^3 across the site and 7.88 lbs/ft^3 in the roads on the mechanized site.
- The compaction was significantly different between the two harvesting systems.
- Manual system caused more soil compaction than the mechanized system, mainly due to site and machine conditions, soil types, and weather conditions.

Results
(Bulk density vs. no. of loaded machine passes)



Results
(Compaction vs. no. of loaded machine passes)