

BC MINISTRY OF FORESTS, LANDS, AND NATURAL RESOURCE OPERATIONS

GUIDE TO THE VEGETATION MANAGEMENT (Manual Methods) QUALITY INSPECTION SYSTEM

- For use with specifications for manual brushing contained in:
- ministry contract forms - FS717A , or
 - the Forest for Tomorrow (FFT) Vegetation Management.
(manual methods) Standard



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Introduction

This booklet is a guide to the Ministry of Forests, Lands and Natural Resource Operations' *Vegetation Management (Manual Methods) Quality Inspection System*. This system can be used to determine the performance quality for manual vegetation management projects funded by the Province of British Columbia.

Vegetation management quality inspections are carried out to ensure that manual brushing contractors meet the agreed-upon contract specifications, and to determine contractor payment for each brushing unit. These inspection procedures standardize the process and thereby enable a fair and equitable evaluation. This field booklet is designed to assist manual brushing workers, contractors and inspectors in understanding the vegetation management quality inspection procedure.

The inspection system determines how closely the manual brushing conforms to the required standards and contract specifications. Briefly, the system requires the collection of performance data from inspection plots as well as other observations from outside the plots to calculate performance quality and the amount of payment to the contractor.

The system is designed to accommodate the following vegetation control treatments applied over an entire treatment area or around individual crop trees:

- manual cutting, girdling, stem breaking or bending, mulch matting, etc; and
- a wide range of target vegetation, from herbaceous plants to broadleaf trees.

This inspection system is specifically designed to be used in conjunction with the FFT Activity [Specific Standard – Vegetation Management – Manual Methods](#)

and associated treatment plans and work plans or the current ministry manual brushing contract schedule (FS 717A). These contract documents¹ inform the inspection process by specifying the following essential parameters:

- the target number of crop trees per hectare to be brushed (treated);
- the criteria for the selection of crop trees;
- the target vegetation species to be treated;
- the treatment radius around crop trees where target vegetation must be treated;
- mandatory leave trees; and
- other possible treatment specifications.

Each of these items is described in more detail below.

Target Number of Crop Trees per Hectare to be Brushed

Under this inspection system, the contract documents must establish the target number of crop trees to be brushed per hectare. It is recommended that the target number of crop trees to be brushed per hectare should be set higher (e.g. 400 – 600 trees/ ha higher) than the target stocking standard for the site so that all planted trees and any

¹ The term 'contract documents' is used in this booklet to refer to the documents containing the contract specifications.

good quality naturals are brushed. ²

The target number of crop trees to be brushed per plot should be set high enough that there will be few plots with more crop trees than the target number per plot.

Unless the contract documents specify otherwise, the contractor must brush around the best specimens of preferred planted and natural trees to achieve the target number of crop trees to be brushed per inspection plot.

If the contractor successfully brushes more than the target number of crop trees per plot, credit should be provided for brushing the additional crop tree. This should encourage the contractor to treat borderline crop trees as opposed to ignoring them.

Criteria for the Selection of Crop Trees

The contract documents must include a list of the crop tree species in their order of preference and could include a minimum height or other criteria (such as obvious forest health factors) that would make the tree preferred, acceptable or unacceptable as a crop tree.

In recently planted areas where brushing is required to establish a free growing stand and the crop trees are too small for the brushing contractor to readily detect most forest health factors, the contractor is expected to brush around all potential crop trees unless they are showing obvious signs of imminent death (e.g. the needles are turning yellow and brown from root collar weevil).

In stands that contain small natural seedlings alongside much larger crop trees the contractor will not need to brush around small natural trees in plots where the target number of larger crop trees has been brushed. However, there may be situations where some of the larger crop trees have died and smaller natural seedlings may then need to be brushed to encourage their development as replacement crop trees.

It is not recommended that a minimum inter-tree distance be established as a rigid criteria that must be met by crop trees because this may preclude brushing around desirable naturals or planted trees that are slightly closer than the minimum inter-tree distance.

If the number of crop trees in a plot equals or exceeds the target number, the contractor must brush around at least the target number of crop trees per plot by brushing around the best crop trees that are at least 2.0 meters apart followed by brushing the next best crop trees that are closer together.

² At the brushing stage the quality and vigor of some of the crop trees may be compromised by competing vegetation to the point there is uncertainty that all the trees will survive or become free growing. Under these circumstances it makes sense to brush a higher number of available crop trees to increase the likelihood of sufficient stocking to satisfy free growing requirements and produce a well-stocked stand with high merchantable volume.

Target Vegetation Species to be Treated

The contract documents must list all the target vegetation species to be treated or describe the vegetation that must be treated in a way that will be clear to the contractor (e.g. a list of broadleaf trees plus all other shrubs that are within a 1.5 meter radius of a crop tree). To avoid the contract documents not specifying target vegetation species that may be encountered it may be easier to indicate all broadleaf trees and all shrubs as target vegetation that needs to be treated.

Treatment Radius Around Crop Trees Where Target Vegetation Must Be Treated

The contract documents must identify the treatment radius around each crop tree where target vegetation must be treated. The treatment radius stated within the contract documents may vary depending on the height and type of target vegetation. For example, all broadleaf trees within 4 meters of a crop tree are to be treated and shrubs with limited height growth potential may only need to be treated if they are within 1.5 meters of a crop tree. The treatment radius around each tree is measured from the point of germination of each crop tree.

Mandatory Leave Trees

The most common reason for requiring mandatory leave trees is in situations where the stocking of coniferous crop trees is intermittently low because patches of broadleaf trees have taken over the growing space and have caused mortality or seriously suppressed the coniferous crop trees. In such situations, it is desirable to require that commercially valuable broadleaf tree species are retained as mandatory leave trees where no conifers are present. The contract documents should specify the broadleaf species that in addition to being target vegetation are also mandatory leave trees if they are located at a distance as specified in the contract from all coniferous crop trees. The intention of establishing a requirement for mandatory leave trees in such instances is to avoid cutting all broadleaf trees in areas where there are insufficient conifer crop trees and retaining the broadleaves will not significantly impact conifer growth. Without the requirement for mandatory leave trees there will be no enforceable mechanism to prevent the contractor from creating voids by cutting down all the broadleaf trees. In other instances rare tree species can be designated as mandatory leave trees and the circumstances specified for when these mandatory leave trees must not be cut.

Other Treatment Specifications

The contract documents can identify other treatment specifications such as

- the order of preference for optional broadleaf leave tree species,
- the minimum distance that optional broadleaf leave trees must be from crop trees (shouldn't be closer than the brushing treatment radius around each crop tree),
- the height (if any) below which certain target vegetation species don't need to be treated (as long as the target vegetation species is significantly shorter than adjacent crop trees and not expected to seriously compete with the crop trees in the future),

- the maximum height of slash resulting from a manual cutting treatment,
- a maximum treatment height if other than the standard 30 cm maximum stump height,
- a requirement to not completely sever target vegetation stems for bending treatments,
- the location of any no-treatment zones or slash removal zones.

Although certain treatment specifications are necessary, the more treatment specifications, the more complicated vegetation management and its inspection become.

To make the vegetation management as simple as possible, avoid the use of non-essential treatment specifications.

Pre Work Conference

The contract coordinator, the brushing contractor and the inspector should meet (preferably on site), at the commencement of work to discuss and clarify all of the contract specifications and standards that must be complied with.

Vegetation management quality inspection plots should be established for monitoring purposes as soon as brushing starts in order to confirm expectations and rework any quality problems with the contractor's initial work.

Statistical Objective

The intention is not to calculate confidence intervals on the estimate of performance quality but to establish sufficient inspection plots in an un-biased manner so the inspector feels confident that the estimate of performance quality is representative of the work. The inspector can be confident that the contractor should receive full or close to full payment when the inspection plots encounter a consistent pattern of good work with only minor errors.

Survey Design

To provide a truly representative estimate of performance quality an inspection survey must:

1. uniformly and systematically sample the treated area;
2. be free of bias; and
3. have a sufficient number of inspection plots of an appropriate size so that the bulk of the variation in a population is accounted for in the sampling.

A minimum of 15 to 20 plots per treatment unit utilizing a plot size that contains an average of 7 to 10 crop trees will usually deliver the desired statistical precision for an individual treatment unit. To capture an average of 7 to 10 crop trees, a 3.99 m (50 m²) radius plot is typically used in the BC Interior, while a 5.64 m (100 m²) radius plot is commonly used on the coast. A sample of one 3.99m radius plot per hectare is usually sufficient to meet the statistical error for

Interior units larger than 20 hectares. On smaller units the precision of the estimate of performance quality is improved by increasing the number of plots per hectare to a maximum of four plots per hectare.

Where crop tree densities are below 900 trees per hectare or densities are highly variable the use of 5.64 m radius plots is strongly recommended. The same plot size must be used throughout an entire payment unit. With the 5.64 m radius plot size, the total number of plots may be slightly reduced. A minimum of 15 plots per treatment unit is recommended but this will depend on the variability of the quality of work.

If the performance quality is consistently good, establishment of the minimum number of plots should be sufficient; but if performance quality is poor or inconsistent, more plots may be needed to determine that the estimated performance quality is truly representative.

To avoid the risk of bias, a pre-determined (systematic) grid pattern of sufficient inspection plots should be established on the project map so that the entire treatment area will be uniformly and systematically sampled. It is very important to sample the entire treatment area including any timber edges, heavy slash areas, areas of difficult terrain or remote areas.

The distance between plots should be evenly spaced on strip lines (e.g. 100 m apart) but the distance from the start of the strip to the first plot may be varied to between 10 and 110 m. The point of commencement and all plot centers should be ribboned in the field and marked on the project map so they can if necessary, be re-examined. The use of GPS equipment is recommended to establish the plot centre locations as waypoints and establish a track of the area walked between plots. The point of commencement should be an identifiable point (or GPS waypoint) and the distance and bearing to each plot should be carefully measured.

Quality issues

The inspection estimates the level of compliance with most contract specifications using plots. Issues of non-compliance that are sampled within plots are referred to as **errors**. Non-compliance with other contract specifications, such as retaining wildlife trees, retaining rare mandatory leave trees, failure to remove slash from a Slash Removal Zone or treating a No-Treatment Zone are referred to as **faults**. Faults may be identified within the plots but are more likely to be observed by examination outside of plots.

Problems with the quality of work are recorded as:

- plot **errors**, that are defined as either reworkable or non-reworkable, or
- **faults** that correspond with contract specifications that are not suited for examination solely through inspection plots.

Reworkable Plot Errors

Reworkable plot errors are errors found within an inspection plot that **can** be corrected. When a significant number of reworkable errors occur the inspector may choose to flag some of the trees with errors, indicate the area on the project map and, where possible, establish a GPS waypoint so the contractor, where required, can locate the area and correct the reworkable errors.

R1 – Improper Crop Tree Selection

Error R1 – Improper Crop Tree Selection is assigned only when the crop tree that should have been selected for brushing remains undamaged (otherwise the error is NR1 – Crop Tree Damage). As specified in an agreement, the best trees of the highest order preferred crop tree species that are not within the minimum inter-tree distance of each other should have been brushed.

R2 – Target Vegetation Not Treated

Error R2 – Target Vegetation Not Treated is assigned when all the target vegetation within the treatment radius of a crop tree has not been treated. When the inspector encounters significant amounts of target vegetation between plots that has not been treated and the contiguous area exceeds 1/10th ha then the UTM coordinates obtained by establishing a GPS waypoint or similar method of locating the area of missed target vegetation should be provided to the contractor so the area can be located and reworked. On final inspection contiguous areas greater than 1/10th ha left untreated or not treated satisfactorily should be deducted from the payment calculation.

R3– Target Vegetation Leaning on Crop Tree

Error R3 – Target Vegetation Leaning on Crop Tree is assigned when treated target vegetation is leaning against a crop tree or has not been felled to the ground and has the potential to fall onto and damage a crop tree.

R4 – Live Limbs

Error R4 – Live Limbs is assigned when all live limbs on the stump of target vegetation have not been cut or broken off or there is a live limb below the point where a broadleaf tree has been girdled.

R5 – Stump Cut Angle

Error R5 – Stump Cut Angle is assigned when the stump angle on any woody-stemmed target vegetation exceeds 30 degrees from horizontal.

R6 – High Point of Treatment

Error R6 – High Point of Treatment is assigned when a stem of the target vegetation is cut at a height greater than 30 cm above the point of germination, or above an alternate maximum treatment height specified in the contract documents.

R7 – Target Vegetation Not Completely Cut or Girdled

Error R7 – Target Vegetation Not Completely Cut or Girdled is assigned when target vegetation that is required to be completely cut is not completely cut through or a stem that is required to be girdled does not have a continuous girdle band around the entire stem meeting the depth and width requirements of the contract documents. For manual cutting treatments, unless the contract documents specify otherwise, the stems of target vegetation must be completely severed so that the stem does not remain connected to the stump.

R8 – High Slash

Error R8 – High Slash is assigned when the height of the slash exceeds the maximum permissible height specified in the contract documents for a manual cutting treatment.

R9 – Other

Error R9 – Other is assigned for any other reworkable error that is specified in the contract documents. This would normally be an error arising from not meeting an additional non-standard requirement specified in the contract documents.

Non-Reworkable Plot Errors

Non-reworkable plot errors are errors found within an inspection plot that **cannot** be corrected.

NR1 – Crop Tree Damage

Error NR1 – Crop Tree Damage is assigned when crop tree damage results from treatment.

Crop tree damage means damage to a crop tree from vegetation management that results in:

- a cut exposing the cambium or wood on more than one-third of the circumference of the main stem;
- a cut or scrape to the main stem that exposes more than five cm of cambium or wood; or
- breakage of the main stem or breakage or cutting of greater than thirty percent of the live branches.

NR2 – Improper Cutting

Error NR2 – Improper Cutting is assigned when the stems of the target vegetation that are required to be left partially attached have been completely cut or broken off. This error applies to stem breaking or bending treatments where the bark and cambium on one side of the stem is to remain intact at the break or bend.

NR3- Fell or girdle mandatory leave tree

Error NR3– Felling or Girdling a Mandatory Leave Tree is recorded each time the inspector confirms that a mandatory leave tree has been felled or girdled within a plot.

If a mandatory leave tree is determined to be dangerous by a certified danger tree assessor, it may be felled to ensure worker safety without creating a fault.

Suggested reduction in payment per infraction for felled or girdled mandatory leave trees
Suggested reduction in payment per infraction for a felled or girdled mandatory leave tree **outside of inspection plots** is \$100. This charge must not be applied to felled or girdled mandatory leave trees within a plot as these are recorded as non-reworkable plot errors and are therefore included in the performance quality calculation.

NR4- Fell Wildlife Tree

Error NR4 Fell Wildlife Tree is recorded each time the inspector confirms that a designated wildlife tree has been felled.

If a wildlife tree is determined to be dangerous by a certified danger tree assessor, it may be felled to ensure worker safety without creating a fault.

Suggested reduction in payment per infraction for a designated wildlife tree that has been felled **outside of inspection plots** is \$100. This charge must not be applied to a designated wildlife tree that has been felled within a plot as these are recorded as non-reworkable plot errors and are therefore included in the performance quality calculation

NR5 – Other

Error NR5 – Other is assigned for any other non-reworkable error. This would be an error arising from not meeting an additional non-standard requirement specified in the contract documents that cannot be corrected.

Mulch Mat Installation Errors

The following reworkable error codes apply solely to mulch mat installation. The previous reworkable error codes do not apply to mulch mat installation. The Crop Tree Damage non-reworkable error code does apply to mulch mat installation. The plot procedures and performance quality calculations for mulch mat installation are the same as for any other treatment type.

MR1 – Insecure Installation

Error MR1– Insecure Installation is assigned when a mulch mat has not been securely fastened down.

MR2 –Vegetation Not Treated

Error MR2– Vegetation Not Treated is assigned when vegetation that prevents the proper installation of the mulch mat has not been cut, pulled or otherwise removed from where the mulch mat should be placed.

MR3 –Mulch Mat Not Installed

Error MR3– Mulch Mat Not Installed is assigned when a mulch mat is not installed around a crop tree that should have had a mulch mat installed.

Faults That Can Result in a Reduction in Payment

Other violations of contract specifications that could occur either inside or outside of inspection plots are termed **faults**. Typical faults for manual vegetation management that can result in a reduction in payment are described below:

Any observed faults are recorded in the fault section of the inspection plot card below the plot entries. Faults are not to be recorded as plot errors.

F1 – Damage to a No-treatment Zone

Fault F1 – Damage to a No-treatment Zone is recorded each time the inspector confirms that a no-treatment zone (NTZ) has been treated or damaged.

If trees within a NTZ are determined to be dangerous by a certified danger tree assessor, the trees may be felled to ensure worker safety without creating a fault.

It should be established in the contract what the minimal area is, that if damaged, will result in a penalty. The amount by which the payment is reduced or other actions such as contract cancellation are dependent on the significance of resource values in the no-treatment zone and the extent and impact of the damage that has occurred.

F2 – Failure to Remove Slash

Fault F2– Failure to Remove Slash is recorded each time the inspector confirms that slash has not been satisfactorily removed from a slash removal zone (SRZ). The contractor should be given the opportunity to rework this fault. If the contractor is unable, declines or fails to complete the rework satisfactorily then the Province may reduce the basic payment by an amount equal to the Province’s estimate of having another Contractor complete the Work

F3 – Concealed Damage

Fault F3 – Concealed Damage is recorded whenever the cut portion of a cut or damaged crop tree or mandatory leave tree is found intentionally hidden in an obscure location where it would not normally be as a result of cutting. Suggested reduction in payment per infraction is \$100.

F4 –Mulch Mats not Accounted for

Fault F4 –Mulch Mats Not Accounted For is assessed where mulch mats are provided by the Province and the calculation below of *Mulch Mats Not Accounted For* indicates that the number of mulch mats the contractor claims to have installed in the treatment area could not have been installed there.

Calculation of Mulch Mats Not Accounted For

The number of mulch mats reported to have been installed by the contractor minus the number of mulch mats installed per hectare from the inspection plots x the # of hectares treated x 110% = # of Mulch Mats Not Accounted For

Where the above calculation indicates there are mulch mats not accounted for, the basic payment shall be reduced by the amount obtained from the following calculation:

Payment Reduction = [bid price to install each mulch mat + fifty cents] x the # of Mulch Mats not Accounted for.

F5 – Stashed or Wasted Mulch Mats

Fault F5 – Stashed or Wasted Mulch Mats is assessed when an inspector finds mulch mats supplied by the Province that the contractor has abandoned, hidden, disposed of, or wasted by rendering them unusable.

F6 – Non-treatment of Target Vegetation

Fault F6 – Non-treatment of Target Vegetation is recorded and flagged when the inspector encounters significant³ amounts of target vegetation between plots that has not been treated. The UTM coordinates obtained by establishing a GPS waypoint or similar method of locating the area of missed target vegetation can be provided to the contractor so the area can be located and reworked.

Recording the Plot

The following is the recommended procedure for inspecting each plot and recording the results. Figure 1 on page 14 shows a completed sample plot card for 7 plots in a fictional treatment unit A.

1. At the top of the plot card enter the target number of crop trees to be brushed per plot for the treatment unit as determined by dividing the target number of crop trees per hectare from the contract documents by the plot multiplier for the plot radius being used.
2. Observing the entire plot, select and flag⁴ those trees that best meet the crop tree criteria as specified in the contract documents, regardless of whether they were brushed or not. The contractor is expected to brush around the target number of the best crop trees per plot if that many crop trees are present in the plot. The target number of crop trees to be brushed per plot should be set high enough that there will be few plots with more crop trees than the target number per plot.

The inspector will have to examine outside the plot to see if the entire treatment radius of a crop tree located just inside the plot boundary has been satisfactorily brushed. Crop trees that fall on the plot boundary are tallied as being in the plot when the point of germination of the crop trees lies within the plot. After careful examination, if it is difficult to decide if the point of germination of a crop tree is within the plot, always include the crop tree within the plot before considering if the tree has been satisfactorily treated.

Determine the total number of crop trees in the plot and record this in column 3 of the plot card. The total number of crop trees in the plot is determined by first counting all crop trees that have been satisfactorily brushed and only counting any additional crop trees that were not satisfactorily brushed if they

- are needed to bring the total number of crop trees in the plot up to, or closer to the target number of crop trees to be brushed per plot, **or**
- are of better quality than any of the target crop trees in the plot that have been satisfactorily brushed.

In a plot where a smaller less desirable crop tree has been brushed and a larger,

³ If the inspector feels that a small amount of non-treated target vegetation found between plots is representative of untreated target vegetation within the inspection plots there may be no need to rework if the performance quality is above the minimum standard of 85%.

⁴ It is recommended that one color of flagging is used for crop trees that have been satisfactorily brushed and another color is used for crop trees that have not been satisfactorily brushed.

more desirable crop tree has not been brushed, both trees are counted as crop trees even if this means there will be more crop trees than the target number per plot.

3. Each recorded crop tree is assessed for treatment errors. Note any error codes in the reworkable or non-reworkable columns of the plot card as appropriate.

Assign a maximum of one error to an individual crop tree. If there are several errors associated with the same crop tree, record the most serious error code (i.e. a non-reworkable error), noting the other errors in the comments section of the inspection card.

In plots where there are more potential crop trees than the target number of crop trees to be brushed per plot the contractor is required to treat around the best crop trees that are 2 m or more apart before treating around inferior crop trees.

4. If the plot contains the target number of satisfactorily brushed crop trees plus an additional crop tree with a non-reworkable error, the non-reworkable error is not recorded if the crop tree with the error is of lower quality than **all** the satisfactorily brushed crop trees in the plot.
5. After recording crop tree errors, subtract the number of trees in the plot having errors from the plot crop tree total and enter the result in the 'Satisfactory' column.

Finally, record the number of leave trees within the plot. Record the count of mandatory leave trees that the contract documents require to be left under the 'Mandatory' column of the plot card and record the number of leave trees the contract documents state may be left under the 'Optional' column.

Two infractions can occur with respect to leave trees. A mandatory leave tree or designated wildlife tree that is felled outside of a plot is recorded as a fault in the Comments section of the inspection plot card below the plots (see Fault F1 in the next section).

An untreated optional leave tree that is closer to a crop tree than is allowed under the contract documents is recorded against the nearest crop tree as a reworkable error R2 – Target Vegetation Not Treated.

Figure 1. Sample Plot Card (Manual Brushing)

Treatment Unit: A Target # of Crop Trees to be Brushed / Plot: 8
 Plot Radius: 3.99 m
 Inspection Date: _____ Inspector: _____
 YYYY/MM/DD

Plot #	Crop Trees				Leave Trees		Plot Comments/ Observations
	Total	Satis- factory	Rework Errors	Non- rework Errors	Manda- tory	Optional	
1	8	6	2 x R2	0	0	1 Dr	Brush leaning on a crop tree outside of plot.
2	9	9	0	0	0	1 Dr	6Fd, 3 Hw, 1Dr 1 Dr leave tree
3	8	7	0	1 x NR1	0	1 Dr	Top cut off Fd crop tree. 1 Dr leave tree.
4	8	8	0	0	0	1 Dr	8 trees well brushed plus 1 small Hw not brushed.
5	9	8	1xR2	0	0	1 Dr	1 small Hw brushed but better Fd not brushed.
6	8	8	0	0	0	1 Dr	1 small damaged Hw is not : crop tree.
7	8	7	1 x R2	0	0	1 Dr	Cut Dr just outside of plot boundary
Total	58	53	4	1	4	7	

Percent Reworkable Errors: $4 / 58 \times 100\% = 6.90\%$
Percent Non-Reworkable Errors: $1 / 58 \times 200\% = 3.45\%$
Performance Quality % = 100% - Reworkable Error% - Non-reworkable Error %
Performance Quality %: $100\% - (6.90 - 3.45) = 89.65\%$

<u>Fault Code#</u>	<u>Description of Faults</u>
F2	1 A wildlife tree (that was not dangerous to workers) was felled between plots 1 & 2. Deduct \$100 from basic payment.

Comments

Performance Quality Calculation

Calculating Performance Quality - Overview

Unless alternate performance quality formulas are specified in the contract documents or approved in writing by the Ministry, the formulas below are to be used.

The payment for manual brushing projects is based on the graduated payment system. Payment percentage increases as the quality of work increases. One hundred percent payment is reached when the quality of work surpasses 92.5%.

Performance quality (PQ) is calculated by starting out at 100% and subtracting the reworkable and non-reworkable error percentages as follows:

Start	100%
Less:	Reworkable Error %
Less:	<u>Non-reworkable Error %</u>
Equals	Performance Quality %

Calculating Performance Quality

The standard formula for the reworkable error percentage is:

$$\text{reworkable error \%} = \left(\frac{\text{total number of reworkable errors}}{\text{total crop trees}} \right) \times 100$$

Using the sample plot data in Figure 1, the reworkable error % is calculated as:

$$\text{Reworkable Error \%} = 4 \text{ reworkable errors} / 58 \text{ total crop trees} \times 100\% = 6.90\%$$

The standard formula for the **Non-reworkable** error percentage is:

$$\text{non - reworkable error \%} = \frac{\text{total number of non - reworkable errors}}{\text{total crop trees}} \times 200$$

Using the plot data in Figure 1, the non-reworkable error % is calculated as:

$$\text{Non-Reworkable Error \%} = 1 \text{ non-reworkable error} / 58 \text{ total crop trees} \times 200\% = 3.45\%$$

Substituting the above two values into the Performance Quality calculation gives a Performance Quality of 89.65% as follows:

Start	100%	100.00
Less:	Reworkable Error %	6.90
Less:	<u>Non-reworkable Error %</u>	<u>3.45</u>
Equals	Performance Quality %	89.65

Unsatisfactory Performance

Performance Quality Below 85%

The ministry considers 85% to be the lowest acceptable level of performance quality. Under most contracts between the ministry and other parties, when performance quality falls below 85% the ministry may choose to terminate the contract or require the contractor to rework the area by a specified time, if it is possible to raise the performance quality by reworking the area. If the contractor re-works an area, the majority of reworkable errors must be corrected to improve performance quality.

Crop Tree Damage Exceeds 3%

Unless otherwise specified in a contract, the ministry considers work to be unsatisfactory when crop tree damage exceeds 3%.

Excessive crop tree damage is a serious situation, particularly where stocking is already low. In such cases, careless brushing can reduce a stand's final timber yield by a substantial amount. This is why the tolerance for crop tree damage is relatively low.

The % crop tree damage is calculated by dividing the total number of crop trees across all plots having error NR1 (crop tree damage) by the total number of crop trees in all plots and multiplying by 100 to express the result as a percentage.

$$\text{crop tree damage \%} = \frac{\sum NR1}{\text{total crop trees}} \times 100$$

Using the sample plot data in Figure 1, crop tree damage is:

$$\text{Crop Tree Damage\%} = 1 \text{ crop tree damaged} / 58 \text{ total crop trees} = \mathbf{1.72\%}$$

In this example, the damage level is borderline as only one more damaged crop tree would exceed the 3% acceptability limit. A contract may be terminated when 3% crop tree damage is exceeded.

Calculation of Basic Payment

The Payment % is calculated from the performance quality percentage (PQ), by applying the following formula:

$$\text{Payment \%} = (\text{PQ} \times 1.08) - \frac{[100 - (\text{PQ} \times 1.08)]^2}{8}$$

The Payment % will not exceed 100% and is set at 100% if the above calculation indicates the payment % is above 100%. For contracts where the bid price is expressed in dollars per hectare the Basic Payment is calculated as follows:

$$\text{Basic Payment} = \text{Payment \%} \times \text{Bid Price (\$/ hectare)} \times \# \text{ of Hectares Satisfactorily Completed}$$

For mulch mat installation contracts where the bid price is expressed in dollars per mulch mat installed, the Basic Payment is calculated as follows:

$$\text{Basic Payment} = \text{Payment \%} \times \text{Bid Price (\$/ Mulch Mat Installed)} \times \text{Confirmed number of Mulch Mats Installed}$$

The Confirmed number of Mulch Mats Installed does not include any mulch mats stashed, wasted or not accounted for

Reductions to Basic Payment

If the Contractor fails to treat any area(s) which the Province considers to be treatable, and if the Contractor is unwilling or unable to treat the area(s), then the Province may reduce the basic payment by an amount equal to the Province's estimate of having another Contractor complete the Work.

Refer to the section entitled "**Faults that can Result in a Reduction in Payment**" and reduce the basic payment for any applicable faults that the contractor should be assessed for.

i.e. Plot Performance Quality % = 88.610 Less Non-plot Error % (- 0.025) Equals Total Performance Quality % 88.585

Alternate Quality Inspection Systems for Girdling

In situations where the brushing treatment only involves the girdling of broadleaf trees an alternate quality inspection system can consist of circular plots where performance quality is determined by the total # of properly girdled trees divided by the total # of trees that should have been girdled, from all the plots. There is little chance that conifer crop trees will be damaged by vegetation management that is restricted to girdling broadleaf trees so at each plot, there is no need to record the total number of conifer crop trees as well as number of conifer crop trees that are damaged. However, where a commercially valuable broadleaf tree must be retained as a mandatory leave tree in a plot because there are no suitable conifer crop trees, girdling the broadleaf tree would be defined as fault F1 Felling or Girdling a Mandatory Leave Tree. Unless otherwise specified in the contract documents, this alternative quality inspection system would use the calculation above to determine the Payment % from the performance quality percentage. Any reductions to basic payment identified in the standard inspection system would apply unless otherwise specified in the contract documents.