

Tree Planting – Best Management Practices

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Draft

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Project [419-46]

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List of Acronyms

MITD	Minimum Inter-tree Distance
MSP	Mechanical Site Preparation
MSS	Minimum Stocking Standard
NSR	Not Satisfactorily Restocked
PHA	Post-harvest assessments
PHA-S	Post-harvest assessment – silviculture visit
PSB	Plug - Styroblock
PSI	Plug – Styroblock, Individually Wrapped
RESULTS	Reporting Silviculture Updates and Landstatus Tracking System
RGC	Root Growth Capacity test
RISS	RESULTS Information Submission Specification
TSS	Target Stocking Standard

Document Revision History

Version	Date	Description
1.0	2022-03-31	First submission

1. Introduction

The success of a planting program depends on the many steps that take place before the first tree goes in the ground. It is achieved by the silviculturist and the planting company working together with the common goal of a successful project. This document is aimed at supporting silviculturists in achieving successful planting programs.

Planting programs have large amounts of complexity. They take years to set up and are finished in a very short time frame.

Important tree planting program milestones are discussed in detail. Other milestone discussions are mostly covered off in other publications but are still discussed in lesser detail.

Tree planting program milestones:

- Planting contract setup
- Planting viewing
- Planting project setup
- Planting prework (office)
- Planting prework (field)
- Planting project management
- Planting Implementation
- Pay plotting
- Planting program wrap-up
- Planting reporting
- Post-planting monitoring

Other milestone discussions:

- Decision making and regime set-up – pre-harvest assessment
- Decision making and regime confirmation– post-harvest assessment
- Seed supply
- Sowing considerations (ordering the trees from the nursery)
- Nursery
- Cold Storage (if spring planting)

1.1 Project objectives

This document is intended to pass on the knowledge of senior silviculturists to the next generation. The target audience is new silviculturists tasked with managing silviculture programs for government, licensees and BC Timber Sales. Developing an individual into a silviculturist who can successfully manage planting programs takes many years. It is important to properly mentor new silviculturists over a number of years.

The intention is to provide direction that is applicable to any planting program in any area across the province. Specific planting prescription information that is applicable to only one region is not discussed – it is up to each organization and region to develop their own planting prescriptions that will address the specific risk factors within their operating areas.

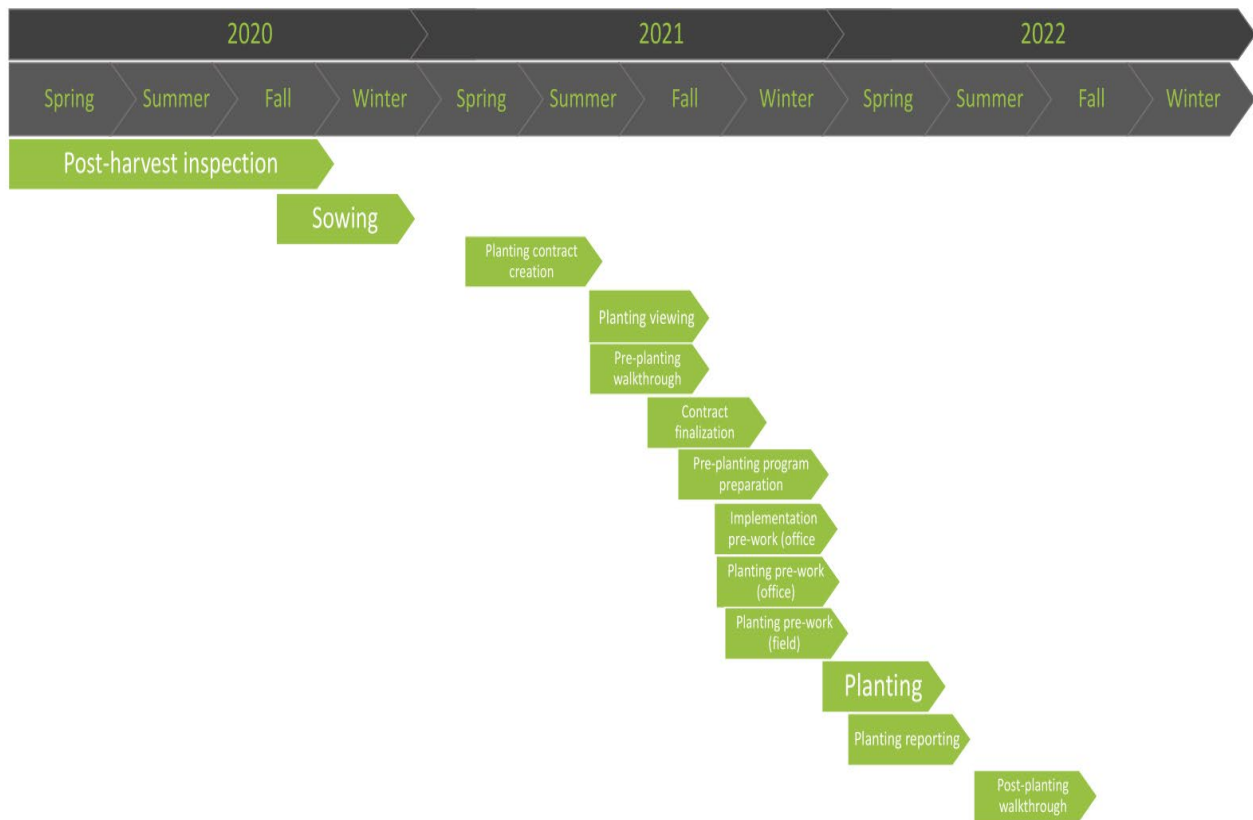


Figure 1. Example timeline for spring planting programs. From harvest to planting complete. Hot lift and coastal planting programs would have different timelines but similar milestones.

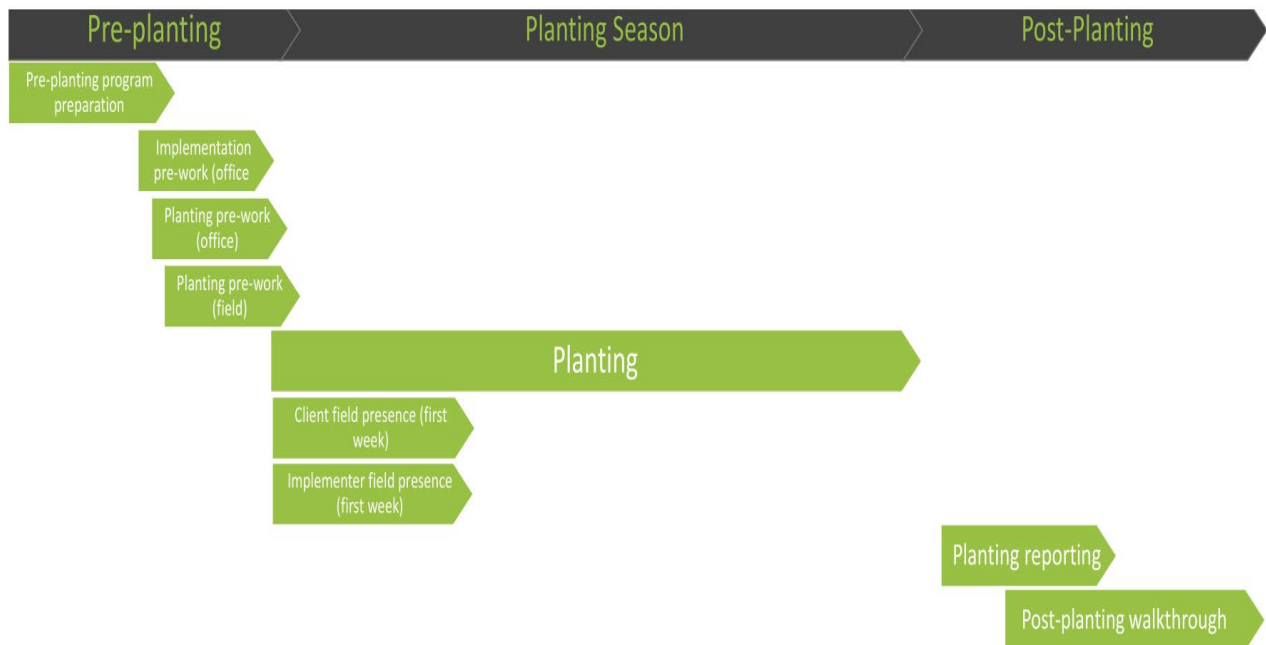


Figure 2. Example timeline for any planting program focussing on the year of planting.

2. Approach

2.1 Data gathering and preparation

The data gathering phase was undertaken in partnership with ministry staff, silviculture consultants, licensee silviculturists, and tree planting contractors that chose to engage for this report.

Data gathered includes:

- 1 An interview with silviculturists covering all aspects of planting programs to identify their current or planned practices.
- 2 A review of existing practices documents.
- 3 Collection of silviculturist tools such as templates, cheat sheets, PowerPoint presentations, and pamphlets.

The majority of this paper will focus on planting viewing, contracts, project setup, and project completion. Stages of silviculture that occur prior to planting contract viewing are discussed but intended to be cursory.

3. Planting Contract Setup

A planting contract that is understood by both parties will create the foundation for a successful program. Each organization should have a standard approach to their planting contracts. This will allow a continuity across multiple years and between different departments. This standardization also applies to tender offers, bid security, security deposits and holdbacks.

Best Management Practice: Organizations should have a standard approach to planting contracts. This includes the contract structure, and inclusion of standard approach and clauses.

3.1 Schedules

Ensure that sections of the contract that are considered boilerplate do not have any additional clauses added in. Planting contractors are within their rights to expect that there are no hidden clauses within portions of the contract that are considered boilerplate.

Best Management Practice: Do not enter additional information in boilerplate schedules.

Best Management Practice: Provide sufficient detail for each planting unit for the planters to review and bid on.

The Schedule B should include detailed information about the individual planting units. A separate attachment is recommended to include access directions and comments if these are not included on the map. This includes distances required for ATV or UTV travel. Comments on difficult access are important in this section, as planting contractors need to be aware of access issues to provide bid prices. Planting unit Information required by planting companies in order to make an educated bid includes:

- Planting unit
- Spring plant vs Summer plant vs Fall plant
- Fill plant / Replant / First time plant
- MSP or raw plant
- Total trees
- Target densities
- Minimum densities
- Minimum inter-tree distance
- Species
- Stock size
- Access information (general)
- Elevation minimum and maximum

Overflow ground should be included in the planting tender package. These should be clearly identified as overflow. The price for these units should be included in the total tendered price. The total value of these trees should not be included in the total contract value.

Best Management Practice: Include overflow planting units in the tender offer form. This will avoid determining price in the middle of the planting program.

Best Management Practice: Any variances or additional information should be placed in a schedule specifically designed for this.

Schedule C items are unique to each planting contract, including such items as:

- Planting timing deadlines (refer to Stock Type Selection Guidelines, updated 2021 for recommended time frame by biogeoclimatic zone)
- Planting production requirements (provide details of minimum and maximum production)
- Interim cold storage rentals (details and who pays)
- Seedling delivery (details and who pays)
- Disposal or recycling of boxes (details and who pays)
- Disposal of garbage (details and who pays)
- Details on planting quality faults that are not already clearly defined
- Internal quality assessment requirements for planting contractors
- Tree planting list of deliverables
- Danger tree assessment requirements and deliverables
- Any additional requirements that will contribute effort or cost for the planting contractor
- Any variances from the planting schedule

Best Management Practice: Planting contracts should include a clause indicating that the planters will provide internal quality assessment. This will take pressure off planting crew leaders who are busy delivering boxes, setting up caches and training planters.

3.2 Contract size and structure

When structuring contracts, size is important. If the contract is too big, there is a lot of risk riding on one contractor to be successful and finish on time, while conversely, managing a multitude of small contracts increases workload.

Best Management Practice: If programs are significantly large, strongly consider multiple planting contracts. This reduces the risk during the planting season. If one contractor is falling behind, the other contractor can pick up trees toward the end of the program – this can ensure that all the trees are planted in the required timeframe.

Put considerable thought into the desired size and location of planting contracts. If there are multiple contracts being created for the planting season, consider the timing of all the units, and their geographical location, so you are creating a contract that makes logistical sense for a planting contractor to complete efficiently. It may be a good idea to create contracts that flow from lower elevation ground, finishing at higher elevation ground, so there is early ground to start-up on, which gradually moves uphill as the season progresses. Ideally, you want to structure a planting contract that planting companies want to bid on.

Best Management Practice: Regularly canvas the planting community that bids on planting contracts in your area. They may be able to provide additional insight on how best to structure planting units between contracts.

3.3 Option to Renew contracts

Option to Renew contracts have positive and negative aspects. Developing a multi-year agreement with a planting company can be beneficial, as it allows them to become familiar with your operating area and its various characteristics. It takes time for a planting contractor to understand the full range of expectations for a client in their particular operating area. It also takes time to communicate the knowledge of the silviculture forester to the planting supervisors, and this knowledge builds over multiple years. It also allows an element of trust to develop between the planting company and the client over time. Consider multiyear agreements to continue to build on successes learned from previous years. This builds respect for each party in the agreement. This also allows the contractor to review the season and determine how better to meet the needs of the client.

It can be difficult to negotiate prices over multiple years, however, as conditions can vary widely year to year. This refers to both market conditions and conditions on the ground. If multi-year prices can be agreed upon, however, there are multiple benefits to this arrangement.

Best Management Practice: Strongly consider Option to Renew contracts. These allow the time for planting contractors to better understand how to meet clients' objectives and requirements.

4. Planting Viewing and Tendering

The planting viewing is a key component in the contract process. They should be considered mandatory, with bidding only open to those who attended the viewing. (FS704, 2012) This is your opportunity to communicate the complexities of the project to all prospective bidders at the same time.

4.1 The viewing package

The viewing package should be comprehensive and complete.

Items to include in a viewing package are:

- Overview map sufficient to navigate to all planting units.
- Detailed access notes.
- Detailed notes about constraints on each planting unit (access issues for trees, planters).
- A planting schedule with details about the planting including: total trees; expected planting density; target density; minimum density; minimum inter-tree distance; MSP vs no MSP; first time plant, replant or fill plant; helicopter/barge/other access; elevation; stock size; species.
- Quality planting unit maps that have details of the planting prescription and any safety considerations.
- Separate safety hazard map if there are considerable safety issues that need to be communicated and their inclusion in a planting map will cause confusion.
- Digital spatial shape files.
- Photographs of sample units or specific issues is helpful.
- A planting specification cheat sheet that has been tailored to the client and operating area.

Best Management Practice: Create a brochure or simple cheat sheet for the planters to review at all phases of planting. This will be helpful for viewing, at office preworks and field preworks. See examples in Appendix 1.

It is important to communicate the most difficult aspects of the work, and ensure there are no surprises.

Safety is an important topic at the viewing. Safety considerations to review include:

- Remote locations
- Danger trees
- Very steep slopes
- Heavy and unstable slash
- Wildlife
- Eye hazards

4.2 Mandatory viewing meeting

Best Management Practice: *Planting viewing meetings should be considered mandatory. This is the opportunity to best describe the challenges that planting contractors will face when delivering this planting contract.*

During the meeting, ensure that notes are taken on all of the discussion, so there is a record of all the topics covered. The notes are meant to include topics specific to the planting contract in question, rather than standard items in general planting contracts. Some questions may arise that need to be answered at a later date. Ensure everyone at the viewing receives the answers in a clear and consistent format.

Best Management Practice: *Document the planting viewing meeting with detailed notes and send these out to the contractors that attended the meeting. This should be used as a starting point for the planting contract prework notes.*

4.3 Pre-approved planting eligibility list

The planting contract viewing can follow a detailed review of eligible planting contractors if desired. The mandatory minimum requirements for inclusion need to be clear and measurable, and should include references. References and evidence should be checked to ensure the company meets the requirements before they are allowed to bid on the contract and not afterwards. Eligibility lists can streamline the tendering and award process by screening out contractors that do not meet the minimum eligibility.

4.4 Timing of tender openings

Coordinate the tender opening dates so that multiple contracts do not open within a narrow time frame. If there are a number of contracts opening up at the same time, it is difficult for planting companies to determine what they can or cannot accept as the full workload picture is not clear. Doing this will reduce the number of low bidders that cannot accept the work due to capacity. This is more easily achieved within an organization's various planting contracts. I.e.: If company A has five planting contracts, and chooses to spread the bid opening over five weeks rather than one or two days, then a low bidder who wins two of these contracts could possibly accept both of them. This situation is not always possible between different organizations, but open communication can help to alleviate this issue.

Best Management Practice: *Stagger the opening dates for planting contract tenders within your organization.*

4.5 Format for tender offer forms

There are opportunities for accepting bids via electronic methods such as eBid (using BCBid) or through regular email. There are benefits to electronic bidding such as: ease of confirming bid was received, reduced reliance on courier, and timelines of bids. With electronic bidding, tender offer forms can be submitted closer to the closing deadline which reduces risk for the planting contractor and reduces the possibility that the contractor has filled their available capacity at the time of the tender opening.

4.6 Unusually low bids

When the tenders are received, they should be reviewed for unreasonably low or outlier bids. Organizations should have a plan in place to investigate and review unexpectedly low bids. This review would include: an extensive reference check, and an evaluation of the company's history, with particular attention to negative evaluations, or contract terminations. If the client decides to move forward with a contract award of this type, they should be considered a higher risk that requires increased administration and supervision.

4.7 Planting tender feedback

To further improve the planting tendering process for your organization, solicit feedback from the planting community.

Feedback can take the form of an anonymous survey, a feedback form that can be sent in by email, or follow-up phone calls asking for honest feedback.

For best results create a list of questions that will focus the respondents' thoughts on the planting package, tender timing, planting contract size, and location. Leave opportunity for discussion on any aspect of the planting tender process.

Best Management Practice: Solicit feedback on the tendering process. This can help improve the tender package, or provide new ideas which will improve future planting project.

5. Planting Project Setup

Planting project set-up should be progressing in the season prior to planting. There are many steps that should be complete or well understood in the season leading up to trees going into the ground.

Best Management Practice: Don't leave important tasks to be completed during the planting season - there is too little time available for everybody involved. Any task that can be accomplished in the season prior to planting should be completed well before the first tree goes into the ground.

There are several steps that will help to make the project smooth for both the client and the planting company. This starts with knowing your ground.

5.1 Field confirm the planting units

Ensure you are familiar with the planting units – they should be visited in the field season prior to planting. This visit can be cursory, if there isn't much to review, or more detailed if it appears that the planting unit isn't clearly understood or if there is considerable change from the original plan. Ideally this occurs prior to tendering so the tender package can be updated, however it can occur after tendering.

- Confirm access
- Review the site limiting factors one last time
- Review the prescription to make sure it is plausible and can be followed
- Confirm the species allocation
- Confirm the location for each planting unit
- Identify if there are areas where there is considerable change from the original plan. This might be areas where there is considerable flooding, natural regeneration or possibly blowdown
- Ensure there are no trespassable boundaries; clearly ribbon any boundaries that a planter might not understand.

Best Management Practice: In the field season prior to planting, touch up any planting boundaries that need marking. Do not wait for planting season.

5.2 Review planting prescriptions

Review the planting prescriptions to ensure they still make sense. Sometimes they are written several years before planting takes place, and things may have changed on the ground. For example, lower-lying areas can become water-saturated over time, or natural ingress can occur, reducing plantable spots. Planting prescriptions should be kept as simple and consistent as possible for maximum success. Planters are moving at a high rate of speed, and continual switching between various densities and planting requirements in the same unit or contract can increase confusion and errors.

Check every planting unit, and the tree allocation. Often there have been multiple iterations of various plans before the final allocations are completed. Ensuring there are no errors or omissions in advance of planting season is preferable to trying to correct them in the middle of your planting program.

Best Management Practice: *If, within an opening, there are two different species mixes, create two different planting units. Make sure these two areas are clearly spatially shown on the map. Examples might include large flat ground where Douglas-fir is excluded versus large sloped areas where Douglas-fir is targeted for planting.*

If there are some small areas that are too small to create a separate planting unit, clearly identify on the planting map where these trees are intended to be planted by hatching. For example, a riparian area suitable for planting with spruce should have the riparian area identified on the map with hatching.

5.3 Reviewing the planting unit maps and planting unit structure

For openings where the silviculturist wishes different species prescriptions for different areas, these locations should be indicated on the planting unit map.

There are a number of scenarios:

- Two or more clearly distinct areas where the planters will be required to plant different species mixes. Set up multiple planting units and clearly indicate the location of each on the map.
- Small areas where a separate species will be planted. A separate planting unit is not required however the location of where the planting prescription is different should be clearly hatched on the map with text box describing the prescription change.
- Two or more areas with different planting prescriptions – areas that are not easily defined. An attempt should still be made on the planting maps to hatch out where these are. A text box should describe in detail the location the prescription change is for. These are the most complicated of planting unit maps and the most time and effort should be increased to communicate the prescriptions. The client or implementer should be on site during planting of these units.

In all instances, safety issues and access obstacles should be identified on planting maps. If this creates a cluttered map then a separate safety hazard map should be created to communicate this.

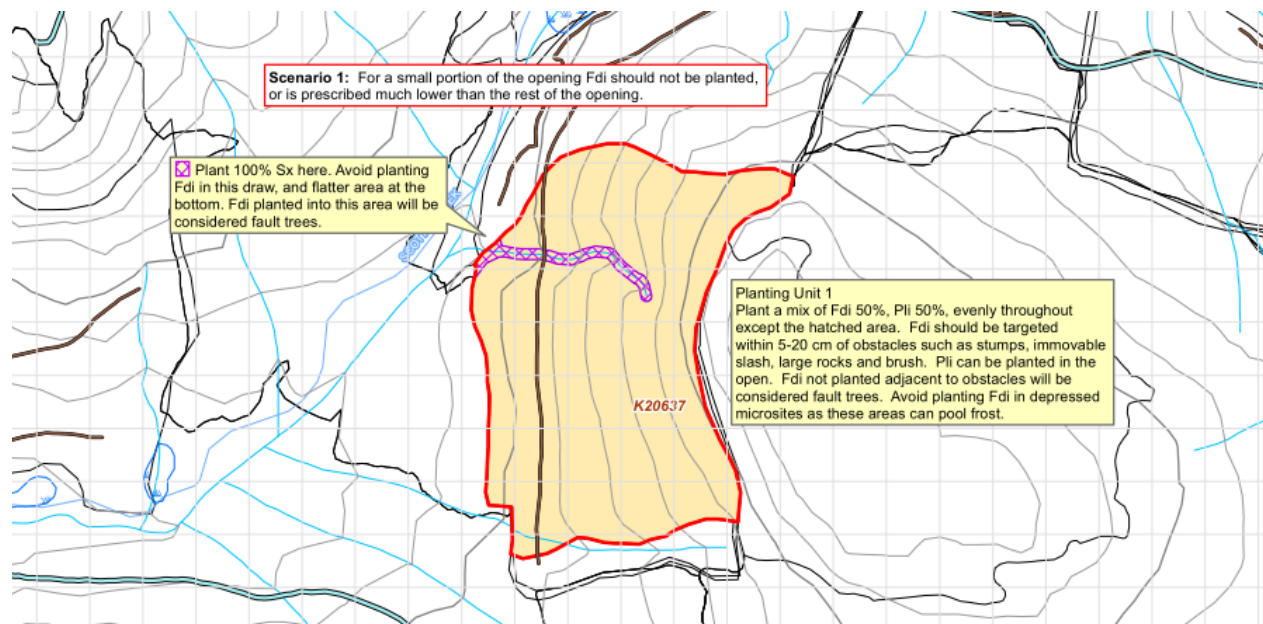


Figure 4. Example planting unit map that spatially defines where a minor prescription change is located . A separate planting unit is not required where a small number of boxes is prescribed.

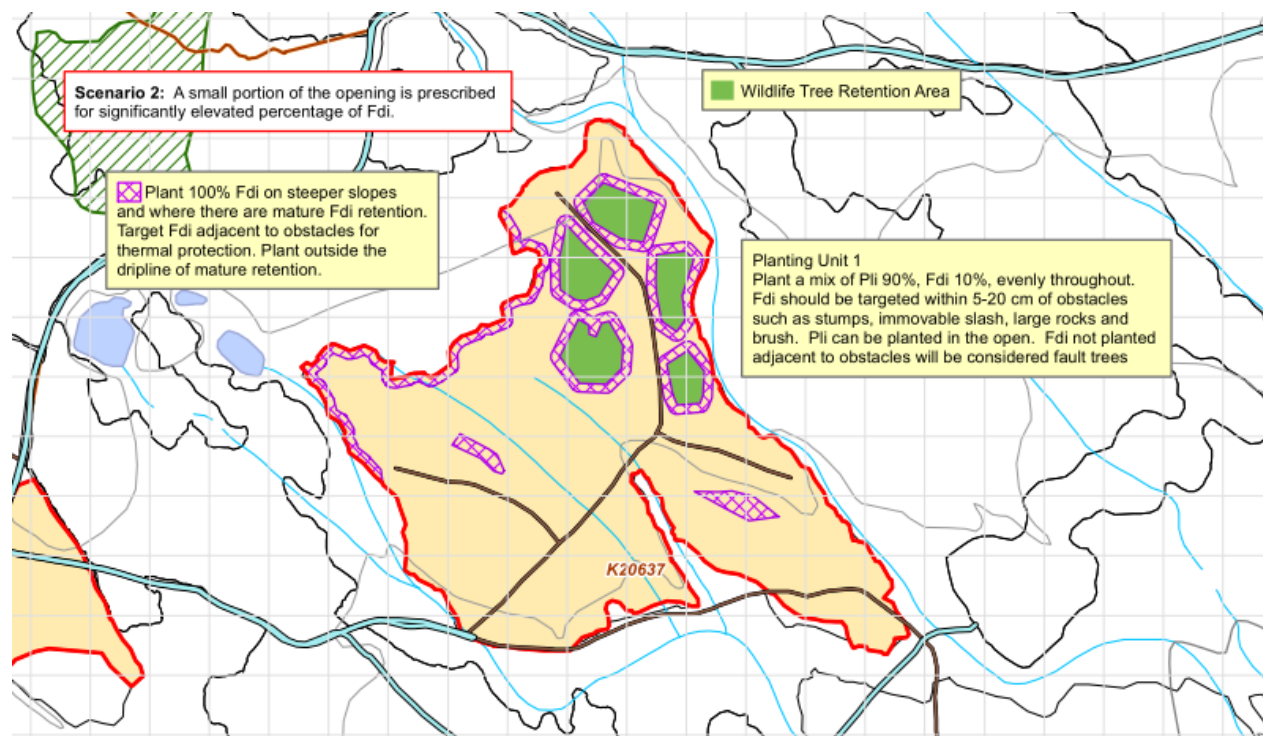


Figure 5. Another example planting unit map that spatially defines where a minor prescription change is located . A separate planting unit is possible but not required.

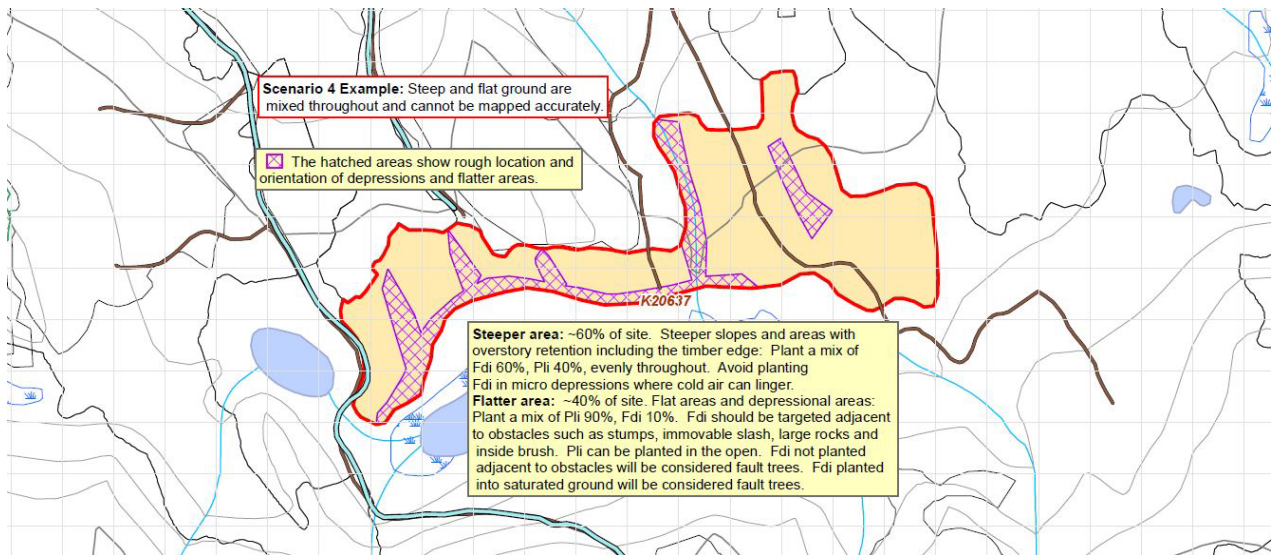


Figure 6. Example of an opening with two different species mixes. The areas targeted for a second species mix are not easily defined but an attempt was made. This type of prescription should have increased oversight from implementer or client.

5.4 Overflow ground

Sufficient overflow ground needs to be identified and ready to plant at short notice. Ideally, the units can be included in the contract, so prices exist for it already. Otherwise, it should be sufficiently similar to the ground already in the contract. There should be a variety of overflow units that will accept the range of seedlots in the contract. As the planting in any contract tends to start at lower elevation units, gradually moving uphill to colder, higher elevation units, it is smoother to locate overflow units at the higher elevation spectrum of your planting program.

5.5 Reviewing your planting ground again, immediately prior to planting

Ensure you review planting access immediately prior to planting. The planting units should be visited to ensure that access routes are not blocked by trees, road washouts, or poorly communicated road deactivations. For spring planting a helicopter reconnaissance should be conducted to determine snow melt, review access for blockages. There is potential for using drones to replace helicopter flights as these can provide imagery that can be reviewed at the office, when more time can be spared to thoroughly review for any access issues.

Best Management Practice: Immediately prior to planting, use drones to review access to all units.

Review snow levels using satellite imagery. Current data can be purchased and reviewed to review snow levels. Previous year's data can be reviewed to see snow trends and determine what order planting units will become snow free.

Best Management Practice: Review satellite imagery to determine block order and review snow free conditions.

5.6 Snowplowing (spring planting)

Snowplowing requirements for spring planting should be reviewed in late winter. Plowing might already have been completed for winter logging in some areas, but this will need to be confirmed in the field. Some areas might have planting ground that opens up early, but access to these areas may be north-facing or at higher elevation, and could have snow on it fairly late in the spring. Snowmobile traffic on roads causes them to melt very slowly, and some roads can continue to be blocked well after the adjacent ground has thawed. Roads in areas of fine soils can remain very wet late into the spring. Getting roads plowed can speed up their spring drying time, and reduce access issues. The roads to planting areas get a lot of traffic, and drier roads can prevent damage. A snowplowing program can allow access to early planting ground where soils dry out quickly, and it helps to extend an already tight spring planting season. (Stock Type Selection Guideline, 2021)

Best Management Practice: *Plan for snow removal to facilitate early startup and for continuity of the planting program. Set up an engineering contract in advance and determine the required roads to plow or fix up following the helicopter or drone flight.*

5.7 Project tracking sheet

There are a lot of elements that needs to be in place prior to planting start-up. Creating a tracking sheet for the planting project as it approaches start-up will help to ensure all of these milestones are met. The tracking sheet should include:

- Contract tendered
- Security deposit received
- Digital sharing sites created (Examples might be FTP, or one of the many cloud-based folders)
- Planting database or spreadsheet updated with sites and request keys
- Trees allocated following confirmation of final lift numbers
- Planting database or spreadsheet shared with contractor and implementor. This should be done 3 weeks or more in advance of planting startup to facilitate shipping requests
- Implementation office prework scheduled
- Planting office prework scheduled and completed
- Planting office prework notes sent out to planters and implementer
- Planting field prework scheduled
- Safety plan received
- Key personnel proof of certifications received (Examples might include: first aid, danger tree assessment certification, faller certification)
- Work plan signed
- Notice to commence letter sent out
- Notice of project received
- Planting field prework completed
- Camp inspection completed

Best Management Practice: Create a tracking sheet or template to keep track of the planting program as it moves forward towards startup. This will ensure that key items are not missed.

6. Planting Prework

There will usually be two prework meetings: an office prework approximately three weeks to one month in advance of the anticipated start-up date; and a field prework, one to two days before start-up. In the time leading up to the office prework, maintaining communication with the planting company over the winter can help to iron out some of the advance organizational details that will ensure the success of the project. Anticipated start-up date, location of the trees, camp locations, camp location permissions, any other authorizations that might be required are some examples of early topics to discuss with the planting company over the winter. Some of these items could take up to one hundred days so these need to be addressed very early. These cannot wait until the planting office prework. Knowing the final planting locations well in advance will also help a planting contractor book accommodation. Restate the expected timelines for the project. This is important to bring up on a regular basis so there is no confusion.

6.1 Office prework

Key items to discuss at the office planting prework:

- Review planting viewing notes that relate to the project.
- If the contract is an Option to Renew, discuss any learnings from the previous season.
- Identify the key representatives for the client, implementer and planting contractor. These should not change over the course of a planting program. It is best practice that there is an alternate identified in case there is a break in communication. Share contact information for these key people.
- Discuss the roles of everybody involved. Clearly indicate what the implementer is expected to do and what the client is expected to do. Examples might be, implementer will be responsible for daily communication and any discussion about planting quality; client will have full authority over prices, invoices, and payment.
- Discuss seedling request key transfer authorizations. Who is authorized to transfer request keys between blocks and under what circumstances? An example might be that the client retains authority but the implementer can make decisions on their behalf on weekends.
- Discuss communication frequency and method. Text, email, phone calls. Determine how planters will communicate their daily work plans and released blocks to the implementer.
- Confirm the number of planters, crews and crew leaders on the project. Confirm the requirement for internal quality assurance.
- Provide stock allocation on a plotter sized page. This allows the entire program to be seen at a glance. Provide these to planters, supervisor and implementer.
- Discuss the work plan, the planting order, timelines to start and complete the project, and the anticipated crew work schedule. The planting order and timelines to complete should be provided to the planting contractor.
- Discuss priority planting. Which units need to be planted first, which units have administrative milestones, which units are overflow, and which units can be left unplanted if necessary.
- Minimum, target, and maximum daily production targets.

- Briefly discuss major parts of the planting prescription: planting faults of concern, microsite considerations, requirements for planting MSP areas, species-specific planting requirements, etc. The majority of these discussions can occur at the field prework.
- Discuss the portions of planting units that are identified as having greater risk. This can include access constraints, on-block access, trespassable boundaries that have been ribboned, and any areas that may be subject to seedlot transfer restrictions.
- Discuss the plan to close out the planting contract. What will partially planted units look like? It is recommended to ask the planters to leave logical unplanted areas that are easiest to access, and to limit the number of unplanted partial units by communicating regularly as they appear. Discuss a plan to stretch out the trees to finish a unit if they are only a few boxes short of planting out.
- Discuss the invoice plan. How often are they to be submitted, how many invoices, and for which units.
- Provide the final geo-referenced overview maps and planting unit maps. These should clearly indicate items that are critical for treatment success.
- Discuss radio frequencies used for each road in the project. Provide a map showing these.
- Review all deliverables. Provide an acceptable deliverable planting map, and danger tree assessment report so they can know what is required.
- If using a database pay plot data collection system, indicate which category each user is to use so that there is no overlap in data between client, pay plotters, and planters internal QA.
- Stock handling. Review expectations such as silvicoil liners, interim cold storage, and field cache setups. Follow up with this during the field prework.
- Discuss cold storage or hot lift expectations. Share any documents that the cold storage or nursery have provided. How will trees in the reefer be managed? Set up a tracking sheet to record trees as they arrive in, and when they get delivered to the planting units. This will allow better tracking of how long trees have been sitting in interim cold storage.
- Location of the trees. Make it perfectly clear where every box is located.
- Provide a report indicating which stock has which pesticide applied. Provide MSDS sheets upon request.
- Review any forest health issues that were identified by the nursery. Communicate these issues to the planting contractor at the office prework. Discuss what to look for and what to do about these issues.
- Have a detailed safety discussion, which should include a wildfire evacuation plan, safety contacts for different safety-related scenarios, PPE requirements, DTA and falling considerations. Discuss the emergency response plan.
- Determine if there is potential for a multi-employer workplace situation to arise, and discuss how these will be managed.
- Details related to the storage and disposal of garbage and cardboard boxes.
- Camp standards and inspection requirements.

The office prework is also a final opportunity to discuss any changes to the plan that are mutually agreed upon. This is the time to agree with issues before the work starts.

Best Management Practice: Document all items discussed and share this document with the planting supervisor and planting implementation contractor. It is easier to set this up in advance and add any changes discussed at the prework meeting.

Best Management Practice: Create a prework signoff sheet that matches the items that you will discuss at your planting prework. Practices vary across the province so these should be specifically generated for your organization and operating area. Adjust every year if new items appear to be important for discussion at the office prework.

6.2 Field prework

Field preworks are best held with just the plantings supervisor, planting crew leaders and any internal quality assurance staff. This will help focus the communication on a chain of command that is accountable for quality. Clients and implementers should avoid acting as the planters' supervisors as this weakens the contractor's accountability. As the planting program progresses, new field preworks will be required whenever a new crew arrives, or the program significantly shifts towards a new prescription or new operating conditions.

Discuss the specific elements of your planting ground while you are standing on it. Whatever else has been explained the office, things become much clearer when the key people are present together in the field.

- Direct the planters to be open about mistakes that occur during planting. There are a lot of things going on and it is expected that a few errors will occur. The client and the implementer must be allowed to help solve issues as they arise.
- Take the planting supervisors to a number of openings that were planted 2-5 years prior and show them where the trees did best. Discuss why they did best in those locations.
- Review planting viewing notes that relate to stock handling and planting quality.
- Review the organization's planting brochure or cheat sheet. Provide multiple copies for all supervisors, crew leaders, and internal quality assurance checkers. See examples in Appendix 1.
- Review stock handling expectations. Silvicool liners, field cache location, cache tarping, bag-up procedures. Establish good habits in the first few days of planting.
- Review expectations of unplanted trees at the end of planting day. Discuss whether field caches can be left overnight and how large these can be.
- Discuss the planting quality faults. Many of the faults are standard but some of them have to be addressed at the prework, such as too-shallow, and too-deep. (FS704, 2012) Review the list of faults and discuss these at the field prework.
- Identify key items for planting success in your program. This will likely be different in different operating areas within your planting program. Identify these scenarios and communicate at the prework. Focus all implementation and communication efforts to achieve success for these items. Examples, dry belt sites versus wet belt sites.
- Communicate to the planters the reasons for items in the prescriptions. Passing along the science behind your prescription will go a long way to getting planters to buy in. Explain the "why". Treat planters as if they can be part of the solution and you will have greater success.
- Have a plan for commonly seen stock issues such as botrytis. Discuss the action plan if one of these stock issues is identified. An example plan for botrytis might include: show photos of botrytis, identify the

problem early, prioritize these trees for planting, open up these boxes and provide air flow, stand the trees up in the cache to allow air to reach the infected area, map out the area where these trees were planted.

- Have a plan to deal with frozen bundles of trees. First make sure these are not PSI trees. Then ensure that the trees are not exposed to ultraviolet radiation. The trees should have their boxes outside, open and separated to increase air flow between boxes. The boxes should remain shaded. Bundles can be rotated as they thaw out. (Spring thawing guidelines, 2020)
- Inspect safety equipment, ensure ERP is on site, and review danger tree assessment for the first unit.
- Safety should be reviewed in the field while the factors are clearly visible. Danger trees can be pointed-out and discussed. Steep slopes and rocky areas are visible. Safety equipment should be inspected at this time, and the ERP and danger tree assessment should be on site.
- Let the planters plant and provide quality feedback on the first trees. Plot density data is not likely to be possible as the planters are starting new planting lines, however digging up a line of 6-8 trees could represent a plot and allow feedback on quality. Be present during the first week of planting to provide feedback to the planting supervisors and crew leaders.
- Set up a system with the planters that their internal QA is harder than the client's expectations. This will work best if you can communicate the main items you will be focusing on as a client as this makes it easier for the planters' internal quality assessors to remove these issues over the first days of planting. The expectation is that the final pay plots will be more lenient than both the planters' internal QA and the client. If this is not the case then there are obvious problems that need to be addressed.
- The preworks are the start of establishing trust with the planting contractor, make it clear that you wish them to achieve success and will contribute to helping them get there.

Best Management Practice: Communicate the “why” behind the prescription. Identify the key elements of success or failure in your planting program. Every operating area will have its own issues, whether it be dry soils, heavy cattle usage, or vigorous herbaceous vegetation. If planters are aware of what the critical issues are, they can plant with this in mind. Taking the time to explain “why” in a planting prescription will go a long way to communicating your vision to the planters. Describing the science that lies behind the prescription’s requirements will increase their level of understanding, and their desire to be part of a successful treatment.

7. Planting Project Management (Client)

7.1 Planting program tracking

The planting program should be carefully tracked as it moves along towards completion. This is useful for providing a snapshot of your project at any time over its course. It should include for each planting unit:

- Planting complete as communicated by planters or implementer
- Invoice received
- Deliverables received
- Invoices that have been paid
- Planting quality
- Excess
- Tree densities
- Trees planted
- Fines assigned
- Unplanted areas
- Traverses of unplanted areas
- Forward scheduling of unplanted areas
- Planting reporting completed,
- Planting area forest cover updated within the client database.

7.2 Start-up

The first few days to the first week are the most important for providing feedback to the planters. It is important to be present in the field during this time. Observations of stock handling should also be made at this time.

It is best management practices to provide feedback through supervisors, foremen and internal quality assessors. They are expected to train their planters how to achieve your prescription and expectations. Avoid giving feedback to individual planters, especially on density. The supervisor, foremen, or internal quality assessors will have a much better understanding of each planter's density and is in a better position to provide that feedback.

Best Management Practice: The client should be present at the field prework and be available for questions and solutions throughout the first days of planting.

7.3 Deliveries or thaw requests

The client or implementer should have oversight on all delivery requests. This can help identify if there are unplanted trees being left at the storage facility. Keep track of the total number of boxes owned as they are being requested and ensure all boxes are ordered by the end of the project.

7.4 Payment

The plots are a guide to determine if the planters are meeting expectations. The client's role is to review the information provided and discuss with the implementer their thoughts on quality progression.

Fines should be reserves for when planting contractors are not progressing towards the suite of expectations. Work with your planting contractors in the early days of the planting contract to achieve what you are asking for. Consider waiving \$25 fines on a \$150,000 invoice.

The planting contract is a tool to enforce expectations. Fines are available for when you are unhappy with the planting and the contractor is not meeting expectations.

If there is an instance where the total tree numbers claimed does not match up with the plots, conduct an investigation. This investigation should firstly focus on the planting unit area, determining if the planting unit has been traversed, if road widths are over-estimated, or if larger areas were planted compared to the original plan. Investigations should then determine how representative the plots are, as it is possible that low density areas have been over-sampled. The planting unit shape does contribute to uncertainty – units with relatively greater edge to interior increase the uncertainty of the sample. If there are no plausible answers to whether there are unaccounted for trees, then further field review may be warranted to find planting that went beyond the expected boundary. Document all decisions made during this work.

There is a high amount of expenses that occur at the front end of a planting project. If planting expectations are being met, the planting company can reasonably expect to be paid as promptly as is possible.

Best Management Practice: Payment should be as prompt as possible, as planting companies have a high amount of costs that occur in a very short time frame. Identify any obstacle to invoice payment and direct strong effort to removing these.

7.5 Planting complete

Once the last invoice has been received these items should be reviewed prior to payment.

- Cold storage confirms that all trees have been shipped,
- All planting deliverables received,
- Untraversed area data received,
- Danger tree assessments received,
- Check for balance between seedlings assigned and seedlings claimed planted,
- All planting units have been confirmed free of garbage,
- Interim cold storage (reefer) area free of garbage. Reefer has been removed.

Security deposits and holdbacks can be released as per the timeline and circumstances indicated in the contract.

Best Management Practice: Make sure the invoices have not overclaimed for trees that were not delivered.

Seedling Label	Assigned	Planted	Balance
FDI, 2020DCC0033	31680	31680	0
FDI, 2020DKA0002	98560	98560	0
FDI, 2020DKA0008	78435	78435	0
FDI, 2020DKA0009	33390	33390	0
FDI, 2020DKA0010	25830	25830	0
FDI, 2020DKA0011	52200	52200	0
PLI, 2020DKA0030	24320	24320	0
PY, 2020DKA0016	331320	331320	0
PY, 2020DKA0025	22110	22110	0
PY, 2020DKA0026	74580	74580	0
PY, 2020DKA0027	630	630	0
Totals:	773055	773055	0

Figure 7. Example post planting balance of request keys delivered versus trees invoiced.

Following planting, review the planting program with the planting contractor, cold storage, summer nursery. Canvas these groups to discuss issues that came up during the program and provide suggestions for improving future planting programs.

Best Management Practice: Request feedback from the planters on the planting program. Following planting review what worked and what didn't work. Look for opportunities for how the planting program can improve.

8. Planting Implementation

Planting Implementation is a role that can be done by the client directly, or be contracted out to an experienced implementation contractor. This is a key position that ensures the planting program continues smoothly and facilitates all communication until the project is complete. The role of the implementer must be clearly articulated by the client, so everyone is aware of their responsibilities. The client and the implementer must be aligned as to tolerances to faults, and this must also be determined at the outset. For example, a client might accept a tree planted at 1.95m when the minimum inter-tree distance is 2.0m.

Good, two-way communication between the implementer and the client must be set-up and maintained throughout the planting project. This is critical to the success of the project. A good way to maintain this is a daily update. While the client is the decision-maker on a planting project, the implementer is often closer to the project, and can make decisions on the client's behalf and communicate those promptly.

8.1 Planting implementation prework notes about best practices

Planting implementation preworks are usually less rigidly defined than planting contractor preworks.

Most items that are relevant for the planting contractor are also relevant to communicate to the planting implementer. Many of these items can wait for the planting contractor's office viewing however there are a number that should be discussed in advance.

Items to discuss at Planting Implementation prework:

- The client must clearly articulate the role the implementer will take on and which roles the client will conduct. This is often challenging and often is reliant on how long a relationship the client has with the implementer.
- The implementer must be present at the office and field preworks with the planting contractor.
- Client and implementer should be on the site for the first two weeks providing feedback to planters.
- Set up a plan for communication between the implementer and the client. Daily updates are recommended and can be in the form of a consider email outlining: planting completion, seedling deliveries, seedling health, stock handling reviews, planting quality, and prescription details communicated to the planters. Keep the client updated about whether the planting units are taking more or less trees than expected so they can be aware of any upcoming need for overflow ground.
- Provide feedback to planters in a timely manner, preferably when the planters are still on site. This gives planters the opportunity to solve issues as they arise and before any payment considerations. The best communication involves a marked-up map of the location of where issues were noted, what ribbon colour was dropped next to the trees, and what specific problems were noted. It is best to have a suggestion as to what needs to be fixed and where so the planting supervisor can better relay this information to internal QA checkers, planting foremen for discussion and remediation with the individual planters.

- Discuss tolerances for faults and excess trees to calculate at pay plots. While borderline faults may be addressed differently, it is always appropriate to add a comment about where tolerances were applied so the client can adjust if necessary.
- The client or implementer should have oversight on all delivery requests. This can help identify if there are unplanted trees being left at the storage facility. Keep track of the total number of boxes owned as they are being requested and ensure all boxes are ordered by the end of the project.
- Check the reefer, and caches often. Record seedling temperature and seedling health. If reefer temperatures deviate from expected recommend a course of action to fix this. If seedling health issues are identified recommend a course of action to minimize damage. Communicate all major findings to the client in regular updates.
- Check stock handling on first days and then periodically. Check boxes, stock handling, caches. This helps show that there is a client presence so that stock handling doesn't degrade.
- Part of implementation is to teach the planter's checkers how to do quality assurance the way that the client intends. This is time well spent. Show them what are faults, paying closer attention to planting microsite location and how to identify underground faults.
- Clients and implementers should avoid acting as the planters' supervisors as this weakens the contractor's accountability. Most communication about planting quality should be directed towards the planting supervisor, foremen or internal quality assurance checkers. Specific faults can be identified to planters if they ask. Never discuss density with individual planters as this should be left to the company's representatives. Implementers rarely have as many plots established as a foreman.
- Excess and re-plants or fill plants. Fill plants are difficult to determine how many trees these should take. These areas are already at high risk of failure. Provide feedback on acceptable planting and review each site on its own merit. We wish to increase densities on these units however the planting quality inspection system punishes a significant number of situations where we would like to plant a tree. Review with the pay plotters whether the goal has been achieved on these sites and recommend paying accordingly.
- Requiring planters to rework ground is more effective than fining contractors at the beginning of planting contracts. While replanting areas does have increased risk for survival, it reinforces the message early in a planting contract of what is required and helps improve the remainder of the project.
- Clearly indicate how many pay plots are expected and the plan for lumping very small planting units into larger payment units.

Best Management Practice: Consider getting surveyors to implement planting contracts. This sets up a very good feedback loop between planting operations and survey treatment recommendations.

Best Management Practice: The implementer must be on site for at least the first three days of planting. This will allow planting supervisors to discuss the prescription, and the implementer can help train the planters' internal quality assurance checkers.

8.2 Field Notes

The implementer should be taking daily field notes during the course of the planting project. These include observations on planting quality, stock handling observations, seedling issues, weather, and safety observations.

Best Management Practice: Each organization should create a template for recording stock handling observations.

Seedling deliveries should be monitored to ensure seedlings are not sitting in the reefer too long. Stock issues should be reviewed and documented regularly.

Best Management Practice: Implementer should review the stock delivery sheets, as well as monitor stock to ensure that it is planted promptly.

Stock Handling and Storage Inspection

Planting Contractor: _____

Date: _____

Planting Unit: _____

Inspector: _____

On-Site Inspection Item	Inspected			Number Inspected (for day)	Inspection Results		Comments
	Y	N	N/A		Acceptable Findings (Y/ N)	Deficiencies Identified (Y/N)	
1) FIST (assess seedling storage in FIST)							
a) Piling of boxes (max 3 high)							
b) Document temperature (in FIST + in boxes)							
c) Boxes left open with seedlings inside							
d) Door(s) unnecessarily left open							
2) Field Caches + On-Site Storage							
a) Suitable location (ie, shaded area)							
b) Adequate tarping of seedling boxes							
c) Inspect seedlings within boxes							
d) Document temperature (in boxes)							
e) Boxes left open with seedlings inside							
3) Observe Bag Up Procedures							
b) Seedling placement in planting bag							
c) Silvicoool liners being used							
d) Only 1 unwrapped bundle per species.							
e) Assess overall seedling handling							
4) Inspection Of Planters At Time Of Planting							
a) Seedling placement in planting bag							
b) Silvicoool liners being used							
c) Only 1 unwrapped bundle per species.							
d) 1 unplanted tree out of the bag at a time.							
e) Seedlings left in bag during downtime.							
f) Assess condition of plugs (moisture)							
5) Wasted Seedlings							
a) Wasted, abandoned, or culled seedlings.							
6) Garbage							
a) Garbage - requiring cleanup or penalty.							

Additional Comments Regarding Deficiencies (findings, planned action items, and completed actions):

Figure 8. Example stock handling cheat sheet. This is intended as a reminder for the implementer to record their observations related to stock handling. See Appendix 3.

8.3 Regular email updates to the client

The implementer should summarize the most important items from their observations and communications with planters. It is a good practice to keep the client informed during fast moving planting contracts.

Example email content:

Planting Daily Update for May 18**Production for yesterday.**

45,110

Planters completed:

M9

Planters Today:

Continue on M10 and M11.

Implementer Yesterday

Pay plotted M9. Met with foremen on M10 and reviewed spacing off overstory and advanced regeneration.

Implementer Today

In Kamloops from May 18-20. Expect block releases on May 20th.

Next few days plan:

Planters will continue on M10 and M11.

Planters now working 4 on and 1 off (May 19th is the next day off).

Rough Description of Quality:

No significant issues that require remediation other than regular minor items.

Stock Handling:

10 Caches and half of planters' bag-ups reviewed. Only minor tarping issues communicated.

Reefer Check:

Reefer inspected. Temperature is within tolerance. Three request keys reviewed and trees look excellent with no bud or root elongation. No garbage noted around reefer. Boxes piled neatly and weighed down with logs.

Tree delivery:

Last delivery May 14, next delivery May 18 and May 24.

Issues Identified and resolution:

Mold has been identified by cold storage on the 2017DCC0041 Pli. These boxes are wet. They are scheduled to ship May 18.

Ken will check the reefer and condition of the seedlings on May 19th. Follow up action will then be determined.

M9 was planted ~7000 trees under allocation. This was caused by a number of wet areas (around 12 inches of water usually) in the eastern portion and some low-density planting that still met spacing requirements. I am not convinced these wet areas will dry up by the time the shipped trees expire. I have directed the foreman and Brian to fit the remaining trees in M10 and M11 by planting at minimum spacing and to show me where this was completed.

Figure 9. Example daily update to client.

Best Management Practice: Each organization should formalize the method of documenting daily activities expected of planting implementers.

Best Management Practice: Communicate good practices as well as poor practices. If you only report on problems the client will get the impression everything is going wrong. It is extremely important to report the planting contractors' successes as well.

8.4 Seedling monitoring

The implementer should be checking the reefer and caches regularly to monitor temperature and seedling health.

Review seedlings for issues such as:

- Actively growing roots
- Actively elongating buds
- Poor root structure
- Poor bundling (from nursery)
- Tree box issues such as saturate boxes
- Botrytis
- Frozen trees

Seedling Monitoring Spreadsheet.

Planting Contractor: _____

Date: _____
Inspector: _____

Date of Sample	Reefer or Field Cache Sample (R/F)	Request Key	Seedlot	Spp.	Nursery	Received Date (at reefer)	Root activity? (none, some, lots)	Bud elongation? (none, some, lots)	Mold on foliage (none, some, lots)	Wilting (none, some, lots)	Frozen bundles? (none, some, lots)	Plug moisture. (Good, OK, Dry)	Temperature of sample (°C)

Figure 10. Example seedling monitoring spreadsheet. This can be used to record good and bad seedlings and help provide direction to planters to mitigate problems. This can also be used to provide feedback to nurseries or cold storage to review problem request keys. See Appendix 4.

8.5 Pay Plotting

Pay plotting can be completed by the client, the implementer, or pay plotters working to assist the implementer. These should be completed as close as possible to the release of a block by the planting company. The number of the pay plots per unit should be determined in advance of the planting.

Pay plots should include explanatory notes. These will help in the event of any dispute. Notes should be collected with each plot. This will allow the client to review borderline calls and determine if payment fines are warranted. Notes should include any fault or excess tree. Example – “excess = 1.7m.” Example 2. “B8 = fully planted in litter.” Notes should also be collected where faults or excess were not assigned but the trees were close to being considered faults. This should be discussed with the client prior to startup.

Review the document: Planting Quality Inspection. Guide to Completing the FS 704 Effective April 2012

Best Management Practice: Invite the planting supervisor or internal quality assurance checker to the first units for pay plots. This will spark discussion and encourage improved practices for planters' internal quality assurance.



Figure 11. FS704 Planting Quality Inspection system.

8.6 Deliverables

Pay plot deliverables should include a final map that clearly identifies:

- Plot locations and plot number
- Unplanted areas and description of why unplanted,
- Safety hazards with a description
- Unburnt piles location
- Roads that are not as mapped
- Roads that are not drivable
- Access restrictions and description
- Planting quality%, Excess %, Payment Rate %.
- Date surveyed.

9. Planting Reporting

The reporting of the data collected at the time of planting is important. The information is used for activity reporting, regeneration delay declaration, and to indicate the number of months between harvest and reforestation, which is a significant indicator in various third-party forest management certification standards such as Sustainable Forest Initiative (SFI).

9.1 Planting Reporting Requirements

The requirements for planting reporting are outlined in the RESULTS Information Submission Specifics (RISS) documents for both licensees and government funded activities. Planting activities are legally required to be reported by May 31st of the following calendar year. Detailed planting stock information is required. Spatial information for planting areas is required.

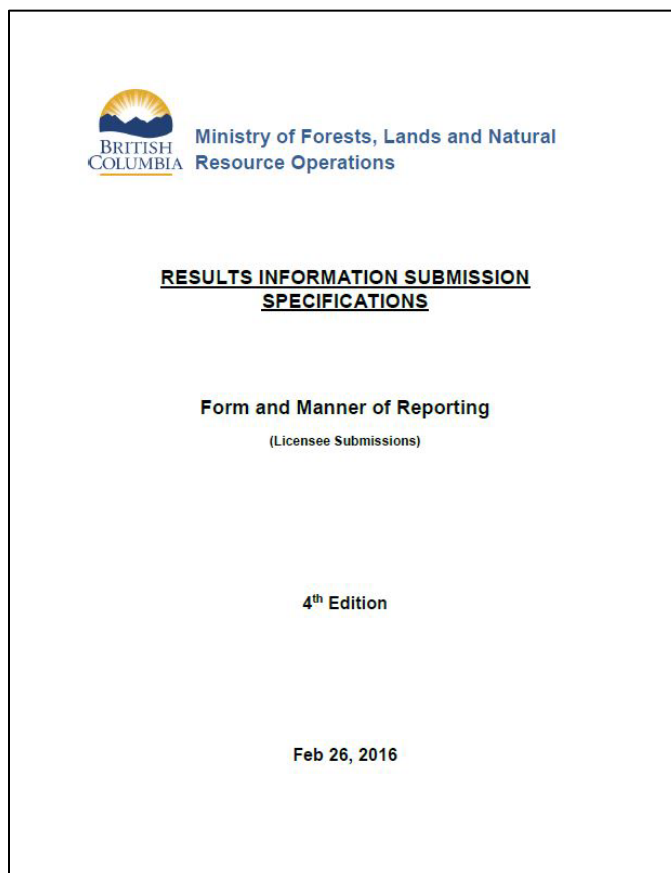


Figure 12. RESULTS INFORMATION SUBMISSION SPECIFICATIONS Form and Manner of Reporting (Licensee Submissions). Review the RISS for detailed description of requirements. There is a version for Licensee and for Government funded submissions.

Forest cover reporting is reported at the time of planting. Often this forest cover record remains the only updated RESULTS record until the free growing survey. Forest cover should be updated in subsequent years after stocking has stabilized and planting mortality is known.

Best Management Practice: Update forest cover at the survival survey the year after planting. This follow-up survey should be used for regen declarations. This will allow better modelling of the forest across the landscape.

10. Post-planting Monitoring

Monitoring plantation survival is an important part of the silviculturist's job. Post-planting monitoring includes a range of activities including a post-planting walkthrough that takes place in the season following planting, and a regen survey that occur one to three years following planting.

10.1 Post-planting walkthroughs

Post planting walkthroughs can be a simple walkthrough or it can involve plots. This should be a senior surveyor's or silviculture specialist. The focus should be on the vulnerable areas that were identified prior to planting or during planting. A lot can happen following planting – stock issues, cattle, rust, drought issues can express in the first year. A fall walkthrough can reduce the time to get trees back on site in the case of a plantation failure.

Best Management Practice: Conduct a post-planting walkthrough in the months after planting. This will give early feedback about the risks to the planted trees.

Consider getting the implementers to do post-planting walkthroughs. This sets up a feedback loop between planting operations and reviewing survival.

Best Management Practice: Post-planting monitoring is extremely important. These walkthroughs should be done by senior silviculturists; they provide the most important feedback on the treatment effectiveness and lessons to improve future programs.

10.2 Regen survey regimes

The post-planting survey regime should be based on risk identified in the post-harvest assessment. Stand level risk can include: anticipated vegetation competition, very dry sites (or a component), very wet sites (or a component), very high coarse fragment, weaker than planned mechanical site preparation, or anticipated animal damage. The survey regime should be adjusted by events that occurred during planting. This can include extremely hot or cold weather, late season snow or frost, stock issues, poor planting quality, signs of animal damage, or early indicators of mortality.

Best Management Practice: Create regimes specific to your operating area to assign to units with different risks. For sites with low risk these can have less frequent planned reviews. For sites with increased risks these should have increased survey frequency and a post-planting walkthrough.

There are benefits to completing your regen survey in year one, and benefits to completing after a few years. Surveys scheduled the year following planting should not occur until after bud set, however. Completing a survey earlier provides faster information about plantation failures, which translates into faster re-planting, while waiting will provide a better picture of the full establishment of your new trees.

Survey intensity should also be driven by site risk. A higher plot intensity is recommended for areas with higher risk of uneven or spotty plantation survival. Areas considered as a low risk for mortality, with more heterogeneous plantation results, will likely require a lower plot intensity.

The most important question your post-planting monitoring should answer is “why?” It is not enough to know that a plantation has been unsuccessful. Silviculture managers need to know the reasons for the poor results, so they can be addressed.

Silviculturists should provide training for any surveyors working on their openings. Teaching your surveyors how to identify risks within each operating area they are working in, and show them proven techniques to remediate low stocked stands will be invaluable. Request that they provide observations on the location and circumstances under which seedlings thrive as well as die.

Best Management Practice: Educate surveyors on how to provide better silviculture treatment recommendations for poorly stocked strata in your operating area.

11. Decision Making and Regime Setup

11.1 Including silviculturist in pre-harvest plans

The success of a planting program starts several years before seedlings arrive, and ideally, before any trees are harvested. Silviculturists should be involved at the site plan level, and development foresters should have a good knowledge of the silviculture challenges in their operating area. Problem sites can and should be removed from harvest plans. These include, but are not limited to:

- Open areas devoid of crop trees
- Xeric sites
- Hydric sites
- Extremely rocky sites

Including silviculturists in pre-harvest planning can help avoid harvesting plans that create extremely expensive silviculture treatments. Silviculturists should walk the ground before the site plan is finalized and include their findings at development round-table meetings.

Best Management Practice: Silviculturists should be involved in development planning and included in site planning round-table discussions. Silviculture regimes should be applied at this stage.

11.2 Post-harvest assessments (PHA)

The post-harvest assessment (PHA) is a critical step in determining the silviculture regime and should be completed by an experienced silviculturist who is familiar with the operating area. A PHA form used should be tailored to a specific operating area and would include issues that are common or possible in the area, as well as potential solutions.

Best Management Practice: Silviculturists should conduct post-harvest assessments to review the site. These assessments will confirm or adjust the original regime applied to the site. It is important that a senior silviculturist completes these assessments.

Multiple options should be presented for each site, to account for contingencies. It is important to have a primary plan, as well as a backup plan for the site, as things can change during a planting program, and being able to make good decisions quickly will help to ensure the success of the regime.

Examples include:

- Indicating a percentage range of preferred and acceptable species, to account for possible under-runs at the nursery, which might alter species mixes.
- Indicating site preparation as the primary plan, but raw planting as a secondary option. It is important to qualify under what circumstances the secondary option is viable for.

The PHA should identify the risks and limiting factors of each site. The PHA should have a recommended course of action that will address site limiting factors and be incorporated into the treatment regime and planting prescription. Site limiting factors might include (but are not limited to):

- Risk of frost

- Short growing season
- Clay soils
- Heavy cattle use
- Dry soils
- Vegetation competition

Best Management Practice: Create a post-harvest assessment template, tailored to each organization and operating area. Identify the key site limiting factors for each operating area.

One of the best methods to anticipate what will happen on an opening is to observe any adjacent previously harvested openings. The PHA should include a walkthrough on adjacent openings if available. Openings that have achieved free growing, or recent plantations will provide the silviculturist with a picture of the future conditions on their site.

11.3 Planting recommendations from surveyors

Planting recommendations may come from silviculture surveyors rather than from a post-harvest assessment. It is important for the silviculturist to visit these sites prior to creating a treatment plan. Silviculture surveyors are an important partner in the development of regimes, but their recommendations need to take place as part of larger program, and should also be viewed under the lens of larger planning and management processes.

Best Management Practice: Review all sites where treatment has been recommended by surveyors. Often surveyors do not have the full history of the site and may not have sufficient operational knowledge of key site limiting factors and how to address them.

12. Seed Supply

Seed supply and sowing are some of the earliest considerations in the management of a planting program. If your organization has limited or no access to the seeds required for your operating area, planting activities will be impacted. Sowing deadlines, especially for large government programs, occur very early in the year, so a long planning horizon for these activities is usually required.

12.1 Seed supply

All organizations that plant trees should maintain a supply of seed suitable for their projected seed needs. The seed supply should be able to meet seed needs over a minimum of five years and preferably ten years. If a deficit is observed in your seed supply, make plans to collect or purchase seed. Target seedlots that will be acceptable over the largest range of your operating area as possible.

Best Management Practice: A seed supply review should be conducted annually to identify the five-year sowing needs for your organization. Focus on securing seed that will transfer over multiple biogeoclimatic subzones that occur within your operating area.

13. Sowing Considerations

13.1 Ordering trees

Sowing requests for a planting program can often get very large and complex. Refer to Stock Selection Guidelines, updated 2021 for extensive details on seedling and nursery considerations. There are a few key decisions made during sowing that can improve operational efficiencies for planting programs.

It is recommended to keep request keys to a minimum where possible. Choose seedlots that fit multiple planting units across your program. This will give as much flexibility as possible to move seedlings between planting units.

The Climate Based Seed Transfer (CBST) system is used to determine if seedlots are acceptable for transfer into any specific biogeoclimatic subzone. Refer to the Chief Forester's Standard for Seed Use for all information related to where different seedlots can be transferred and planted into.

Geographic information should still be considered when choosing seedlots. If choosing a seed from a natural stand, it is still a good practice to choose a seedlot that is close to your site.

There are several key factors in choosing an appropriate seedlot. (Stock Type Selection Guidelines 2021) Choose a seedlot that:

- Meets CBST requirements
- Is appropriate for multiple sites in your planting program
- Has the highest genetic worth
- Has a high germination percentage (>80%)
- Is close in elevation to your site if a natural seed source, preferably lower in elevation than your planting site (not a requirement of CBST but is a preference)

- Is relatively close geographically to your planting site (not a requirement of CBST but is a preference)

Best Management Practice: For sowing requests, order as few request keys as possible and target seedlots that will transfer over multiple biogeoclimatic subzones within your planting program.

Stock size is an important consideration for ordering trees. Larger stock sizes are generally more expensive and will impact the overall cost of your planting program (Stock Type Selection Guidelines 2021). As site risks increase, the size of the plug should increase, however, while on sites with lower risks, smaller plugs can be ordered.

When ordering trees for spring programs, consider frozen stock (PSI) for the early planting units. This makes it easy to start planting immediately after the site is ready to plant.

14. Nursery and Cold Storage Considerations

Nurseries and cold storage considerations are another early component of planting planning. Decisions made at these early planning stages will have a large impact on the ultimate success of your planting program.

- Refer to Stock Selection Guidelines, updated 2021, for extensive details on nursery and cold storage considerations.
- Refer to Thawing and Handling Guidelines for Conifer Seedlings in British Columbia Revised October 2020.
- Refer to Ministry 2018 Hot Lift Stock Ordering.

14.1 Nursery considerations

Seedling nurseries are an important component of your planting program. Some organizations will have a long-term relationship with a nursery based on many years of interaction. It is important to maintain an open line of communication with your nursery. This should involve site visits, where you can see how your trees are growing and become part of the conversation about the acceptability tolerances of various seedlings.

Best Management Practice: Visit the nursery where your trees are growing. Take an active part in decisions that affect the trees that will be planted in your program. Use the knowledge of nursery staff to inform your planting prescriptions and other practices. Learn about their business. Understand what they are doing to grow your trees. This builds a connection between what you are asking for and the end use of these seedlings.

At the nursery review your trees, bud size, caliper, and root growth. This will help you understand the stock choices available.

For hot lift planting programs (summer and fall planting) place all of your seedlings at the same nursery. Once stock is lifted there is a limited amount of time before these trees need to be planted. (Stock Type selection guidelines, 2021) Consolidating seedlings at one location will reduce transportation logistics and reduce the time before these trees get planted.

Best Management Practice: Consolidate all hot lift trees in the same location.

Bush Loads

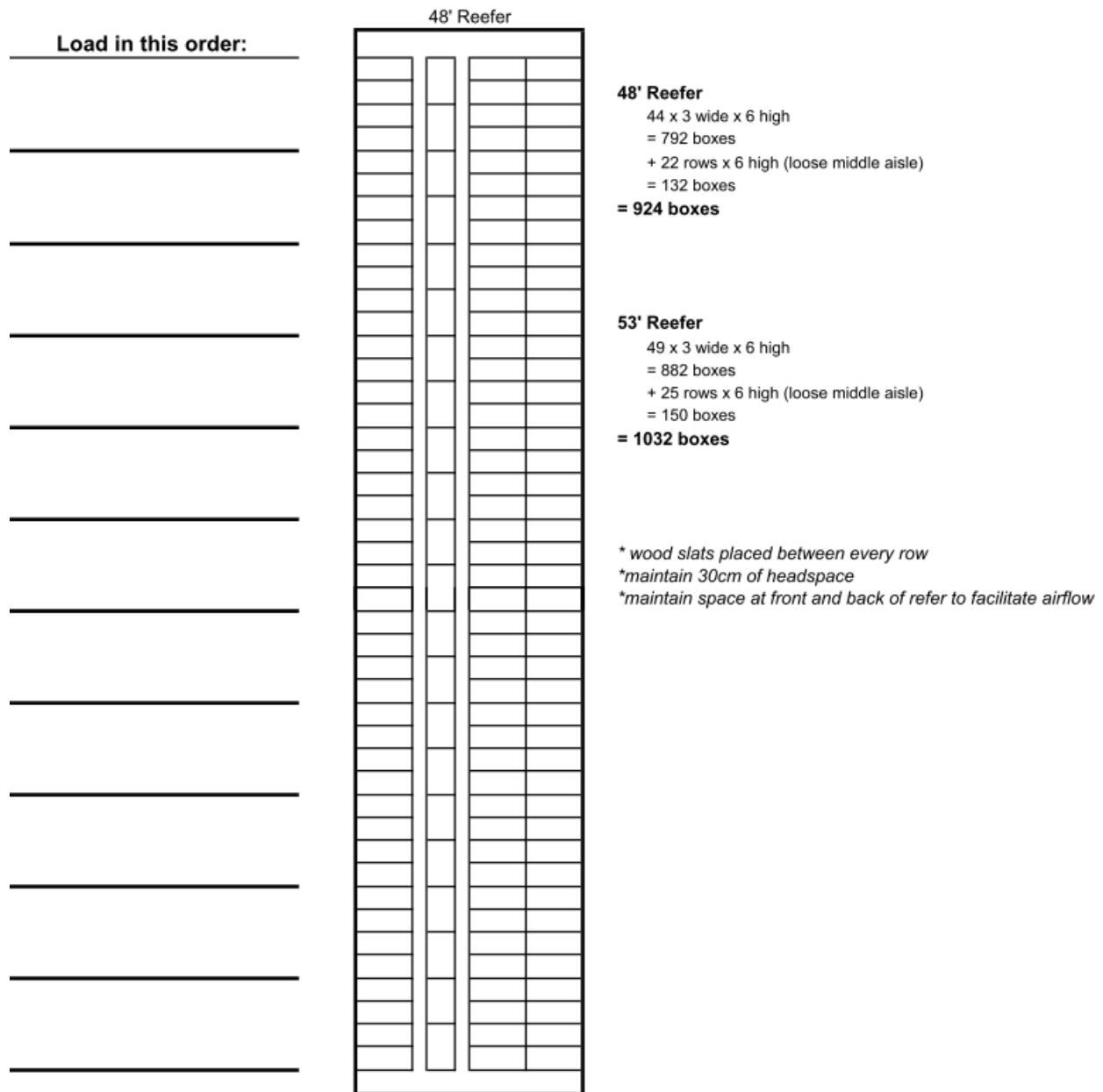


Figure 13. Provide shippers with specific instructions on how the delivery should be loaded. This diagram is an example template that can be use to effectively communicate how boxes should be loaded for bush loads. Efficient loading can save unnecessary box handling in the field.

14.2 Cold storage and shipping considerations

Storing all your trees in one centralized location helps to make logistics easier for your planting program, but it is not always possible. The cold storage should be as close to the planting project as possible. The earlier you can make your plans known to the cold storage manager, the better, as it allows them to organize the storage area keeping the earlier trees more accessible.

If working with spring trees, contact the cold storage and give them a rough estimate of when trees will be thawed and in what order. This will help them organize their cold storage and keep the earlier trees more accessible.

For thaw requests, clearly communicate the shipping method and date, and who will be receiving the shipment. Thawing requests should be done by the box, not by the number of trees. Every person involved in these logistics should be keep involved in the communication.

Best Management Practice: Consolidate all spring trees in one cold storage location. This will reduce delay and errors associated with difficulty in accessing planting stock.

15. Informal Trials (Tests)

Silviculturists should conduct their own trials in their operating areas to expand knowledge and improve future successes. Any treatment regime identified should be subject to testing and adjustment. Note, these trials shouldn't be confused with research trials which have a much more rigorous approach.

All trials should be documented with clear distinction on maps where these have occurred. The number of variables needs to be managed. If you want to know about environmental impacts, hold the other variables the same (planting year, season, instruction, stock type, site prep, etc.). If you want to know about cultural variables, keep the environmental variables constant. Doing trials across other blocks improves the reliability of results, because you aren't extrapolating from a single site. Trials should be conducted on the same opening and the same standards unit where possible. Trials need a control population of the same size as the treatment. Think carefully what you should describe as a control and include it in the trial. Research samples should be a specific selection of treatment and control trees. Research trees should be tagged or staked, so that you can return to the same trees in subsequent measurement/review periods.

Trials size could be:

1. Larger scale where half an opening has one treatment, while the other half has another.
2. Smaller scale where a 20m x 20m section is treated slightly different. These have value as anecdotal support for theories or where an existing regime works but slight changes are suspected to improve results, but also may fail.
3. Very small areas of high-density planting should be established as a common practice on all extremely dry or dry sites to allow for multiple excavation over multiple seasons. These should be easily accessible, mapped and made available to surveyors for review and commenting.

Below are examples of tests a silviculturist may perform to further knowledge:

- Establishment of min-max thermometers at grass height to record extreme temperatures observed by seedlings.
- Seedlot progeny – seed sourced from drier sites vs seed sourced from moister sites (for drought testing), and from northern or higher elevation sites and southern or lower elevation sites (for frost testing).
- Stock size – plant some 512A, 412A, 412B, 309 sized Fdi and compare how they do over different seasons.
- Planting depth – test deep, normal, flush, and even shallow plug placement.
- Planting microsite – obstacle planting location, test aspect, stumps, rocks, brush. Test on burned landings.
- Planting stock – top pruning at nursery or on site adjusting the root to shoot ratio.
 - Ask nursery to top prune several boxes of trees prior to hardening off, track these and test them.
 - Alternative is to manually top prune trees following planting.
- Nurse crop planting – planting under established or establishing trees.
- Nurse crop planting – planting in conjunction with other trees or vegetation.
- Mechanical Site Preparation – size of spot.

- Plant multiple locations on prepared spot.
- Mechanical Site Preparation – disturbance %.
 - Test different size or intensity of the same disturbance.
- Mechanical Site Preparation – one treatment type versus another.
 - Plant multiple locations on prepared spot.
- Raw planting – have planters plant a box of trees on recently harvested sites scheduled for MSP and planting at a further season.
 - Test stock size, microsite location and species survival.
- Planting timing – leave small areas to plant in subsequent or prior weeks to test root growth and survival.
- Planting timing – fall planting.
- Fertilizer application – treat versus no treatment.
 - Different types of fertilizer treatments can be included.

If small scale size of tests is chosen, plant at high densities to cover as many diverse microsites as possible to rank effectiveness.

Best Management Practice: Small operational trials are an extremely cost-effective way of testing for appropriate regimes most likely to work in an area. Silviculturists should engage with their local research silviculturist to improve trial design, expand questions worth testing, and to help drive research project ideas.

This is important. If trials are designed with some rigour, their results will be more widely accepted and applicable.

16. Recommendations

Each organization should standardize their templates. These include:

- Planting contracts so that planters can know where to look for specific information about your planting project.
- Post-harvest assessment templates should be generated for each organization/operating area and include direction on collecting information specific to the risks commonly found in that area.
- Planting office prework checklist.
- Planting field prework checklist.
- Planting cheat sheets or brochures specific to each organization and operating area. See examples in Appendix 1.
- Interim cold storage sign-out sheets.
- Stock handling inspection cheat sheets.
- Seedling quality inspection sheets.
- Stock ordering maps for reefer loads.
- Camp inspection sign-off sheet.

The following extension / training is needed for newer silviculturists to better understand the following:

- Contract law.
- Planting tendering including Invitation to Tender, Request for Proposal, and Expression of Interest.
- Planting program management, including preworks, data handling.
- FS704 training for pay plots should be extended throughout the province.
- Silviculture treatment recommendations – planting. For silviculture surveyors.

Surveys:

- For the sites at greatest risk, conduct a fall walkthrough following planting.
- Increase the survey frequency. The first full survey on the riskiest site should be no later than one year following planting.
- Surveys should include a component of seedling root excavation to allow for better feedback on plantation success.
- Surveyors should be given greater direction on information required when assessing the riskiest sites.

Testing areas:

- Silviculturists should create informal trials to test ideas about increasing seedling survival. These trials should be documented so that surveyors can look for the results and help inform treatment prescription recommendations.

Provide a location where surveyors can excavate a few seedling's roots. These areas should not be within the testing areas.

17. References

Ministry of Forests, Lands and Natural Resource Operations publication, 2012. Planting Quality Inspection, Guide to completing the FS704 Effective April 2012

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Wallis, J., 2014. Tree Planting Workbook.

Ministry of Forests, Lands and Natural Resource Operations publication, 2018. Ministry 2018 Hot Lift Stock Ordering

Ministry of Forests, Lands and Natural Resource Operations publication, 2018. Chief Foresters Standard for Seed Use. Effective 2018.

Appendix 1 Three examples of planting brochures or cheat sheets.

Appendix 2 Example of planting office prework checklist

Appendix 3 Stock Handling checklist example

Appendix 4 Seedling monitoring worksheet example

