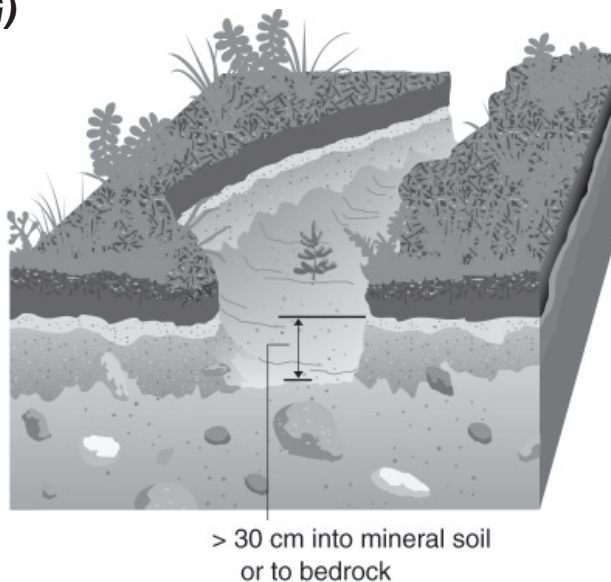


3.4.3 Deep gouges (G)

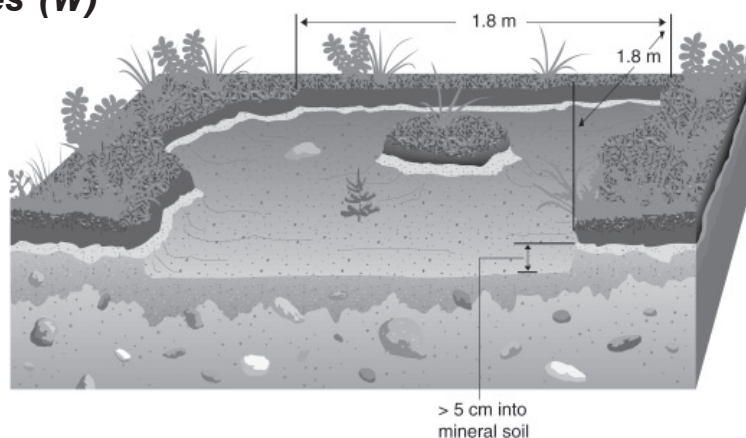


Deep gouges are excavations into mineral soil that are deeper than 30 cm or to bedrock at the survey point.

⇒ Measure from the undisturbed mineral soil surface to the mineral soil surface in the gouge.

Deep gouges must be counted as soil disturbance on all sites.

3.4.4 Wide gouges (W)

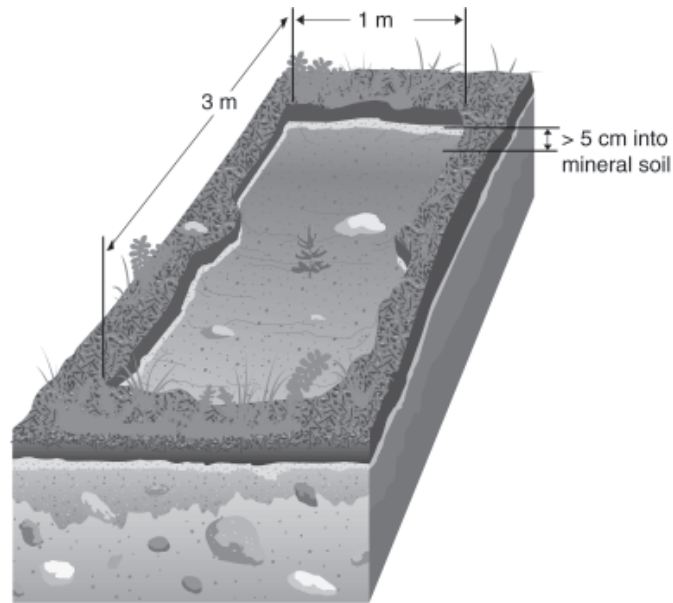


Wide gouges are excavations into mineral soil that are a) deeper than 5 cm at the survey point and b) deeper than 5 cm or to bedrock, on at least 80% of an area 1.8 x 1.8 m.

⇒ Measure the depth of the gouge from the undisturbed mineral soil surface to the mineral soil surface in the gouge.

Wide gouges must be counted as soil disturbance on all sites.

3.4.5 Long gouges (L)

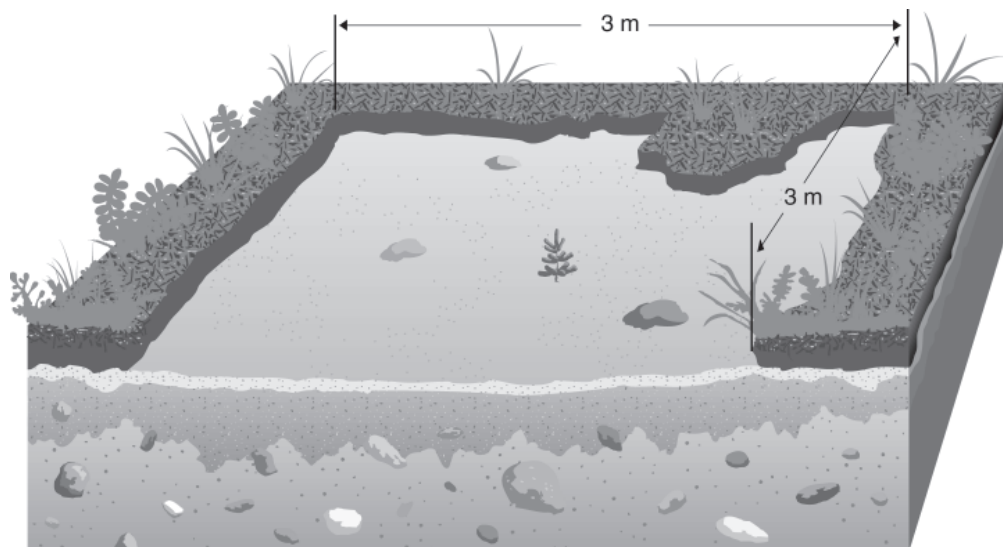


Long gouges are excavations into mineral soil that are a) deeper than 5 cm at the survey point and b) deeper than 5 cm or to bedrock on 100% of an area 1 x 3 m.

⇒ Measure the depth of the gouge from the undisturbed mineral soil surface to the mineral soil surface in the gouge.

Long gouges must be counted as soil disturbance on all sites.

3.4.6 Very wide scalps (V)



Very wide scalps are areas where the forest floor has been removed at the survey point and from over 80% of an area 3 x 3 m.

Forest floor is considered removed when the underlying mineral soil is exposed as a result of scalping, gouging, or burning, and the exposed mineral soil is covered by:

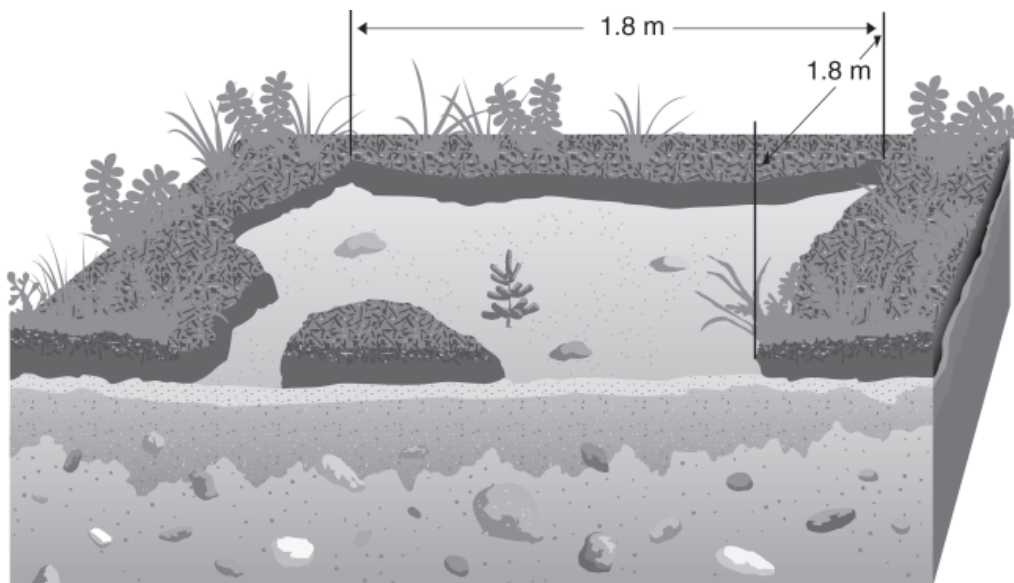
- fine woody slash, undecomposed needles, or dislodged rotten wood, or
- dislodged forest floor that is less than half the depth of the adjacent undisturbed forest floor.

Forest floor is not considered to be removed when it is:

- intact forest floor of any depth, typically showing roots growing into the mineral soil;
- mixed forest floor and mineral soil resulting from prescribed site preparation mixing treatments (mixed forest floor is a non-compact layer at least 5 cm thick at the surface, at least half composed of forest floor material); or
- exposed mineral soil covered by dislodged forest floor that is at least half the depth of the adjacent undisturbed forest floor (dislodged forest floor must be similar to the adjacent undisturbed forest floor to be acceptable).

Very wide scalps must be counted as soil disturbance on all sites.

3.4.7 *Wide scalps (S)*



Wide scalps are areas where the forest floor has been removed at the survey point and from over 80% of an area 1.8 x 1.8 m.

The same definition of forest floor removal applies here as is described above for very wide scalps.

Wide scalps must be counted as soil disturbance on sites with:

- very high soil displacement hazard,
- very high compaction hazard,
- very high soil erosion hazard,
- moderate or high likelihood of landslides, or
- where the hazards for soil compaction, soil displacement, or soil erosion have not been assessed.

3.4.8 Rehabilitation disturbance

Rehabilitation disturbance occurs when a temporary access structure or other type of soil disturbance is satisfactorily rehabilitated.

⇒ Record points that land on rehabilitation disturbance as not counted or undisturbed (“–”).

The acceptability of rehabilitation should not be assessed using the soil conservation surveys described in this manual, but should be evaluated based on completion of the treatments as required in the Timber Harvesting Practices Regulation or described in a soil rehabilitation plan. (Note that rehabilitation disturbance can be dealt with differently under woodlot licence areas, as described in the section on “Woodlot licence area requirements.”)

3.4.9 Prescribed fire impacts

Large areas where *prescribed fire* has completely consumed the forest floor should be treated like scalps. Prescribed fire impacts must be counted as soil disturbance if they meet the specifications described for very wide scalps or wide scalps.

3.4.10 Woodlot licence area requirements

Requirements and definitions related to soil conservation on areas under woodlot licences are provided in the Woodlot Licence Forest Management Regulation, which came into effect on November 30, 1998. Before this date, the requirements for woodlot licensees were the same as for major tenure holders. The following discusses some of the requirements of the new regulation.

The district manager can direct the woodlot licensee to conduct a survey to determine both the total area of the cutblock occupied by permanent access structures and the nature and extent of soil disturbance in the NAR.

For *woodlot licence areas*, a permanent access structure is any in-block road, landing, pit, or quarry not identified as requiring rehabilitation in an operational plan. Excavated or bladed trails, other logging trails, or similar structures may also be permanent access structures if identified as such in an operational plan. The maximum proportion of the total area within a cutblock that may be occupied by permanent access structures is the amount specified in an operational plan, or 7% if there is no amount specified.

Those structures not identified as permanent access structures and not rehabilitated contribute to the total area occupied by soil disturbance. The maximum proportion of any standards unit within the NAR that may be occupied by soil disturbance is the amount specified in the forest development plan or site plan, if an assessment of soil hazards has been carried out. If an operational plan for the area does not specify the maximum proportion of the NAR that may be occupied by soil disturbance, then the limit is 5%.

For areas covered by site plans, the maximum limit for soil disturbance must accommodate the area that will be occupied by all non-permanent access structures. (Note that the term “temporary access structure” is not used, nor defined in the Woodlot Licence Forest Management Regulation.) Even after these structures are rehabilitated, they may still be counted as soil disturbance if they meet any of the criteria for dispersed disturbance. For example, the surface of a rehabilitated temporary road that does not have any forest floor remaining could be categorized as a scalp and therefore count as soil disturbance. (This would not count on an area covered by a prescription held by a major licensee or a timber sale licensee.)

For areas covered by silviculture prescriptions approved before the Woodlot Licence Forest Management Regulation came into effect, access structures identified as requiring rehabilitation do not count as soil disturbance if they are satisfactorily rehabilitated.

For an area under a stand management prescription that calls for mechanized ground-based stand tending treatments using heavy machinery, the maximum proportion of the area to be treated that may be occupied by soil disturbance is the amount specified in the prescription—or 5% if no amount is specified.

4 Survey methods

4.1 Information needed from the approved plan

- ⇒ The purpose of a soil conservation survey is to determine whether the standards in the approved plan (silviculture prescription, stand management prescription, or site plan) have been adhered to. Check the approved plan to determine the following²:
- the date the plan was approved and, in some cases, when it was submitted for approval.
 - Note that if the prescription was submitted before June 15, 1998 but approved after this date, it must adhere to the rules in place prior to the June 15, 1998 legislation and regulation amendments;
 - which access structures are permanent, and the approved maximum allowable limits for these structures;
 - Although not a requirement, worksheets used for calculating road occupancy from road layout and design standards may sometimes accompany the prescription. These worksheets can be useful for comparing proposed and constructed dimensions;
 - which access structures are temporary, by how much maximum soil disturbance limits can be temporarily exceeded to construct temporary access structures, and, if required, *the maximum allowable limits for temporary access structures*;
 - which excavated or bladed trails and other temporary access structures have to be rehabilitated, the maximum time to complete rehabilitation following the completion of harvesting, and, if required, *the methods for rehabilitation*;
 - whether fill slopes are considered favourable or unfavourable growing media (this information is optional for prescriptions, but is useful to know when measuring haul roads and unrehabilitated excavated or bladed trails);
 - whether fill slopes adjacent to permanent roads will not be reforested to improve visibility or to facilitate snow removal;
 - what maximum allowable level of soil disturbance has been approved for each standards unit;
 - *what maximum allowable level of forest floor displacement has been approved for each standards unit (if required)*;

² Note that the information in italics is no longer a requirement for prescriptions submitted and approved on or after June 15, 1998.

- whether roadside work areas may be surveyed separately from adjacent portions of a cutblock;
- the minimum area to which maximum soil disturbance limits should be applied (see section on “Survey methods for soil disturbance—Site stratification”); and
- the hazards assessed for soil compaction, soil erosion, soil displacement, and, if required, *forest floor displacement and mass wasting (Interior sites)*, as well as the likelihood of landslides if a terrain assessment has been carried out (this information is used to determine which soil disturbance categories to count in each standards unit).

Information from the silviculture prescription, stand management prescription, or site plan can be recorded on a Soil Disturbance Summary form (FS 889 in Appendix 6) for reference when assessing soil impacts.

4.2 Visual inspection

A visual inspection is the first level of assessment and can be as simple as a walk-through of the area. It is recommended that the method of inspection and any findings are documented. The back of the Soil Disturbance Summary form (FS 889 in Appendix 6) can be used to make notes and map any areas requiring a further ground check (e.g., such areas as unauthorized temporary access structures or heavily disturbed roadside work areas).

During the visual inspection:

- Verify the location of permanent and temporary access structures, and check whether road widths and landing sizes appear to be excessive or not.
- Look at temporary access structures to determine whether the required rehabilitation has been completed.
- Classify several points within each of the disturbance types present in the NAR (this may involve digging with a shovel to assess compaction and measuring the dimensions of the disturbance).
- Compare the observed disturbance types with the soil disturbance categories that will count on that block.
- Determine whether the disturbance types (see Appendix 7) and levels observed are allowed under the approved plan.
- Identify areas that appear to have excessive disturbance.
- Decide whether a transect survey is warranted.
 - If after an initial visual assessment it appears that disturbance levels may be high, a quick informal survey using a “pacing” method can be useful in

getting a rough estimate of disturbance levels. This “ballpark” estimate may help when deciding whether or not a formal survey is warranted.

- Determine whether a survey should be done for an entire standards unit or a stratified portion of a standards unit (see section on “Survey methods for soil disturbance—Site stratification”).

5 Survey methods for access structures

A road traverse survey or landing survey should be conducted if road widths or landing sizes appear larger than normally required for similar operations and if they are not consistent with road layout and design standards. If structures not identified in an approved plan already exist, they should be treated as an operational plan violation.

5.1 Road traverse survey

Application

- ⇒ Use the following method for measuring the length and width of haul roads and permanent skid trails (i.e., excavated, bladed, or unbladed structures that will be kept free of trees to facilitate repeated stand entries).

Layout

Figure 2 shows layout details of the road traverse survey.

- ⇒ Hip-chain the length and measure the width at fixed intervals (see “Width measurement interval,” below).
- ⇒ Make the first width measurement at one half of the width measurement interval distance from the point of commencement (POC).
- ⇒ Measure the length and width in horizontal distance.
- ⇒ Do not measure the road width on landings.
- ⇒ At junctions or switchbacks, move the width measurement location in 5-m increments in the direction of travel, until you are back on the regular portion of the road. The distance to the next width measurement will be your normal width measurement interval, less the distance you offset.
- ⇒ Conduct a separate survey for each different type of structure (such as permanent skid trails or haul roads) that differ in width by more than 3 m (e.g., a narrow spur road and a wide haul road). See Figure 3.

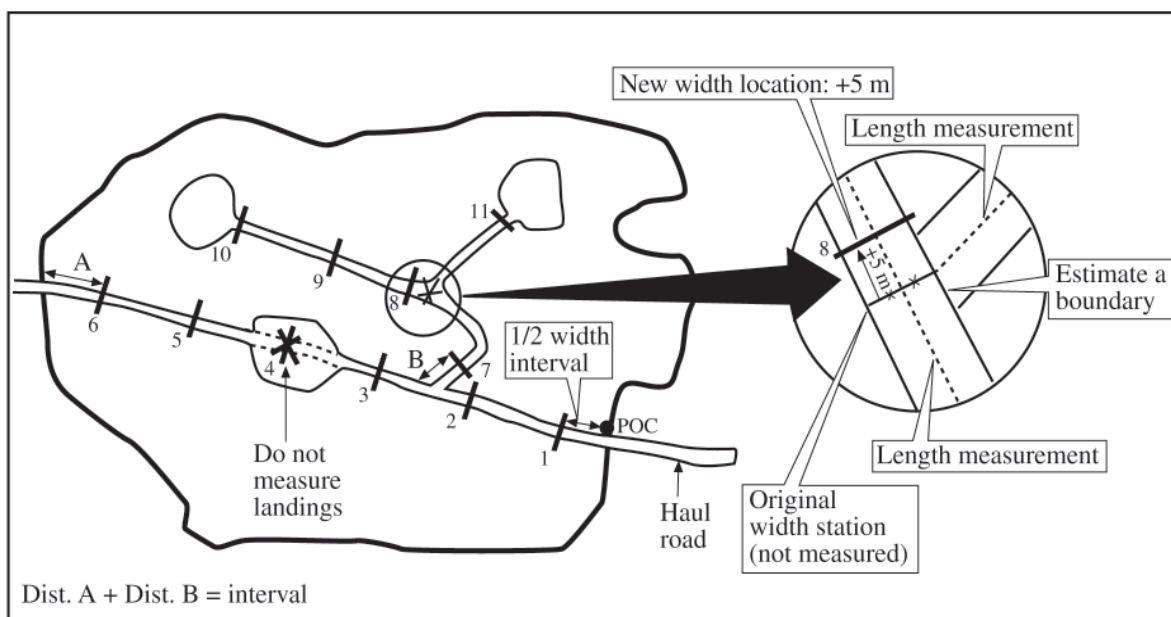


Figure 2. Layout for road traverse survey. Measure the width at approximately 10 locations.

5.1.1 Width measurement interval

The target number of width measurements is 10. Figure 3 shows a typical cutblock, with 10 width measurements for a main haul road and 10 for a spur road.

⇒ Determine the width measurement interval by estimating the total length of road, excluding landings, and dividing by 10.

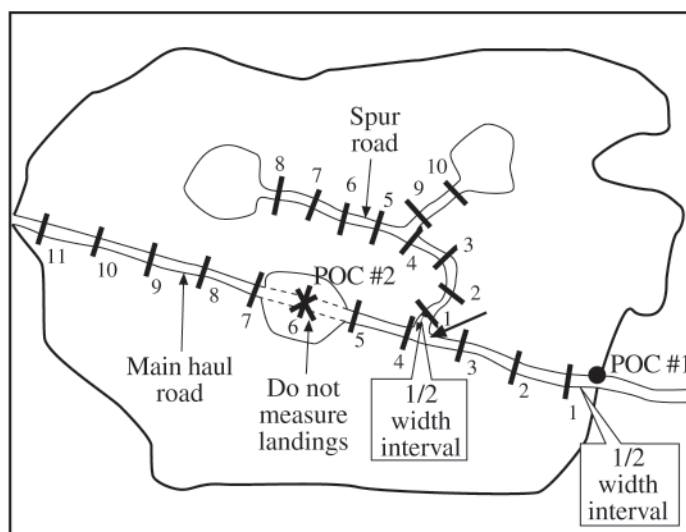


Figure 3. Separate surveys for roads with different widths. Do separate surveys, with approximately 10 width measurements, for roads that differ by more than 3 m in average width.

5.1.2 Width measurement

On sloping ground, the width measured depends on whether the fill slopes are considered favourable or unfavourable for growing trees (see Figure 4) and whether the fill slope will be kept free of trees. Surveyors should review the prescription to determine whether this information has been provided. In most cases information on fill slope material is not specified, and it will be up to surveyors to assess whether material is favourable or unfavourable, in the field. Surveyors should consult with silviculture staff before making this assessment, especially if they are not familiar with local conditions. Detailed descriptions of unfavourable growing media are provided in the *Soil Conservation Guidebook*, and further information may be contained in local or regional guidelines.

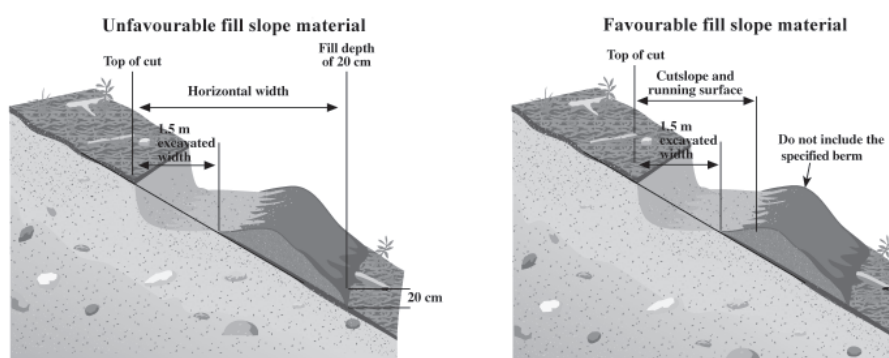


Figure 4. Measuring road widths on sloping ground. Include unfavourable fills greater than 20 cm deep as part of the access structure. For favourable fills, measure only the excavated portion and the compacted running surface.

- ⇒ If fill slopes are unfavourable for tree growth, measure the width to the top of the cut from a point where the sidecast is consistently greater than 20 cm deep. Do not count as sidecast any accumulations of slash that are clean woody debris (i.e., containing less than 30% mineral soil). Ignore isolated patches of sidecast deeper than 20 cm that are not a contiguous part of the road fill. Road fill with buried stumps or slash is always considered unfavourable.
- ⇒ If fill slopes are favourable for tree growth, measure the width of the road or trail from the top of the cut to the outside edge of the running surface. Do not include the uncompacted berm and fill slope.

Road edges that will be kept free of trees (to provide adequate visibility, ensure safety standards or facilitate snow removal) should be included as part of the road area.

- ⇒ On level ground, measure the width in horizontal distance (see Figure 5), including:

- the running surface plus any ditches to the outside edge of each ditch line;
- berms that are made of unfavourable soil material that are greater than 20 cm deep; and
- the area to be kept free of trees for visibility, snow removal, etc.

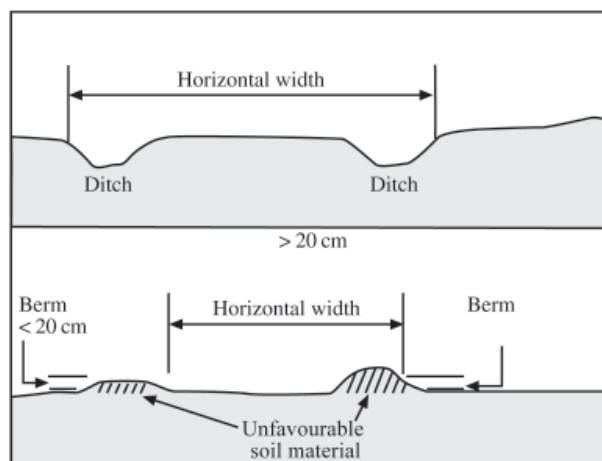


Figure 5. Measuring road widths on level ground. Measure to the outside of the ditches (if present). Otherwise, include berms of unfavourable fill if they are greater than 20 cm deep.

Calculations

- ⇒ Record the measurements on the Traverse Survey Field Card (FS 880; see Appendix 6), and then use the Traverse Survey Calculation Card (FS 881; see Appendix 6) to do the calculations:
1. Complete separate calculations for each type of structure, such as spur roads, main roads, and permanent skid trails. Record the measurements for each type of structure on the front or back of the FS 880 card.
 2. For each type of structure, calculate the total length in horizontal distance.
 3. For each type of haul road, measure the length of road that passes through landings and record this under comments on the FS 880 card.
 4. For each type of structure, calculate the mean and standard deviation for width from the data on the FS 880 card.
 5. For each type of structure, enter on the FS 881 card the number of width measurements, its length³ and mean width, and the standard

³ Use the total length if, when you are calculating the landing area, you exclude the area of the roads that cross through it. Otherwise, subtract the length of road on landings from the total length, but include the areas of road that pass through landings in the landing area measurement.

deviation of width. If you need an estimate of landing area minus its road area, enter the road length on landings in a separate column so that the area of roads on landings can be calculated.

6. Follow the calculation procedure on the bottom of the FS 881 card to determine the area disturbed and its lower confidence limit. When calculating the percentage of area occupied by roads and other permanent access structures, use the total (gross) cutblock area after harvesting has been completed, taking into account any deletions or additions.
7. Use the percentage area error calculated on the FS 881 card (and on the Landing Area Calculation Card FS 886, described below) to calculate the lower confidence limit for the proportion of the cutblock occupied by permanent access structures. Follow the calculation procedures on the bottom of the Soil Disturbance Summary Card (FS 889, see Appendix 6).

5.2 Landing survey

Application

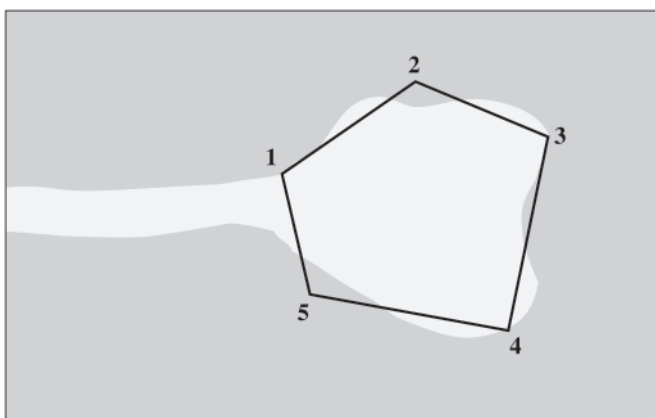
- ⇒ Use the following procedures and methods for determining the area of landings, pits, quarries, and turnouts.

Layout

- ⇒ Avoid surveying landings before disposal of the debris pile. If a survey must be conducted before routine debris disposal, and the edge of the constructed landing cannot be readily determined, measure to the outer edge of the debris pile.
- ⇒ Piles that have been burned, with ash remaining, must be assessed according to the soil conditions under the ash pile. If the pile was burned on the landing running surface or unfavourable sidecast, count it as part of the landing. Otherwise, count the burned portion as part of the NAR.
- ⇒ Measure landing areas depending on whether fill slopes are considered favourable or unfavourable for tree growth (the same as for haul roads):
 - If fill slopes are unfavourable, measure to the top of the cut from the point where the sidecast is consistently greater than 20 cm deep.
 - If fill slopes are favourable, measure from the top of the cut to the outside edge of the landing surface.

- ⇒ On level ground, include the compacted running surface, berms of unfavourable soil deeper than 20 cm, and associated ditches.
- ⇒ Measure landings using a hip chain traverse of the perimeter (the preferred method) or the representative length and width measurements, as described below.

5.2.1 Hip chain traverse



Complete a hip chain traverse to obtain a closure error of 10% or less. For most landings, four to eight stations will provide sufficient accuracy.

If landings are measured using a closed traverse, record the net landing areas directly on the FS 886 form.

5.2.2 Representative length and width measurements

- ⇒ Hip chain representative width and length measurements. Estimate one-quarter and three-quarters of the total distance on the centreline of each dimension (see Figure 6), and record the information on the Landing Area Calculation Card (FS 886; see Appendix 6).
- ⇒ Follow the calculation procedures on the Landing Area Calculation Card (FS 886). To calculate landing area without the area of roads that cross landings, follow these steps:
 1. Determine the length of roads on landings from the road traverse.
 2. Determine the area of roads on landings:

$$\text{area of roads on landings} = \text{length of roads on landings} \times \text{average road width from the FS 881 card}$$
 3. Subtract the area of roads on landings from the total landing area before calculating the lower confidence limit for landings.
 4. Use the percentage area errors from the FS 886 card for landings and the FS 881 card for roads to calculate the lower confidence limit for the proportion of the cutblock occupied by permanent access structures. Follow the calculation procedures on the bottom of the FS 889 summary card.

To be in compliance, the lower confidence limit for the proportion of the cutblock occupied by all permanent access structures must be less than the maximum allowable limit specified in the prescription.

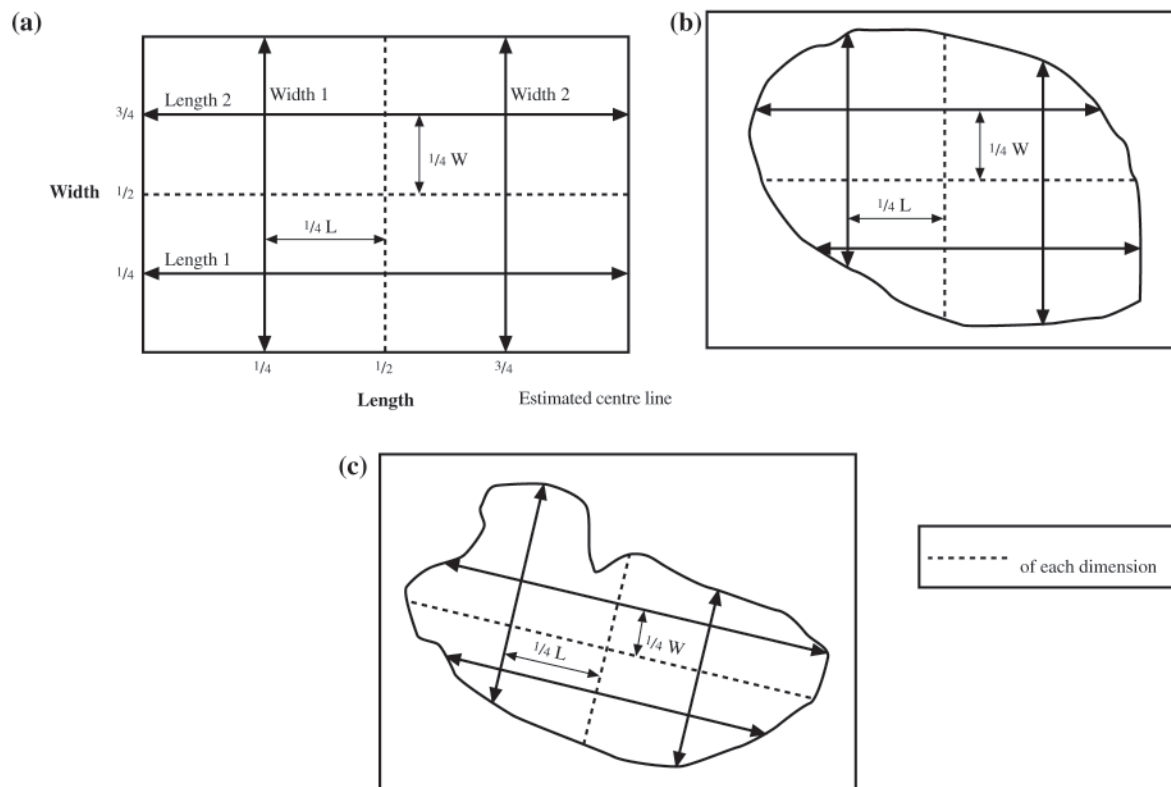


Figure 6. Idealized layouts for landing surveys. It can be (a) a rectangular landing, (b) an elliptical landing, or (c) a complex landing shape. Measurements are taken at points that approximate one-quarter and three-quarters of the length and width of each landing.

6 Survey methods for soil disturbance

Soil disturbance within the NAR includes such harvesting and site preparation disturbances as unrehabilitated excavated or bladed trails, compacted areas, corduroyed trails, dispersed trails (from repeated machine traffic and wheel or track ruts), and gouges and scalps as defined in the Operational Planning Regulation.

The average levels of soil disturbance in the survey area are determined by transect surveys. Transect surveys must be completed as soon as possible after the disturbance was created to avoid confusion caused by the re-establishment of minor vegetation.

Before doing a transect survey, the surveyor should walk the area to become familiar with the various soil disturbances, to confirm the planned orientation of the transects, and to compare disturbance assessments with co-workers.

Transect surveys are also used for assessing compliance with forest floor displacement limits, where such limits are required.

6.1 Site stratification

The objective of stratifying the NAR is to focus a survey on relatively homogeneous areas of soil disturbance that appear to exceed the limits in the prescription or site plan. The intent is not to focus a survey on areas where concentrated disturbance is anticipated (e.g., where trails converge at landings).

Stratification of a standards unit can only be done for either of the following two situations: a) the prescription clearly specifies that the soil disturbance limit applies to a certain size area within the standards unit (e.g., stratification down to one hectare would be appropriate if the prescription specified that the maximum soil disturbance limit of 10% applied to any given hectare of SU “B”),⁴ or b) a survey is required on a roadside work area (described below), in which case it is necessary to have a separate stratum from the adjacent NAR, to assess compliance with the maximum soil disturbance limit of 25% that is set in regulation.

Where stratification of a standards unit is not permitted, surveying should be carried out only on the whole standards unit if it appears that the average level of soil disturbance over the entire unit exceeds the limit.

⁴ The previous edition of the guidebook stated that any standards unit could be stratified down to a minimum of 1 ha and assessed for compliance with maximum soil disturbance limits.

6.1.1 *Criteria for stratified areas*

For areas where stratification is permitted the following criteria should be followed:

- ⇒ The minimum strata size cannot be less than the area to which the limit applies as specified in the prescription, and should not be less than 1 ha (the minimum recommended area for surveying).
- ⇒ Use the same disturbance categories as you would use in surveying the entire standards unit.
- ⇒ Ensure that soil disturbance within each stratum is relatively uniform.
- ⇒ Do not create strata only to encompass small areas where there is an unavoidable concentration of soil disturbance, such as areas immediately adjacent to landings where numerous trails may be converging, and areas surrounding major trail junctions, or surrounding individual skid trails. Note, however, that these areas can be included as part of a larger stratum.

6.1.2 *Surveying roadside work areas*

Roadside work areas are those sites located adjacent to haul roads and used during roadside harvesting operations for decking, loading, processing, and debris disposal. These areas can be subject to concentrated and high levels of soil disturbance. The maximum soil disturbance limit for roadside work areas is 25%, as required in the Timber Harvesting Practices Regulation.⁵ Prescriptions may identify these areas as separate standards units from adjacent portions of the NAR, which will normally have much lower maximum limits for soil disturbance. If these roadside work areas are not identified as separate standards units, they should be considered as a separate stratum for survey purposes.

6.2 *Classifying soil disturbance*

- ⇒ Measure soil disturbance in the NAR with transect surveys, classifying survey points at fixed distances along transect lines. Classify survey points according to the soil conditions observed at the point and in the area around the point.
- ⇒ Always use the flow chart in Appendix 2 to ensure that soil disturbance is counted appropriately.

⁵ Before June 15, 1998, roadside work areas had to be in compliance with maximum soil disturbance limits specified for the standards unit of which they were a part. As of June 15, 1998, roadside work area need only comply with the 25% limit established in the Timber Harvesting Practices Regulation, despite any limit that may be specified in a prescription.

6.2.1 *Assessing the survey point*

At each survey point along a transect line, determine whether soil disturbance exists in accordance with definitions that apply to the prescription for the area. The point observations in these surveys do not involve a fixed plot size.

To classify a survey point, first determine the type of disturbance directly below the point. For example, if the point falls on a small patch of undisturbed forest floor in the middle of a heavily disturbed area, classify the point as undisturbed (field symbol “–”).

6.2.2 *Assessing the area around the survey point*

Most types of disturbance involve size criteria, where the extent of disturbance around the point must also be assessed. For example, a wide gouge (field symbol “W”) must be gouged greater than 5 cm into mineral soil (or to bedrock) on at least 80% of a 1.8 x 1.8 m square.

The extent and type of disturbance in the area around the point is a secondary attribute that is also required to classify the point. For example, if the point is gouged deeper than 5 cm, but the area around the point is only scalped less than 5 cm deep, then the point could not be classified as a wide gouge (W). It may be classified as a wide scalp (field symbol “S”), which may or may not count depending on the assessed soil hazards.

⇒ Think of the area around the point as a sampling window. The sampling window:

- must include the survey point, but need not be centred around it (Figure 7);
- can be oriented in any direction;
- must be oriented to maximize the amount of disturbed area included within the window (Figure 7);
- must be of the size and shape of the disturbance being assessed; and
- can overlap with the sampling windows of adjacent points (Figure 8).

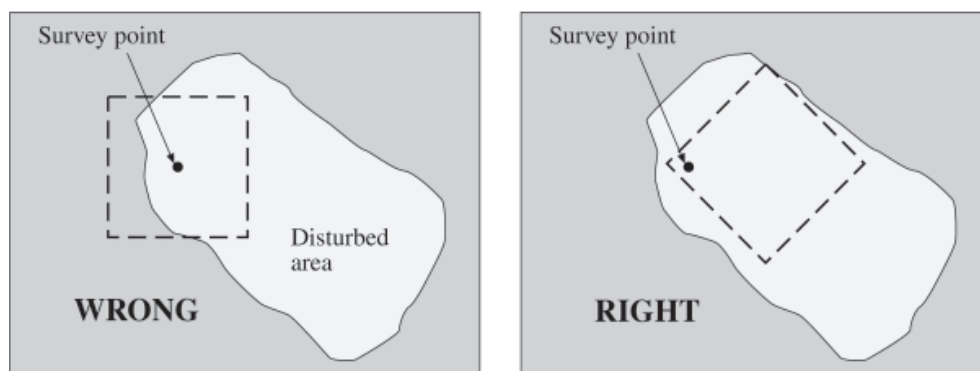


Figure 7. Sampling window orientation. Orient the sampling window to include the maximum amount of disturbed area. The survey window need not be centred around the survey point.

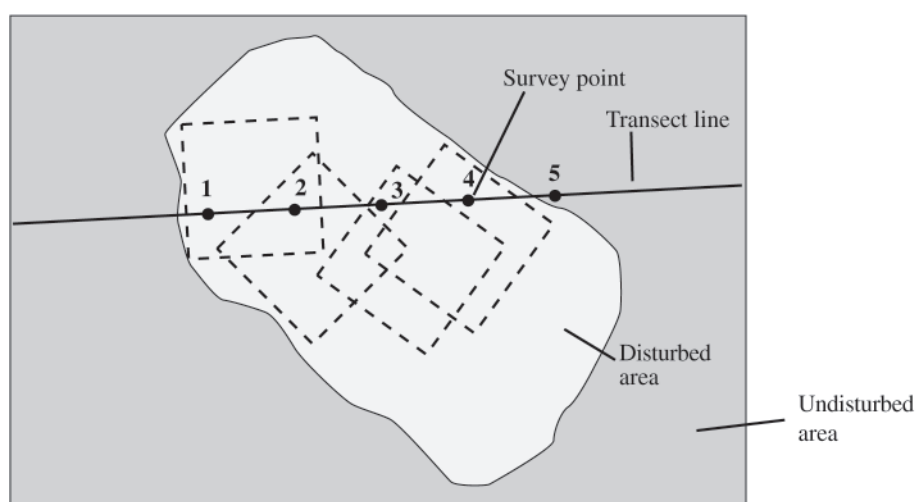


Figure 8. Sampling windows can overlap.

For soil disturbance to be classified within some gouging and scalping categories, a percentage (usually 80%) of an area must be disturbed to a certain level or depth. The percentage is set lower than 100% to account for the natural variation that occurs with some disturbances (e.g., small patches of forest floor that remain in a scalp).

Window dimensions are specified as a percentage of a square or rectangle. In practice, this means that the dimensions of the disturbance can be smaller if the area is 100% disturbed.

Figure 9 shows typical patterns of disturbance and the equivalent dimensions of smaller squares for two common window sizes (1.8 x 1.8 m for a wide scalp or wide gouge and 3.0 x 3.0 m for a very wide scalp).

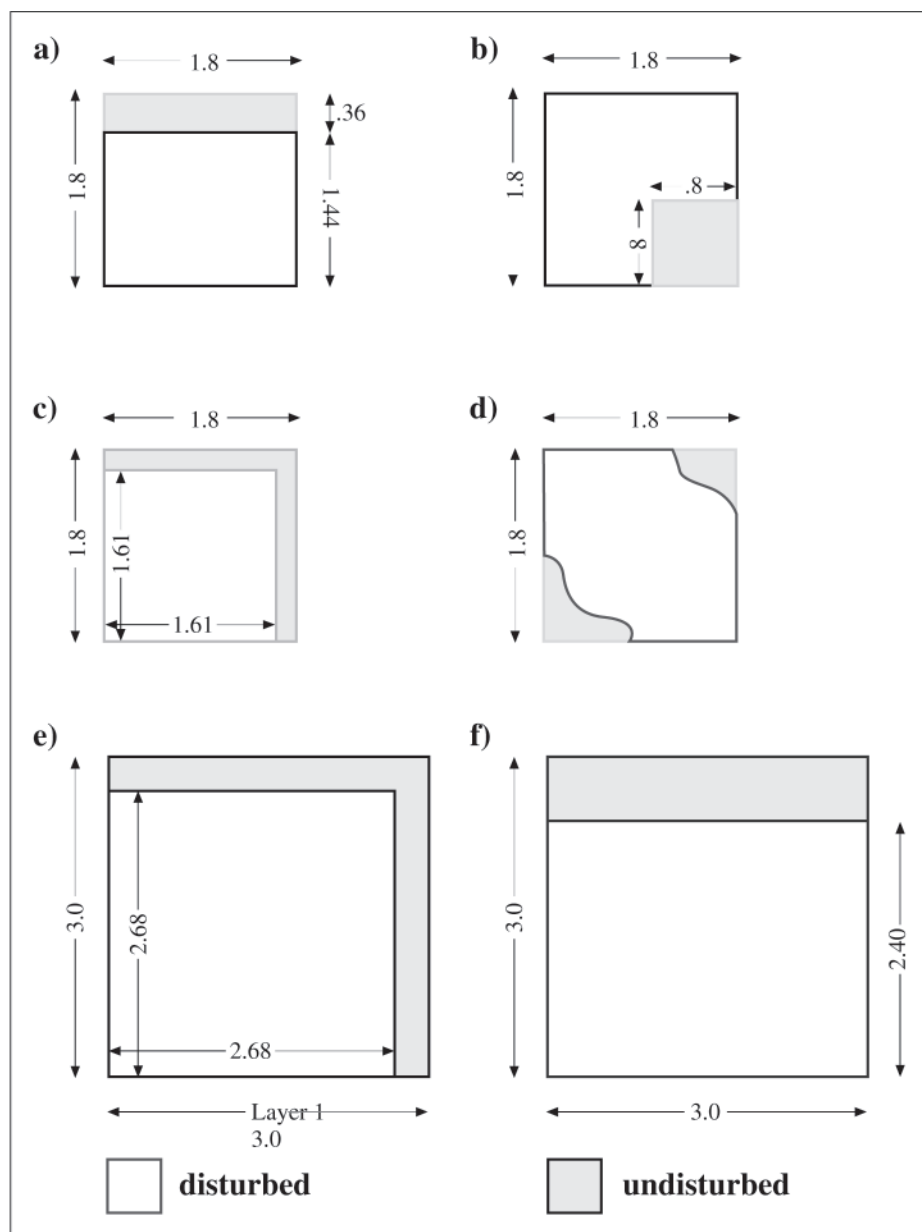


Figure 9. Equivalent sampling window sizes. Typical configurations for disturbance occupying 80% of a 1.8 x 1.8 m sampling window are shown in (a), (b), (c), and (d). Examples of disturbance occupying 80% of a 3.0 x 3.0 m sampling window are shown in (e) and (f).

7 Transect method for areas 10 hectares and smaller

For small areas typically 10 ha or less, the surveyor must establish a series of parallel transects within the survey area, with survey points assessed at defined intervals along each transect. Transects should be laid out to cover the area evenly with approximately 500 points. Two steps are then involved:

- A preliminary survey, using one-half the planned number of transects, must be completed and preliminary calculations made.
- If the preliminary survey results warrant it, the remaining transects must be sampled.

7.1 Preparation

⇒ Follow the steps below:

1. Walk through the survey area to determine the main orientation of soil disturbance, if any. See Figure 10.
2. Decide on a transect orientation that will cross the major disturbance at right angles. If the disturbance has no major orientation, locate transects in a convenient direction.
3. Record the transect bearing on the Transect Survey Field Card (FS 885; see example in Appendix 6).
4. Using Table 3, determine the transect and point spacing for the size of the survey area. Transect and point spacings are shown for areas up to 20 ha in size. It may be cost-effective to use this method for areas up to 20 ha if they have gentle terrain and a limited slash loading.
5. Determine the starting distance for the first transect from the point of commencement (POC) by picking a random number from Appendix 3.

To select a random number, first choose a row from 1 to 40 and a column from 1 to 12. The number in the table at the intersection of the chosen row and column is the one to use as a random percentage. (If a number larger than 100 is selected, use the last two digits.) Multiply the selected random percentage by the transect spacing from Table 3 to determine the distance from the POC to the first transect.

Table 3. Transect and point spacings for small area surveys. Survey points established at these spacings will achieve a sample size of 500.

Area (ha)	Transect spacing (m)	Point spacing within transects (m)
1.0	5	4
1.5	6	5
2.0	8	5
2.5	10	5
3.0	12	5
4.0	16	5
5.0	20	5
6.0	24	5
7.0	28	5
8.0	32	5
9.0	36	5
10.0	40	5
11.0	44	5
12.0	48	5
13.0	43	6
14.0	46	6
15.0	50	6
16.0	45	7
17.0	48	7
18.0	51	7
19.0	54	7
20.0	57	7

7.2 Field survey layout

⇒ Follow the steps below:

1. Establish and label the point of commencement (POC) (see Appendix 5 for marking conventions).
2. Lay out a baseline perpendicular to the transect orientation and flag the location of each transect. Try to locate the baseline in the middle of the area you are surveying so that you have a reference point to help you accurately locate transects.
3. For the first transect, proceed along the baseline using the distance calculated in step 5 of the “Preparation” section. Figure 10 shows a typical layout for this small area method.
4. Sketch a map of the survey strata on the back of the Soil Disturbance Summary Card (FS 889; see Appendix 6). This will help you keep track of your progress and record the survey coverage.

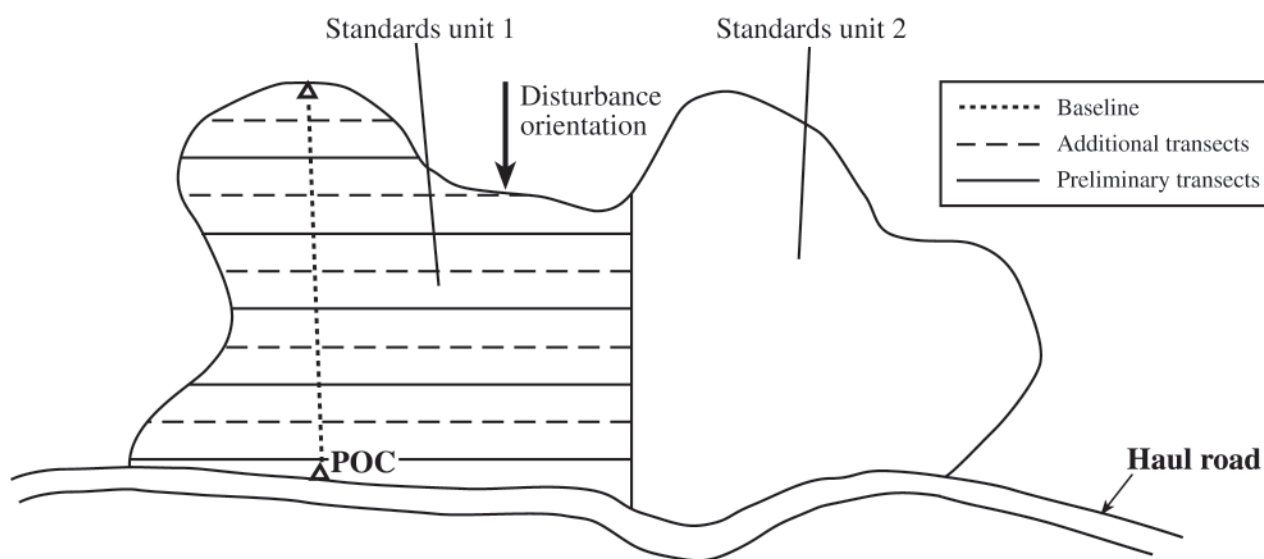


Figure 10. Typical transect survey layout for small areas (<10 ha). The layout shows the transect lines crossing the skidding disturbance. The solid transects are measured first; the dotted transects are added if necessary.

5. Chain along the transects in slope distance. Transects must be chained to ensure that sample points are located without bias. Various methods may be used as long as the points are determined objectively.

The recommended method is for two people to chain 100-m segments and then make point observations while walking towards each other. A hip chain is not acceptable here, as it is difficult to locate sample points objectively when walking over or around obstacles.

On uneven terrain, keep the chain near the ground (within 1 m) by hooking it under slash or running shorter distances. Leave flagging to mark the start and end of each transect segment (e.g., each 100-m section) you survey (see Appendix 5 for field marking conventions). Do not move the chain until those measurements are complete.

7.3 Observations along the transect

- ⇒ Tie or stake the chain taut and classify the soil disturbance directly below every survey point on the chain, using the spacing determined from Table 3. Record results on the Transect Survey Field Card (FS 885) using the symbols from Tables 1 and 2.
- ⇒ Measure to the edge of the survey area. Do not sample the zero point and do not count points that fall outside the survey area (e.g., permanent access structures, mapped non-productive areas).

7.4 Locating subsequent transects

- ⇒ At the end of a transect, move over the equivalent of two times the transect spacing. If you wish, mark the additional locations of the transect end points that could be completed in a full survey. Start the next transect.

7.5 Field calculation procedure

- ⇒ Use the Small Area Transect Survey Calculation Card (FS 897) to summarize the results from your preliminary survey. A completed example of this form is shown in Appendix 6.

1. Add up the number of points classified as counted soil disturbance and the total number of surveyed points. Enter these values in the “Preliminary Survey” column of form FS 897.
2. Calculate the preliminary percentages for counted disturbance by dividing the total for each by the total number of surveyed points.
3. For counted disturbance, obtain the confidence interval (CI) from the table on the back of the calculation card.

“Sample size” on the card means the total number of survey points. The column head “%” means the percentage counted disturbance from step 2.

4. Calculate the upper and lower confidence limits for the preliminary counted disturbance. To do this, add and subtract the confidence interval to the percentage disturbed and to the percentage displaced.
5. Using the upper and lower confidence limits as shown in Table 4, determine whether further surveying is necessary.

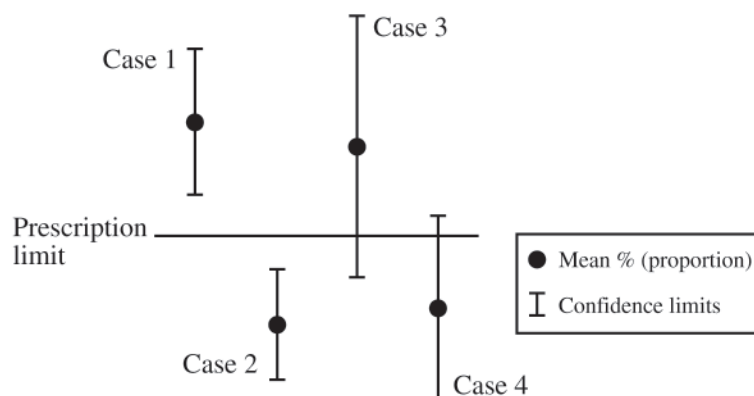


Table 4. Decision rules for comparing survey results to prescription limits

Case	Preliminary percentage	Confidence limit (CL)	Decision
1	Above	Lower CL is above the prescription maximum	Stop surveying
2	Below	Upper CL is below the prescription maximum	Stop surveying
3	Above	Lower CL is below the prescription maximum	Survey remaining transects
4	Below	Upper CL is above the prescription maximum	Survey remaining transects

7.6 Finalizing the survey

⇒ Follow the steps below:

1. If necessary, survey the remaining transects.
2. Subtotal the counted disturbance and then total number of points for the additional transects and record these numbers in the appropriate column.
3. Add these subtotals to the previous subtotals for the preliminary survey above to determine the final survey totals. Enter these survey totals on the FS 897 form in the top “Final Survey” box.
4. Calculate the final percentages for disturbance, as done in step 2 of the preliminary survey.
5. For counted disturbance, obtain the confidence interval (CI) from the table on the back of the calculation card.
6. Calculate the final upper and lower confidence limits for counted soil disturbance.
7. Calculate the non-compliance percentages for disturbance by subtracting lower confidence limits from the limits stated in the silviculture prescription.
8. If the final percentage disturbed and the lower confidence limit (cases 3 and 4) are still on opposite sides of the prescription limit, consider the area to be in compliance.

8 Transect method for areas larger than 10 hectares

For large areas, typically greater than 10 ha, the surveyor must systematically locate a number of grid centres within the area to be surveyed. To do this, points must be assessed at 1-m intervals along two 30-m transects radiating out from each grid centre. The number of grid centres depends on the size of the area to be surveyed. For areas up to 50 ha, a minimum of 30 grid centres is required. For areas larger than 50 ha, one grid centre for each additional 5 ha must be added. (These are recommended as the minimum number of grid centres.) Refer to Figure 11 for layout.

For a more precise estimate of the soil disturbance, it may be necessary to increase the number of grid centres. It is possible to calculate confidence limits for this survey, but they are wider than those obtained using the small area method. Whenever possible, the small area method should be used. In the case of large standards units, all parties (i.e., Forest Service district staff and license holders for the area in question) may wish to consider agreeing on a representative area that could then be surveyed more efficiently using the small area method.

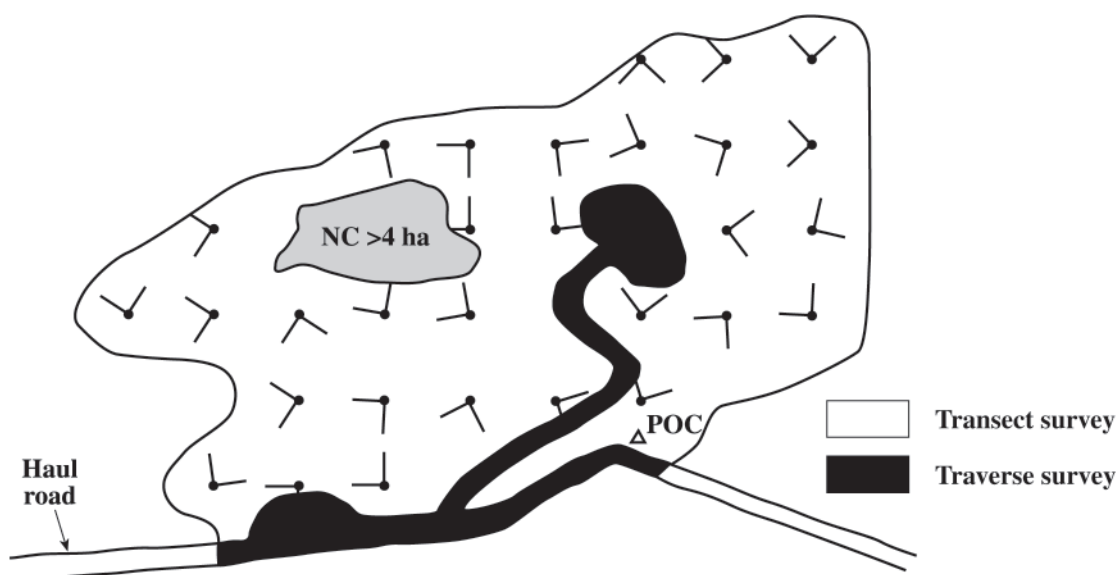


Figure 11. Transect survey layout for large areas (>10 ha). Establish regularly spaced grid centres on cardinal bearings from a random start. As also shown here, survey points are not established in areas of non-commercial cover greater than 4 ha or permanent access structures. Permanent access structures should be surveyed using the road traverse and landing survey methods.

8.1 Grid centres and grid layout

1. The first grid centre is located along a random bearing from the POC (selected from the table in Appendix 3). If the random bearing leads outside the survey area, add increments of 90° to the bearing until it leads into it. (See Appendix 4 for grid spacings to cover areas of various sizes.) Locate the first grid centre at one-half the grid spacing distance from the POC.
2. Flag each grid centre. Number the grid centres with unique numbers for each surveyor (e.g., 1, 2, 3... and 101, 102, 103...).
3. Use cardinal bearings (north, south, east, or west) to locate the remaining grid centres. Chain between grid centres in slope distance. Fill the entire survey area. This may require more or less than the target number of grid centres. The Transect Survey Field Card (FS 885) provides a space for recording the 45° offset spacing that allows diagonal shortcuts between grid centres on adjacent lines.

8.2 Transects and points

1. Fill in the random POC bearing on the Transect Survey Field Card (FS 885).
2. At each grid centre, choose a random bearing (from the table in Appendix 3) for the first transect, and add 90° for the second transect. If a grid centre falls outside the NAR, do not sample any transect points at that grid centre.
3. Mark the start and end of each transect exactly at the 0-m and 30-m marks with blue flags. If large changes in elevation occur, anchor the transect tape. Do not move the survey chain once it is set in place.
4. Record soil disturbance at the point directly below each metre mark. Fill in data on the Transect Survey Field Card, using the symbols from Tables 1 and 2.

As shown in Figure 12, do not sample portions of transects that are outside the NAR. Do not survey points on permanent access structures, outside the cutblock boundary or survey area, or within non-commercial cover greater than 4 ha. Do not sample points that land outside the NAR (e.g., if 12 m of a transect falls on a haul road, measure only the remaining 18 of the transect's 30 points; do not measure any of the points on the road). Mark each non-surveyed point with an X on the Transect Survey Field Card.

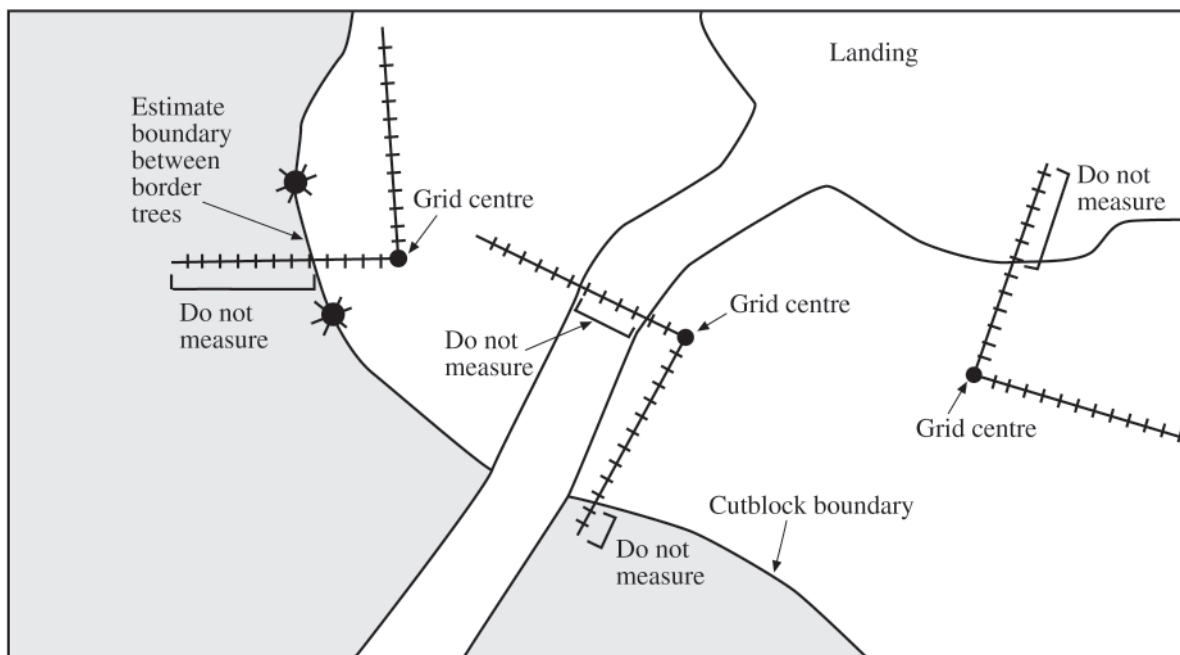


Figure 12. Omit points outside the net area to be reforested (NAR). Do not measure transect points outside the cutblock or on permanent access structures.

8.3 Calculations

1. Transfer the data for each grid centre from the FS 885 form to the Transect Survey Tally Card (FS 896). This optional form helps verify grid centre totals before the calculations are done.
2. Calculate statistics using either a spreadsheet or the Transect Survey Calculation Card (FS 895). The Ministry strongly recommends that a spreadsheet be used. (For more information on spreadsheet programs, contact the Forest Practices Branch in Victoria.)
3. Copy the lower confidence limit data from the bottom of form FS 895 to the Soil Disturbance Summary Card (FS 889) if the calculations were completed without the spreadsheet.
4. See Figure 13 for a flow chart of the tally and calculation procedure.

To be in compliance, the lower confidence limit for the proportion of counted disturbance must be less than the maximum allowable soil disturbance limit.

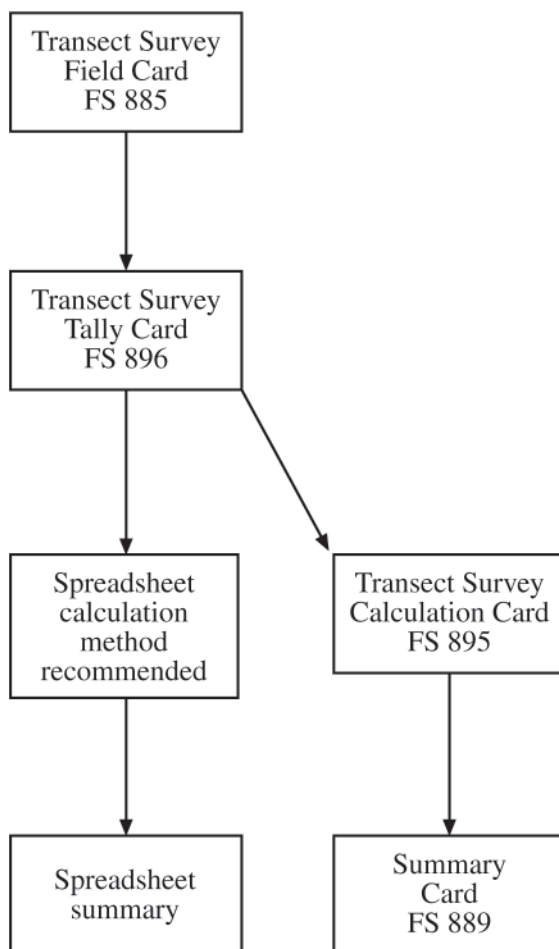


Figure 13. Flow chart for forms recording large area transect surveys.