Highlights of changes

Planting Quality Inspection

Guide to Completing the FS 704

Effective April 2012

The entire document was updated to reflect current terminology and references.

CONTRACTING SYSTEM

Most planting takes place during spring and summer, but the majority of contracts are tendered the previous fall. In general, contracts funded by the Ministry of Forests, Lands and Natural Resource Operations, including BC Timber Sales are advertised on the BC Bid website, however, planting contracts under the Forests For Tomorrow and Land Based Investment Programs may be exclusively advertised on the Program Administrator's website.

Planting contract tenders may require contractors to attend a mandatory information meeting, in the office, field or both, prior to submitting a tender. At the very least, contract coodinators should schedule a mandatory office meeting in order to provide details on contract specifications and expectations. Contracts are bid either by the tree, by the hectare, or as a lump sum for the whole unit. Contract payment is based on the outcome of the planting quality inspection.

PRE-WORK CONFERENCE

The contract coordinator and planting contractor must meet prior to the commencement of planting to discuss contract specifications. If the contract coordinator will not be doing the quality inspections, the inspector must be present at the pre-work conference. At the pre-work, planting quality is defined and acceptable limits are set for faults such as air pockets, shallow planting or inadequate planting spot preparation. Since what constitutes an acceptable microsite varies from site to site, it is important that this be clearly defined for each planting, unit both in the contract and at the pre-work. The expectations of both the planting inspector and the contractor must be made clear before the work progress plan is signed and planting begins,especially on sites with difficult access(e.g.,helicopter access).

A detailed example of a pre-work conference checklist is provided in Appendix 3 of the planting chapter in the *Silviculture Manual*.

The importance of making all bidders aware of contract specifications has been added

Also, the importance of defining planting quality and acceptable limits has been added and specifically mentions that the person doing quality inspections must be present at this meeting.

CONTRACT REQUIREMENTS

Once notified of the starting date, the contractor will commence work according to the provisions outlined in the notice to commence. Failure to commence work on time may result in contract cancellation. The contractor will maintain a high level of planting quality, achieve planting densities within specified limits, complete the contract on time, and abide by all other contract requirements. The contractor is also responsible for completing internal quality inspections and must provide proof of such if requested by the contract coordinator or inspector.

During planting, the contractor must ensure that unplanted seedlings are kept in good condition. Planting stock must always be kept in a suitably cool location. Seedlings are alive and must be treated with care.

The FS 704 Planting Inspection Report has a section for recording stock transportation conditions, on-site storage, and other contract requirements regarding handling of seedlings. Payment reductions for contravention of these requirements are stated in Schedule A (FS767A) of the Planting Contract.

The selection of microsite by the planter is critical. Microsite selection will have a greater effect on seedling survival and growth than spacing so it is important that the contractor and inspector have agreed on what defines an acceptable microsite for each species prior to the start of planting.

The prescribed contract spacing and the minimum inter-tree spacing (minimum spacing) are specified in Schedule B of the contract. The planting density establishes the maximum number of plantable spots per plot, as shown in the table in Appendix 1.

When determining the minimum inter-tree spacing, the contract coordinator must consider that minimum inter-tree spacing must be greater than or equal to that specified in the site plan for the trees to be tallied at the regeneration delay or free growing assessment.

Added statement regarding contractor responsible for completing internal quality inspections
And reiterated that what defines an acceptable microsite must be agreed upon before starting.

SURVEY METHODS

Inspections are based on systematic sampling methods. The level of statistical error recommended for planting quality inspection surveys is 10% or less for trees planted, and 5% or less for planting quality. The survey and plot assessment methodologies described in this guide work very well when planting densities are greater than 800 stems per hectare (sph). When planting densities are lower, it becomes more difficult to accurately assess planting quality and density, especially if the inspection plot size is not increased as recommended.

A sample of one 3.99m radius (50 m^2)plot per hectare is usually sufficient to meet the statistical error for units larger than 20 hectares. On smaller units sample accuracy is improved by increasing the number of plots per hectare to a maximum of four. Small planting units with similar planting prescriptions may be combined into a single payment unit.

While the number of plots on any payment unit should never be less than 20, it must be sufficient to address the variability in density and quality present on the unit(s), and meet the statistical error.

When planting densities are 800 sph and lower, the use of a 5.64 m radius (100 m^2) sample plot is **strongly recommended**. Using a larger plot size will increase the number of trees sampled in each plot and help address the higher variability in density that generally characterizes low density planting blocks. Because more planted trees are sampled in each plot, the effect of excess trees on the excess percentage may also be reduced. The same plot size must be used throughout the survey of the entire unit. With the larger plot size, the number of plots may be reduced. A minimum of 15 plots per payment unit is recommended but this will depend on variability and meeting statistical error.

While always present the use of 5.64 m radius plot for situations of low planting densities or fill planting was more prominently stated

Establishment of density plots, that tally only trees planted, is recommended if an acceptable sampling error has been achieved for planting quality but not for number of trees planted.

The FS 704 plot data can often be used to demonstrate that regeneration delay has been met. For this to happen, certain conditions must be met as defined in the *Silviculture Survey Procedures Manual*, Section 9.4.3. Even if these conditions aren't met, it may still be practical to collect the additional data during the planting quality inspection in order to declare regeneration delay as being met on completion of planting.

The primary goal of the planting quality inspection is to determine planting quality and payment due to the planting contractor. When combining the planting quality inspection with the regeneration delay survey on low planting density units, the contract coordinator must consider the trade-off between using a larger plot size (5.64 m) to improve the accuracy of the planting quality inspection versus using the standard 3.99 m radius plot to increase the efficiency of the regeneration delay survey.

This section was added to the document to highlight the focus of the inspection is on determining planting quality and payment. Additional benefits or outcomes from the data while being important should not override the important role these checks play.

ASSESSING THE PLOT

The following five main steps outline the basic process of locating and assessing a planting quality inspection plot. Planting quality inspection plots should be established for monitoring purposes as soon as planting starts in order to address problems with the contractor as they occur. Payment plots should be completed as soon as the contractor provides notification that the block is complete.

Example plots beginning on page 9 further clarify the process and explain how the inspector assesses certain situations including; site prepared ground, unplantable ground, close and wide spacing and acceptable naturals.

Plot No.	No. of Trees Planted	Plantable Spots	Excess Trees	Credit Satis. Planted Trees	Unsatis. Planted Trees & Code	Comments/ Instructions
Step1	Step 2	Step 3	Step 3	Step 4	Step 4	Step 5

Step 1: Plot Location

Plot lines begin from an identifiable point of commencement (POC) on the planting unit. Plots are established to meet the required sampling intensity. A pre-determined grid pattern allows both full coverage of the area and maintains the requirement for random plot location.

Sample plots must be located within the net area to be reforested (NAR). Roads and landings must not be sampled unless they have been rehabilitated or site prepared. It is important to sample the entire NAR, including timber edges, and slash or brush areas, to avoid biasing the results. In planting units with significant timber edge (e.g., irregular boundaries, retention areas) it becomes even more important to sample the entire NAR. In these situations, the inspector must also consider whether the sampling intensity is adequate to address the increased variability.

Step 2: Number of Trees Planted

Once plot center has been located, the inspector establishes a 3.99 m or 5.64 m radius plot. The inspector flags trees inside the plot and does a tree count while looking for obvious problems. The number of trees planted is tallied.

This section was added to highlight that the entire planting area should be sampled and to not inadvertently oversample some areas.

In order to determine if trees are properly planted on acceptable microsites, and because most faults occur below ground, the inspector must excavate a sample of seedlings within the plot (recommended Root Excavation procedures are described in the glossary). Initially, all trees in each plot are excavated and carefully examined. If more than two planting faults are consistently recorded in each plot, the inspector will continue to excavate all trees in each plot. Otherwise, excavation of a minimum of two trees in each plot is generally sufficient to ensure that quality standards are being maintained.

When tallying the plot results, the number of unsatisfactory, satisfactory, and excess must equal the number of planted trees. This must be checked at each plot and with unit totals. Where the number of trees planted exceeds the number of plantable spots, the difference between the two must equal the number of excess for that plot. This cannot be checked on a unit basis as plantable spots sometimes exceed trees planted.

There is sometimes more than one way to assess a plot. When this happens, the method that is to the advantage of the contractor is used.

Step 5: Comments/Instructions

Comments on the number of acceptable naturals, unsatisfactory tree fault codes, plot conditions, and instructions of a minor nature to contractors are noted here.

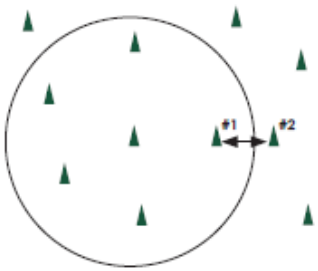
PLANTING INSPECTION REPORT

Plot data is recorded and summarized on the Planting Inspection Report (FS 704) (page 33 and 34). An assessment of stock handling practices is also recorded on the Inspection Report. Calculations at the bottom of the form (page 34) produce the planting quality percent and excess results.

This was changed to reflect this one anomaly where an influence tree could cause a fault within the plot. In these situations, the benefit of the doubt is given to planter

Deleted: *However, an exception to this rule may arise when trees planted at less than the minimum spacing straddle the plot boundary (see page 19).*

Plot #11 - Close Spacing - Inside or Outside the Plot



Planted trees

M =6

Plantable spots =6

Plot No.	No. of Trees Planted	Plantable Spots	Excess Trees	Credit Satis. Planted Trees	Unsatis. Planted Trees & Code	Comments/ Instructions
11	6	6	0	6	0	

Trees #1 and #2 are less than the minimum spacing from each other. All of the neighbouring trees that surround #1 and #2 are at an acceptable spacing. The removal of either #1 or #2 would solve the problem. When it is not clear which tree is incorrectly spaced, the tree outside the plot is the fault tree.

The example plots for this situation was also changed to reflect this situation

Removed: *Tree 1 is therefore classified as an excess tree.* And the indication of a fault in the example

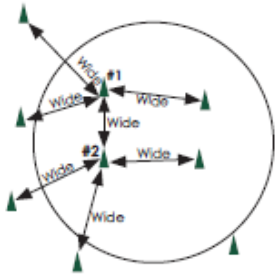
Replaced: *While a single widely spaced tree is not considered a fault, a group of widely spaced trees causes the efficient use of the plantable ground to be questioned.*

Wide Spacing

Planters may space trees widely, on occasion, to move past obstacles or compensate for trees planted at minimum spacing. A single widely spaced tree is not considered a fault, however, a plot is classified as having wide spacing when there is a group of two or more trees, inside the plot, spaced further than contract spacing from each other and all their neighbours, inside or outside the plot.

The inspector ignores the widely spaced trees and re-assesses the plantable spot count for the area of the plot that they occupied, in relation to how they should have been planted; that is, normally spaced between contract and minimum spacing. This number, plus the number of properly spaced planted trees, is recorded as the plantable spots for the plot.

Plot #6 - Wide Spacing



▲ **Planted trees**

M =6
Plantable spots =6

Plot No.	No. of Trees Planted	Plantable Spots	Excess Trees	Credit Satis. Planted Trees	Unsatis. Planted Trees & Code	Comments/ Instructions
6	4	6	0	4	0	**Wide spacing**

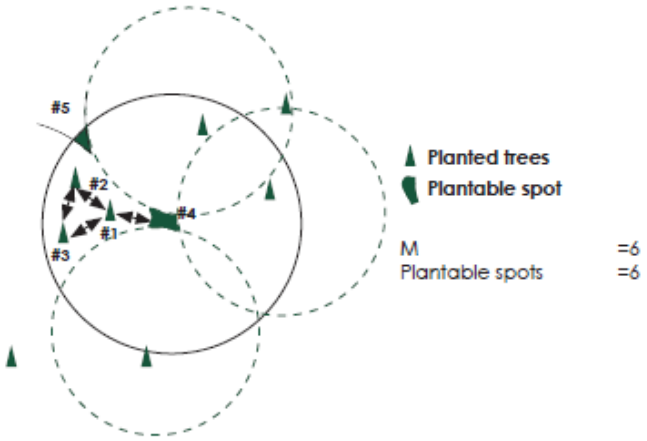
The inspector should question if there is any reason to disagree with the planter's spacing. In this example, trees 1 and 2 are too widely spaced. A re-check of plantable spots, ignoring the position of trees 1 and 2, reveals that there are 6 plantable spots.

Wording changed to try and make the intent more clear

Close Spacing – Groups

Situations arise where there is a group of neighbouring trees that are all spaced at less than minimum from one another. In these situations, the inspector begins evaluating each tree in the group to determine if it could have been planted at another point inside the plot where no other planted tree or acceptable natural would be less than minimum spacing from that point. Through this process, the inspector can determine the minimum number of trees that have been planted in the wrong place. If a close tree could have been planted within the spacing latitude, the tree is coded as a fault tree – B1-Too close. If it could not be moved within the spacing latitude, it becomes an excess. The inspector continues to evaluate each tree until the spacing problem is solved (i.e., it has been identified where and how many trees should have been planted in order to meet all of the rules).

Plot #12 - Close Spacing - Groups



Replaced: *within the spacing latitude*

This made this more firm and to give the planter some lee-way in placement of the seedling within contract specs

Excess Trees

If more trees are planted than "plantable spots," the extras are coded "excess trees," regardless of any other faults they may have. Once the inspection is complete, excess trees are added and compared to the total trees planted to determine the percent excess for the unit. A 7% tolerance is applied before any charges are calculated for excess (page 36). An exception to this occurs on low density (≤800 sph) planting units, where a 10% tolerance is applied before any charges are calculated for excess (page 36).

When assessing excess trees, acceptable naturals must be identified. The number of acceptable naturals spaced at contract spacing or greater will reduce the number of plantable spots (see page 10, *Acceptable Naturals/Residuals*).

Planting near or at minimums can create an excess situation where extra trees are planted and the M value for the plot is exceeded. The minimum spacing is designed to facilitate optimum microsite selection and cannot be used all the time.

In plots with excess trees and faults, where the excess tree(s) cannot be identified, the fault tree is considered the one in excess and is recorded as such. A comment is recorded that it was also faulted (e.g., "Excess = C4").

There may be situations where both fault and excess trees are tallied in a plot.

First indication of change to excess calculation for low density planting units

Excess Charges

Percent excess is calculated by dividing the excess trees by the total trees planted.

$$\frac{7 \text{ excess trees}}{108 \text{ trees planted}} \times 100 = 6.5\%$$

Excess charges are calculated using the following table for all units, with the exception of low density (≤800 sph) planting units, or as specified in Schedule A of the planting contract. **Note that charges are cumulative once excess has exceeded 12%;**

% Excess	Charge
0 - 7%	No charge.
7.1% - 12%	(Excess %/100-0.07) x total trees for payment area x price per tree.
>12%	(Excess %/100-0.12) x total trees for payment area x $0.20

On low density (≤800 sph) planting units a 10% tolerance is applied before charges are levied for excess trees and the following table is used to calculate excess charges. **Note that charges are cumulative once excess has exceeded 15%.**

% Excess	Charge
0 - 10%	No charge.
10.1% - 15%	(Excess %/100-0.10) x total trees for payment area x price per tree.
>15%	(Excess %/100-0.15) x total trees for payment area x $0.20

So here is where we have added that on those low density planting units greater tolerance around excess trees is given before charges are applied. This is to recognize the greater variability in this sites. This greater tolerance combined with the proper use of the large plot sizes on low density units should address most of the problems that have been faced with disagreements on excess charges on these types of units.

B. Planting Spot Selection

Planting spot selection must be thoroughly discussed at the pre-work conference.

1. Too close (to other acceptable seedlings or acceptable naturals)
2. Too wide (A single widely spaced tree is only a warning, not a fault. The impact of wide spacing in a plot is a reduction in planting quality because the number of satisfactory trees is less than the number of plantable spots.)
3. Overhead obstacles
4. Planting medium too shallow
5. Too dry (usually on a dry mound or loose gravel)
6. Too wet (usually in a depression or creek bed)
7. Poor microsite selection
8. Poor planting medium (as defined in the contract and at the pre-work conference)

Seedlings must be planted where they have the best chance of growing into mature trees. If a seedling has been planted in a spot defined by B3-B8, the inspector must determine if a plantable spot exists within the spacing latitude. If a plantable spot exists, the tree is given a fault (eg. B4). If no plantable spot exists, the number of plantable spots is adjusted and the tree is excess.

Replaced : *(only a warning not a fault)*

Provided more clarity on the “the warning” associated with too wide

Removed codes refering to scalping and screefing

Removed code for roots not straight

Codes renumbered to reflect alterations

C. Planting Quality

Planting quality must be discussed at the pre-work conference and planting quality faults clarified.

1. Inadequate planting spot preparation as defined in the contract
2. Tree improperly positioned on a prepared spot or mound
3. Improper root or plug placement – J or U roots
4. Exposed roots or plug
5. Tree not straight
6. Improper shading as defined in the contract
7. Air pocket (Any air channel from the surface to the root zone that may potentially cause the plug to dry out. Air pocket faults must be clearly defined at the pre-work and they should only be assessed through proper root excavation.)
8. Too loose
9. Too shallow
10. Too deep
11. Unacceptable backfill (backfilling planting hole with litter layer, or snow)

Further explanation of planting faults and normally accepted standards may be found in the planting chapter of the *Silviculture Manual*.

Largest changes in codes removed techniques that are not really applied any more and made it more specific to the contract clauses on planting spot preparation. Removed roots not straight clause as it was deemed to be redundant with the improper root or plug placement code, and tried to give more specific direction on what an air-pocket is and that it can only be assessed using proper root excavation techniques (i.e no “finger” tests)

FS704D has been changed to reflect these new codes (2011 version is up to date)

Removed: *In order to maintain the overall density at prescribed levels, the planter should compensate for the tighter spacing of one tree by planting the next tree at greater than contract spacing but within the spacing latitude.*

Planting Density – Number of planted trees per hectare.

Plantable Spot – A planting location that is both an acceptable microsite and correctly spaced from other planted trees or acceptable naturals.

Root Excavation – Carefully excavating planted trees with a small shovel or trowel to check on the placement and condition of roots, and the planting medium. This should be done in such a way as to carefully and fully expose the plug and the surrounding planting medium. In this way planting faults such as air pockets and j-roots can be clearly identified.

Spacing Latitude – The allowable variation between the contract spacing and the minimum spacing. Spacing latitude allows for the maximum use of plantable microsites, represents the maximum allowable deviation from the contract spacing, and provides the flexibility for altering the strict contract spacing as dictated by specific site conditions. The planter is expected to use this latitude to make use of the most appropriate planting microsite.

Screefing – Removing organic material to a specified depth. This may be as simple as removing only the litter (L) layer to reach the fermenting (F) layer of the forest floor prior to planting a seedling. Screefing requirements will be specified in the contract.

Provide some more direction on root excavation and removed some of the language under spacing latitude that could be deemed as contradictory or confusing.

- New booklet available on-line at http://www.for.gov.bc.ca/pscripts/ISB/FORMS/forms.asp
- Hard-copies available from the above link

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