



## **Measuring and Monitoring Afforestation Plantations at NoFC**

**A Practical Carbon and Fibre Yield Assessment  
Procedure for Newly Established Plantations on  
Lands that Qualify as Reforestation or  
Afforestation, as defined under the Kyoto  
Protocol.**

# UNDER CONSTRUCTION

**Preliminary Assessment to Establish  
Baseline Carbon Units**

**To: May 6<sup>th</sup>, 2004**

Designed by: Derek Sidders in cooperation with Tim  
Keddy and Barb Kishchuk, NoFC, Edmonton



**Natural Resources  
Canada  
Canadian Forest  
Service**

**Ressources naturelles  
Canada  
Service canadien  
des forêts**

The following protocol has been developed over the last year with the objective of designing a practical carbon monitoring system for afforestation scenarios in Canada. It is assumed that all sites that will be assessed are candidates for high-yield afforestation or reforestation under the “Kyoto Definitions”, and as such, are not treed and in most cases are agriculture field type scenarios. These will be area based stands or forests that are at least 30 m wide and 0.5 hectares in size.

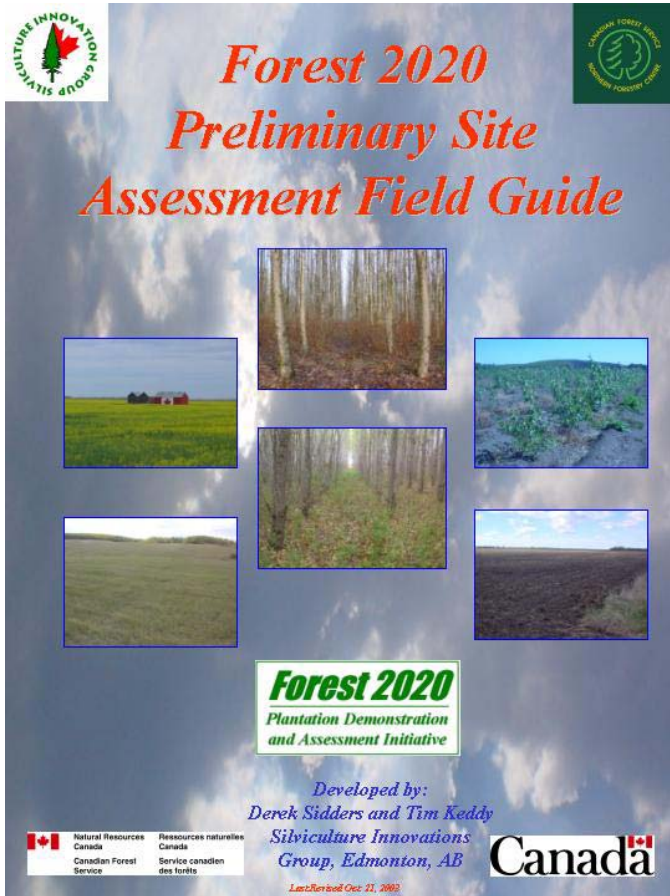
This protocol and associated references, calculation tables (not included as of May 6) , etc... are intended as a preliminary field guide to the measurement and monitoring of afforestation plantations, allowing local adaptations to be added, relative to the end users needs and priorities.

**This guide is presently being used by NoFC to gather all of the pre-establishment samples related to the Forest 2020 Plantations in the Prairies.**



# Step 1: Preliminary Site Description

Initially the candidate site should be assessed and described using the Preliminary Site Assessment Field Guide or acceptable local equivalent. See Appendix “A”.



**Preliminary Site Assessment**  
*Conducted to evaluate the potential suitability of a site for use as a Forest 2020 demonstration site.*

Forest 2020 Plantation Demonstration and Assessment Initiative		Preliminary Site Evaluation Form		Forest 2020 Plantation Demonstration and Assessment Initiative		
Site ID #	Province	Landowner Name	Land Location	Assessment Date	Assessed By	
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
<b>Contact Information</b>			<b>Contact Person</b> <i>(if different than landowner)</i>			
<b>Landowner</b>			Name <input type="text"/>			
Address <input type="text"/>			Address <input type="text"/>			
Town <input type="text"/>			Town <input type="text"/>			
Province <input type="text"/>		Postal Code <input type="text"/>		Province <input type="text"/>		
Phone Number <input type="text"/>			Phone Number <input type="text"/>			
<b>Site Location Information</b>			<b>Directions Map</b>			
Directions From Closest Community <input type="text"/>						
Closest Community <input type="text"/>						
Terrestrial Ecozone <input type="text"/>	CLI <input type="text"/>	Latitude <input type="text"/>				Longitude <input type="text"/>
Plant Hardiness Zone <input type="text"/>	Elevation (m) <input type="text"/>					
<b>Site Information</b>			<b>Site Map</b>			
Topography <input type="text"/>	Slope <input type="text"/>	Slope Position <input type="text"/>	Aspect <input type="text"/>			
Drainage <input type="text"/>	Stoniness <input type="text"/>	Moisture Regime <input type="text"/>	Site Length (m) <input type="text"/>			
Present Vegetation <input type="text"/>	Present Use <input type="text"/>	Site Width (m) <input type="text"/>				
Soil Texture 15cm <input type="text"/>	Soil Texture 30cm <input type="text"/>	Total Area (ha) <input type="text"/>				
pH <input type="text"/>	Salinity <input type="text"/>	Tillage Methodology <input type="text"/>	2003 Vegetation Cover <input type="text"/>			
<b>Site History</b>						
Land Use Prior to 1990 <input type="text"/>		History 1990-2003 <input type="text"/>				
Land Use Prior to 1950 <input type="text"/>						
<b>Comments</b>						
<input style="height: 40px;" type="text"/>						

Developed by Tim Keady and Derek Sidders, Northern Forestry Centre, Edmonton, Alberta. October 18, 2009

Figure 1. Preliminary Assessment Tallysheet

This information will be the initial fields required for the National Afforestation Database developed by Thomas White of PFC: Web Location:

<https://nai.nfis.org/test/splash.jsp>

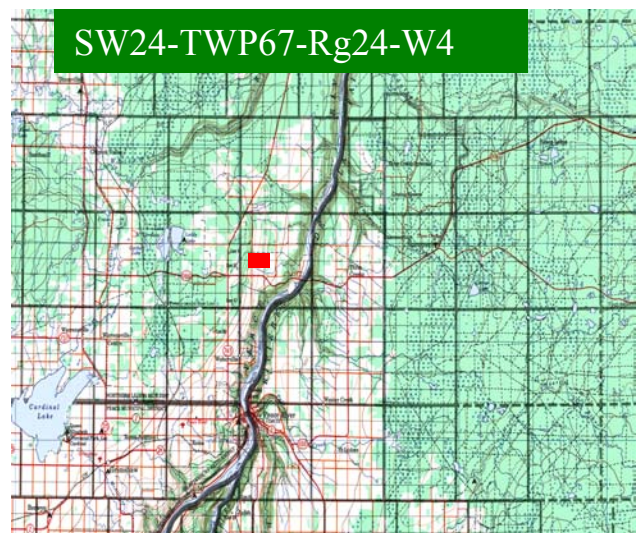
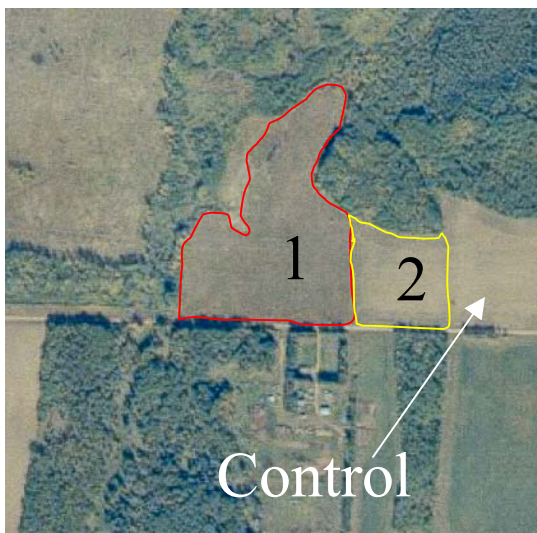
# Step 2: Site Stratification and Mapping

**Partition the candidate site**, based on ground condition similarities such as vegetation, topography, natural breaks, etc. Map and measure all partitions using basic ground based mapping technology (GPS; soils/ topographic map; aerial photo; etc... ) on an appropriate scaled map medium and number each partition. All major access routes and physical features of the overall site should be included on the map. Each partition should have a Step 1: Site Evaluation Form completed, including site locator information and area in hectares.

**Control:** An adjacent piece of similar land under the same present (previous growing season) management should be identified and mapped on the site map and or aerial photo. If deemed necessary, this site should also have a monitoring plot established on it. If that is the case, follow the procedures in step 3-? for this site also. It will be re-assessed at an appropriate time to validate or quantify the site carbon change under regular agriculture or land use other than tree plantations.

Examples:

1



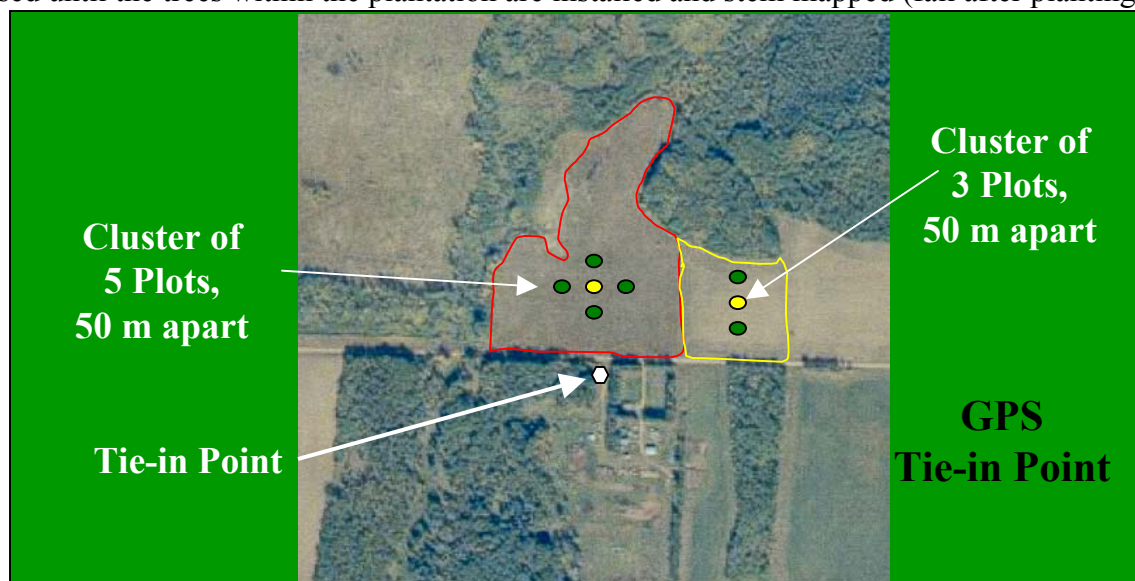


## STEP 3: Establishment of Permanent Sample Plots: Preliminary Pre-treatment Assessments

**Sample intensity:** The minimum number of plots to be established per site will be based on the following:

Description	Site or Strata Area in Hectares				
	1	1-5	5-25	25-50	50+
Minimum # of Plots	1	3	5	9	13
Pattern	N/A	Cluster	Cluster	Cluster	Cluster
Spacing from Centre Plot (centre to centre)	N/A	50 m	50 m	50 m	50 m
Direction Cardinal Directs		with the length E-W or N-S	1 plot in each direction	balanced	balanced
Example		● ● ●	● ● ● ● ●	● ● ● ● ● ● ● ● ● ● ● ●	● ●

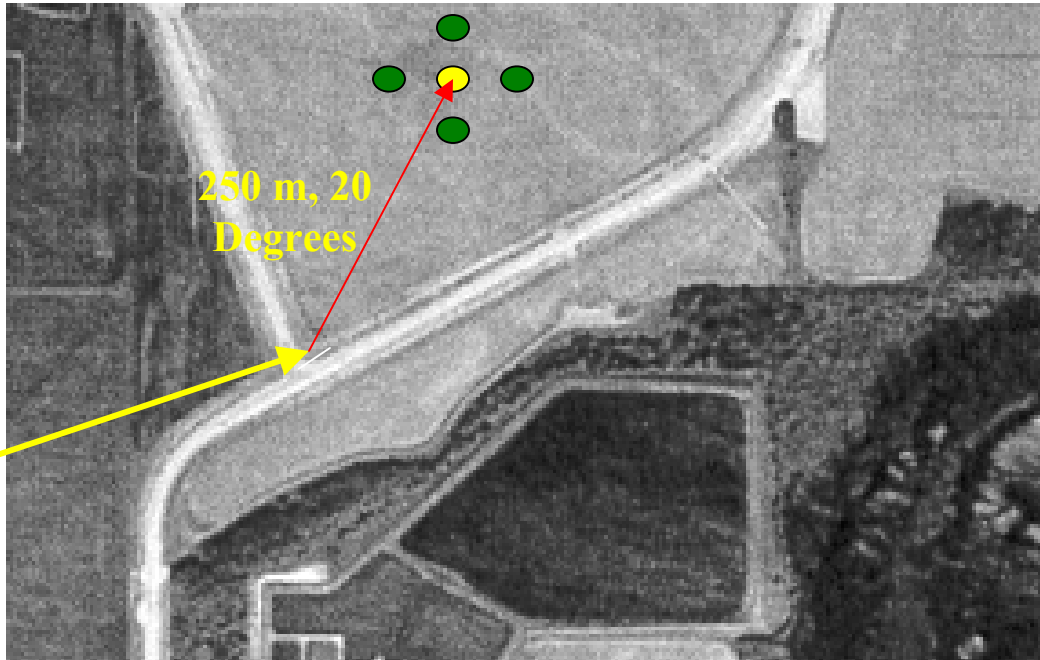
**Establish** a Tie-in Point using Long-term Infrastructure on the local site (Gate Post, Fence Post, Hydro Pole, tree) or install a T-Bar Steel Post with Metal Locator Label. Identify, using the photo or map, the centre point in the plantation from which all plots will be located. GPS the Tie-in point. The distance and bearing are determined from the photo or map and are recorded on the tally sheet. This will be the initial circular plot centre. Other plots will be centred 50 metres apart in cardinal directs from the centre plot (all centre points can be GPS). The centre points will be marked temporarily using a steel or wooden pin and removed once the preliminary sampling has been completed. Once the plantation has been installed and treatment inputs reduced, the plot centres can be permanently marked using a steel pin or other marker. All assessment components of the site, for the lifespan of the plantation, will be collected from these plots. Plots will be 100 square metres in size based on a 5.64 m radius from the centre point. The area based plot is not used until the trees within the plantation are installed and stem mapped (fall after planting).





Plot Tie-in Marker

## Example of Tie-in Marker and Site Directions to Plot Centre



Tie-in  
Point

**Alberta**

**Site #: NOFC-WB-007**

**LLD: NE22-71-08 W6**

**Size (15 ha)**

**GPS Tie-in Marker**



## STEP 4: Pre Disturbance Above Ground Biomass, Organics and Soil Sampling

The location of the 4 samples for above ground biomass, organics and soil within each plot are located at **2 m centres** from the plot centre in all cardinal directions. (a 1 m distance is added for each follow-up assessment and recorded on the tally sheet).

4-1) **Above Ground Biomass**: At each point, a 30 cm by 30 cm above ground biomass sample is removed and placed in a plastic sample bag and labeled by Plot # and Location: 1-E, 1-W, 1-N, 1-S. This includes all rooted plants within the 30 cm by 30 cm area (use a wooden or steel frame to isolate the sample material. Clip or shear off this material as close to the soil surface as possible.

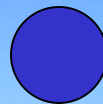
4-2) **Organics**: At those same 4 points remove the loose litter and fibrous organic material within the 30 cm by 30 cm area using a knife or other tool, place in plastic bag and label, as described in 4-1.

4-3) **Soil**: After the organics are removed at the centre of the 30 cm by 30 cm sample area, remove a 5 cm by 5 cm wide by 30 cm deep bulk soil sample using a narrow 30 cm shovel or a large volume soil probe, place in plastic bag and label as above.

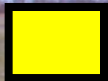
4-4) The final sample, **bulk density**, is taken at the soil surface to 8 cm depth and at the 15-23 cm depth using a soil mass sampler of 100-500 cubic cm. These are taken at the 2.5 m mark to the East and West of the plot centre, bagged, tagged and stored. Fixed area, soil bulk density sampler to be used.



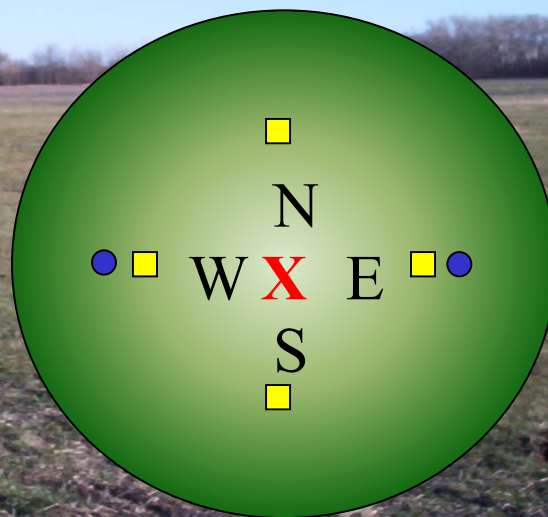
**5.64 Radius Plot, 100 square metres**



**100-500 cubic cm Mass Sample (Bulk Density)**



**30 cm X 30 cm Above Ground Biomass, Organic, and 5X5X30 cm deep Bulk Soil samples**





# Step 4 Continued: Site Photograph

From each plot centre it is recommended that a site photograph be taken facing to the north. A digital photograph is preferred and should be stored/filed appropriately with the electronic and hardcopy of the tally sheets and plantation information included in the tracking system.

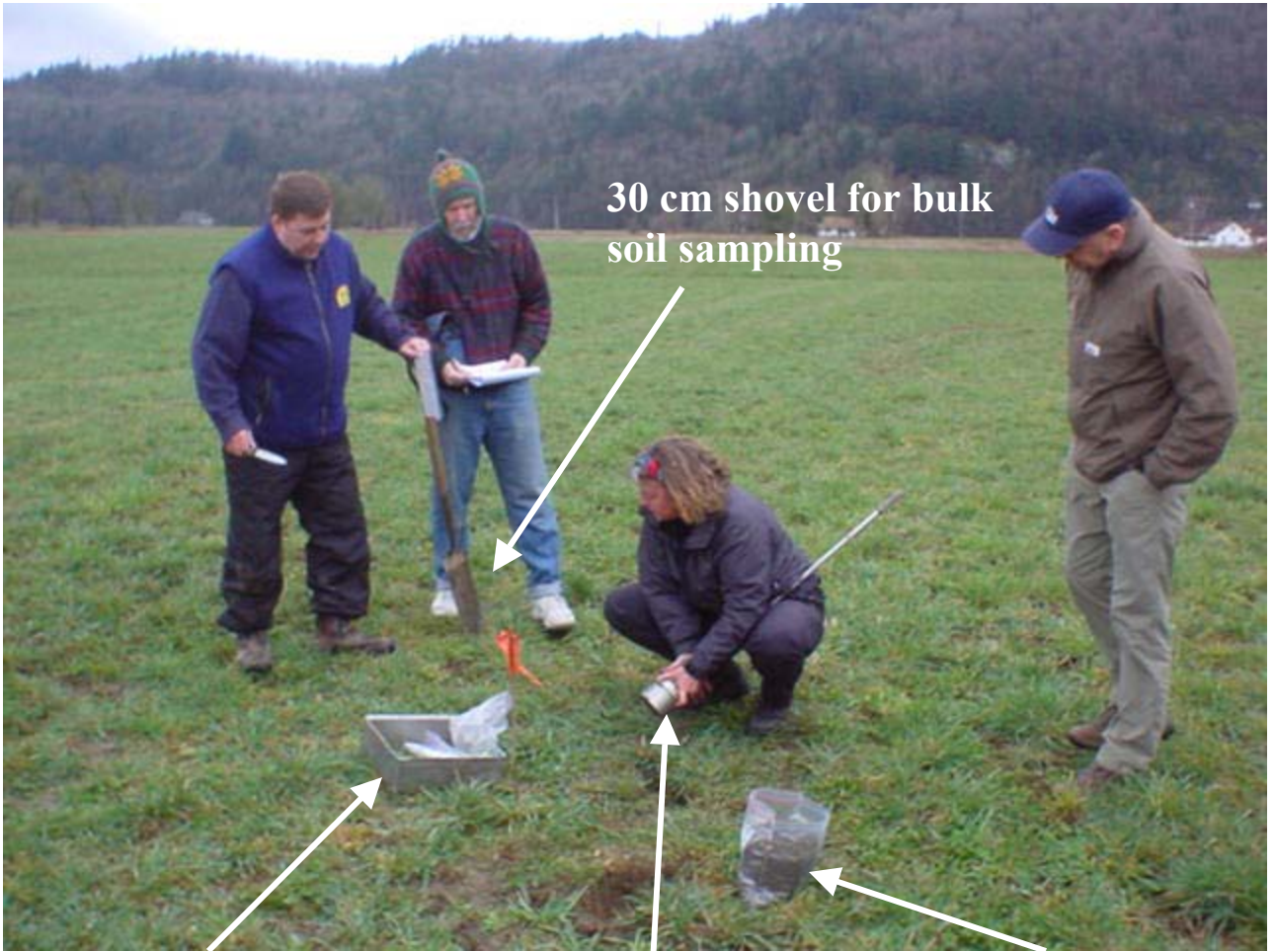


**Pre-Treatment Example**



**End of First Year Example**

Item	Definition	Method	Handling	Storage	Processing
Above Ground Biomass	Plants that are rooted in the soil or organics -4 samples/plot	Within 30 cm by 30 cm frame, clip or shear all material and bag.	Field: Plastic bag, labeled and stored in cooler.	Freezer at < -3 Deg. C	Thaw, place in paper bag, dry in oven at 70 Deg. C for 48 hours, weight after removal from oven
Organics	Litter, Fibrous and Humus layers -4 samples/plot	Within 30 cm by 30 cm frame, remove LFH layers using knife or other approp. tool, and bag.	Field: Plastic bag, labeled and stored in cooler.	Freezer at < -3 Deg. C	Thaw, place in paper bag, dry in oven at 70 Deg. C for 48 hours, weight after removal from oven
Soil Bulk Sample	Mineral Soil -4 samples/plot	Using 30 cm narrow faced shovel, take a 5cmX5cm by 30 cm deep soil sample and bag.	Field: Plastic bag, labeled and stored in cooler.	Freezer at < -3 Deg. C	Thaw, thoroughly mix and remove a 250-500 cc sample for analysis at an appropriate facility, total Carbon, pH and EC.
Soil Mass Bulk Density	Fixed area, none disturbed soil horizon  -2 samples at 2 depths/plot	Using an acceptable bulk density sampler, remove above ground biomass and organics and sample the top 0-8cm and 15-23 cm and bag.	Field: Plastic bag, labeled and stored in cooler.	Field: Plastic bag, labeled and stored in cooler.	Thaw, place on oven tray and dry in oven at 105 Deg C for 48 hours, weigh on removal from oven.



30 cm shovel for bulk soil sampling

30 cm by 30 cm sub-plot frame

Bulk Density Sampler

Bagged Bulk Soil Sample, 5cm X 5 cm X 30 cm deep

Photo from Abbotsford Workshop, March 4, 2004

To COME:

End of First Year Sampling, etc...

Calculations Tables, References