ENHANCED REGENERATION OF DIFFICULT SITES TRIAL

ESTABLISHMENT REPORT

PROJECT # 94-3-06

submitted to:

MANITOBA MODEL FOREST

by:

Synthen Resource Services
Winnipeg, Manitoba

in conjunction with:

Peacock Forestry Services
Pine Falls, Manitoba

JULY, 1995

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EXECUTIVE SUMMARY

Forest renewal efforts in the Model Forest on highly productive mixedwood and lowland softwood sites are sometimes unsuccessful. This can often be attributed to the degree of competing vegetation that develops after harvesting and traditional site preparation treatments. Depending on the magnitude of this vegetation release, the conifer crop trees often fail to become established or are prevented from growing to their potential for many years.

There are numerous sites within the Model Forest as well as other areas of Manitoba that fit these criteria. To address this issue the Advanced Forestry Practises Working Group in cooperation with the Canadian Forest Service Technology Development Unit in Edmonton, initiated a site preparation/vegetation management research trial to be implemented in the Model Forest. The primary objectives of this trial are:

1.To compare existing mechanical site preparation treatments to new mechanical treatments and to combined mechanical-chemical (herbicide) treatments.

2.To evaluate the impact of treatments on the development of herbs, grass, shrub and hardwood vegetation on mixedwood and lowland sites.

3.To evaluate the impact of the treatments on the development of important browse species.

4.To serve as a demonstration area highlighting various site preparation and vegetation management techniques.

Four sites in the Model Forest were selected. Three of the sites are in the Pine Falls Paper Company's Forest Management Licence, with the fourth in the Belair Provincial Forest. Although the sites could be classed as two mixedwood sites and two lowland blackspruce sites, each site is unique due to the past harvesting history and the soil/vegetation conditions occurring on the site. Subsequently the site preparation treatments for each vary to some degree.

The project was initiated in the winter of 1994 with shearblading of those areas requiring the removal of established brush, grass, slash, stumps and residuals in preparation of a secondary treatment. The majority of secondary treatments were completed in the summer/fall of 1994. Treatments requiring frozen ground conditions did not occur until the winter of 1995. Each treatment was replicated four times on each site. Within most treatments four planting rows were created. On several plots there was only room for three rows due to insufficient width of the shearbladed strips. One hundred trees were planted in each replicate in the spring of 1995.

This report provides details of the project establishment phase and an initial analysis of the primary and secondary site preparation treatments and the tree planting.

ACKNOWLEDGEMENTS

The authors wish to thank Derek Sidders (Canadian Forestry Service, Edmonton) who planned and overlooked the project and also provided some of the necessary scarification equipment. The authors also wish to thank Vince Keenan (Pine Falls Paper Company) and John Dojack (Manitoba Natural Resources) for their valuable comments and for providing some of the equipment used in the trial. A special thanks to Paul Bourgeois and Alain Chevrefils of P and A Contracting, who provided the operators, prime movers and mechanical expertise. Without their help this project could not have been carried out.

This project was funded by the Manitoba Model Forest and its project partners. Questions concerning this project should be directed to either the authors or Derek Sidders of the Canadian Forestry Service in Edmonton.

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1.0 INTRODUCTION

The reforestation techniques currently being used within the Model Forest have been generally successful. Improved harvesting methods, site specific treatments and improved planting stock have contributed to this success. However, not all sites regenerate adequately using conventional reforestation methods. These sites usually have severe competition and high mortality rates following site preparation and planting. They can be difficult to plant and tend to regenerate back to a composition not reflective of the original stand. They are primarily lowland softwood sites and upland mixedwood areas and in some cases, may have burned or flooded.

To address this problem, the Manitoba Model Forest partners identified the need to carry out a trial to test and demonstrate a wide variety of new and combined reforestation techniques on these difficult sites.

Initiated by Manitoba Department of Natural Resources as the primary sponsor and Pine Falls Paper Company and the Canadian Forest Service as partners, a project entitled "Enhanced Regeneration of Difficult Sites Trial" was submitted to the Model Forest under the Advanced Forestry Practices program. Peacock Forestry Services and Synthen Resource Services were awarded the contract by the Model Forest to implement and report on the project.

Project partners identified four sites (two mixedwood and two lowland) within the Model Forest where typical reforestation techniques have not been successful. Partners decided that twenty two site preparation treatments would be evaluated and compared. Eleven treatments would be carried out on the mixedwood sites and eleven on the lowland sites. The project was to be carried out over three years and broken into three phases. Phase I would involve laying out the trial and implementing the site preparation treatments. Phase II would include the planting and initial measurements of crop trees and Phase III would involve the follow up analysis based on two years growth and production of the final report.

The objectives of this study are as follows:

1. To compare existing mechanical site preparation treatments to new mechanical treatments and to combined mechanical-chemical (herbicide) treatments. Treatments will be evaluated on their ability to maximize the growth and survival of planted stock and reduce the need for subsequent tending.

2.To evaluate the impact of treatments on the development of herb, grass, shrub and hardwood vegetation on mixedwood and lowland sites.

3.To evaluate the impact of the treatments on the development of important browse species.

This report is the first of several deliverables of this project. It is an initial establishment report describing the trial layout, a description of the site preparation techniques that were carried out and a summary of the initial measurements of the crop trees.

2.0 SITE DESCRIPTIONS

As mentioned previously, four sites were selected in the Model Forest for this trial. Although the sites could be described as two mixedwood sites and two lowland black spruce sites, each site is unique and subsequently the site preparation treatments prescribed for each site varies somewhat. The following are brief site descriptions.

Belair Mixedwood

The initial stand was comprised of aspen, white spruce, balsam poplar, balsam fir and pockets of black ash. White spruce stems were clear-cut between 1990 and 1993 leaving a high residual hardwood component, mainly aspen, of approximately 30% (by crown closure). The soils are moderate to imperfectly drained on flat topography. The organic layer averages 12 centimetres in depth over a sandy silt and sandy loam soil. Aspen and balsam poplar suckering and willow and alder brush are present on the site as well as a moderate grass ground cover. The slash is moderate but patchy with scattered blow-down.

Softwood regeneration on this site is limited due to the excessive soil moisture, moderate organic layer, established brush and hardwood competition and the associated cold soils.

Beaver Creek Mixedwood

The initial stand was comprised of aspen, white spruce and jack pine originating from the 1895 fire. The softwood stems were clearcut in the summer of 1993 leaving a scattered residual hardwood

component, mainly aspen, of approximately 20% (by crown closure). The soils are moderately well drained on flat to gently rolling topography. The organic layer averages 7 centimetres in depth over a silt clay soil. Light brush including maple, willow and beaked hazel are present on the site. The slash is moderate, comprised mainly of spruce and pine tops and limbs.

Softwood regeneration on this site will be hampered by the competition associated with the natural aspen, brush species and other ground competitors which will establish with the increase in soil temperature and surface light.

Broadlands Lowland

The black spruce/ tamarack site was harvested in preparation for agriculture development in the late 1950s. It regenerated willow and alders with aspen on the higher adjacent land. In 1979, the area was included in the FML forest land. Abitibi reforested the site following tractor blading and disc trenching in 1987. The plantation was successful until it was destroyed in a spring grass fire in 1989. Replanting proved to be unsuccessful due to dense grass and a higher water table.

The site can now be described as a heavily grassed field with an organic/sod depth of 40 - 50 centimetres. The moisture regime is sub-hydric with imperfect/poor drainage. Soil texture is silty clay and the topography is flat.

The limitations on this site are lack of adequate rooting environment due to the depth of the sod layer and cold wet organics below the sod.

Trans Licence Lowland

The original mature black spruce/tamarack stand was burned in a spring fire in 1980, started from the highway right-of-way. A salvage harvest followed. In the winter tractor trails were made through the unmerchantable standing timber for firewood cutters. Following tractor blading, the site was planted. Plantation success was marginal. In 1990 a spring "hazard reduction" right-of-way fire escaped into the grassy plantation destroying most of the trees. The fire stimulated dense grass and fireweed cover.

The site presently can be described as a peat bog with a deep sod layer on the surface. The moisture regime is sub-hydric with poor drainage.

Established grass and related sod over the original peat microsite has eliminated the desirable softwood tree growing environment. Cold, wet soil (organics) is also limiting. Elimination of the sod/grass and an elevation in the microsites will enhance the potential of reclaiming this site for black spruce.

Figure 1 shows the general location of all four study sites.

3.0 STUDY DESIGN AND METHODOLOGY

The study design and assessment procedures used for this project were developed by the Canadian Forest Service (CFS). The design is similar to the layout of other CFS trials which have been reviewed and approved by statisticians and conform to the procedures described in the Standard Assessment Procedures for Evaluating Silviculture Equipment (Sutherland 1986). Due to the variability between sites, the treatments between the sites are to be evaluated independently of each other.

Experimental Design and Layout

The first step was to layout the block design for this trial. It was determined that each site

Figure 1: General Site Location Map

would consist of four replication blocks of similar treatments. To accommodate for the variation within the study sites, replications were laid out to run parallel with topographic and residual cover variation (the most significant change on these sites). The replicate blocks were marked out with 4 x 4" corner posts painted orange.

Treatment plots were laid out systematically within each replicate. The dimension of each treatment plot was 50 metres long by 10 to 12 metres wide depending on the site. Within each treatment four planting rows were created and were planted with black or white spruce (depending on the site). In some cases only two or three rows were created since several of the treatment plots were not wide enough to accommodate four rows. In most cases, a minimum of 100 trees were planted on each plot (25 trees per row). Two stock types, one being overwintered container and the others, three year old bareroot stock was planted in row-pairs on each treatment.[1] To minimize bias influenced from the windrow piles, the stock types were planted in alternate row-pairs. Bareroot stock was planted in the first two rows of each treatment in reps 1 and 3 and container stock was planted in the third and fourth rows. This planting sequence was reversed in reps 2 and 4. In treatments containing only three rows, the middle row was split in half and planted with both stock types. A description of the various planting sequences can be found in Appendix B.

In summary, each site had two rows of twenty-five trees per stock type planted in each treatment plot with four replications of each treatment. Figures 2 to 5 show the block design for each site.

Site Preparation Treatments

Site preparation in most cases involved three separate treatments. The primary treatment, which consisted of shearblading the site, was completed in the winter of 1994. All mixedwood treatment plots and most of the lowland plots were shearbladed.

The secondary treatment was a variety of chemical and mechanical treatments, creating continuous and intermittent disturbances. These treatments were carried out through the summer

[1] *In the case of treatment plots with only three rows, the planting design was remodified (i.e., 34 trees per row).*

Figure 2

Figure 3

Figure 4

Figure 5

of 1994 and spring of 1995. A list of the specific treatments carried out on each site can be found in Table 1. A description of each of the treatments is summarized in Table 2. Pictures of various equipment used in this trial are included in Appendix C.

The final treatment, which is planting, was completed in the spring of 1995. Black spruce was planted on the two lowland sites and the Belair site. The Beaver Creek site was planted with white spruce. All seedlings within the experiment blocks were controlled planted on the prescribed microsites. To ensure that the planting was done properly, acceptable planting microsites were pre-pinned for each treatment. All seedlings were tagged by replication, treatment number, row and tree numbers. A description of acceptable planting microsites is shown in Figure 6.

Assessments

Following shearblading, a post primary treatment assessment was carried out by Peacock Forestry Services and Synthen Resource Services. The field crew established two baselines traversing the study replications. Baselines were located 15 metres in from the outside of the blocks running perpendicular to the direction of the bladed strips and marked at each end with 2 x 4" posts painted yellow. Baselines were numbered by replicate number and location.

A tight chain was laid out along the baseline and the following indices were measured progressively:

- Width of the sheared strip
- Width of the windrow of sheared strips
- Width of the undisturbed ground between windrows
- Height of the windrows
- Duff depth at the 2m, 4m and 6 metre mark across each strip (a 30 cm soil sample was also collected at the 4 metre point of each strip)
- Duff depth of the undisturbed section between windrows
- Estimate of canopy cover for each strip
- Estimate of shear efficiency
- Identification of ground impediments such as logs and stumps

TABLE 1: LIST OF THE VARIOUS TREATMENTS CARRIED OUT ON EACH SITE

SITE	PRIMARY TREATMENT	SECONDARY TREATMENT	DATE	PRIME MOVER	TOOL	TECHNICAL
BEAVER CREEK	1 sheared	Screef	May, 1995	n/a	foot	30 cm x 30 cm screef
	2 sheared	Vision-selective	July, 1994	skidder	ForCan 500	one metre wide continuous spray band 4L active ingredient per hectare in a 250L/ha mix
	3 sheared	Vision broadcast and disc trencher	August/September, 1994	skidder	Donaren powered disc trencher cluster nozzle ground applicator	ground application at 4L active ingredient per hectare in a 250L/ha mix continuous furrows
	4 sheared	Disc trencher	July, 1994	skidder	Donaren powered disc trencher	continuous furrows
	5 sheared	Disc trencher and Vision selective	July, 1994	skidder	Donaren powered disc trencher ForCan 500	one metre wide continuous spray band 4L active ingredient per hectare in a 250L/ha mix continuous furrows
	6 sheared	Disc trencher and Velpar-L selective	July, 1994	skidder	same as treatment 5	same as treatment 5 16L active ingredient
	7 sheared	Bracke intermittent scalp and Vision selective	August, 1994	skidder	Bracke herbicider	one metre wide continuous spray band 4L active ingredient per hectare in a 250 L/ha mix intermittent scalps
	8 sheared	Grizz powered mixer	May, 1995	D-8 crawler tractor	Grizz powered mixer	continuous one metre bed of mixed mineral and organic mounds
	9 sheared	A-2 Rototiller	July, 1994	D-7 crawler tractor	A-2 Forester Rototiller	one metre bed of mixed mineral and organic soil
	10 sheared	Mini mounder	May, 1995	John Deere mini excavator	mounding bucket	25 cm x 100 cm intermittent scalps

TABLE 1: LIST OF THE VARIOUS TREATMENTS CARRIED OUT ON EACH SITE (cont'd)

SITE	PRIMARY TREATMENT	SECONDARY TREATMENT	DATE	PRIME MOVER	TOOL	TECHNICAL
BELAIR	1 sheared	screef	May, 1995	n/a	foot	30 cm x 30 cm screef
	2 sheared	Vision-selective	July, 1994	skidder	ForCan 500	one metre wide continuous spray band 4L active ingredient per hectare in a 250L/ha mix
	3 sheared	Broadcast Vision and disc trencher	August/September, 1994	skidder	Donaren powered disc trencher cluster nozzle ground applicator	ground application at 4L active ingredient per hectare in a 250L/ha mix continuous furrows
	4 sheared	Disc trencher	July, 1994	skidder	Donaren powered disc trencher	continuous furrows
	5 sheared	Disc trencher and Vision selective	July, 1994	skidder	Donaren powered disc trencher ForCan 500	one metre wide continuous spray band 4L active ingredient per hectare in a 250L/ha mix continuous furrows
	6 sheared	Bracke intermittent scalp and Vision selective	August, 1994	skidder	Bracke herbicider	one metre wide continuous spray band 4L active ingredient per hectare in a 250 L/ha mix intermittent scalps
	7 sheared	Grizz powered mixer	March, 1995	D-8 crawler tractor	Grizz powered mixer	continuous one metre bed of mixed mineral and organic mounds
	8 sheared	A-2 Rototiller	July, 1994	D-7 crawler tractor	A-2 Forester Rototiller	continuous one metre bed of mixed mineral and organic soil
	8 sheared	Meri Crusher	August, 1994	skid steer tractor	Meri Crusher	same as rototiller finer mix

	9 sheared	Mini Mounder	May, 1995	John Deere Mini excavator	Mounding bucket	25 cm x 100 cm intermittent scalps

TABLE 1: LIST OF THE VARIOUS TREATMENTS CARRIED OUT ON EACH SITE (cont'd)

SITE	PRIMARY TREATMENT	SECONDARY TREATMENT	DATE	PRIME MOVER	TOOL	TECHNICAL
BROADLANDS	1 sheared	Straight plant	May, 1995	n/a	foot	screef
	2 sheared	Excavator Mounder	August, 1994	Crawler excavator	mounding bucket	1m x 1m intermittent scalps
	3 sheared	Meri Crusher	March, 1995	Farm tractor	Meri Crusher	continuous one metre bed of mix organic soils
	4 un-sheared	Meri Crusher	March, 1995	Farm tractor	same as treatment 3	same as treatment 3
	5 un-sheared	Excavator Mounder	July, 1994	Crawler excavator	same as treatment 2	same as treatment 2

TABLE 1: LIST OF THE VARIOUS TREATMENTS CARRIED OUT ON EACH SITE (cont'd)

SITE	PRIMARY TREATMENT	SECONDARY TREATMENT	DATE	PRIME MOVER	TOOL	TECHNICAL
TRANS LICENCE	1 sheared	Straight plant	May, 1995	n/a	Foot	screef
	2 sheared	Meri Crusher	August, 1994	bobcat steer tractor	Meri Crusher	continuous one metre bed of fine mixed organic soil
	3 sheared	Straight Plant and vegetation mat	May, 1995	n/a	Foot	0.9 x 0.9 m vegetation mat
	4 sheared	Velpar-L selective	July, 1994	n/a	Hand pumped backpack sprayer	2m circular spot application 16L active ingredient per hectare in a 250L/ha mix
	5 sheared	Ripper Plow	March, 1995	D-8 crawler tractor	C/H plow	V-shaped continuous furrows
	6 un-sheared	Excavator Mounder	July, 1994	Crawler excavator	Mounding bucket	1m x 1m intermittent scalps
	7 un-sheared	Disc trencher and Velpar-L selective	July, 1994	skidder	Donaren powered disc trencher ForCan 500	one metre wide continuous spray band 16L active ingredient per hectare in a 250/ha mix continuous furrows
	8 sheared	Mini Mounder	May, 1995	John Deere Mini Excavator	Mounding bucket	25 cm x 100 cm intermittent scalp

TABLE 2: DESCRIPTION OF THE VARIOUS TREATMENTS AND MICROSITES

Shearblading

The shearblading treatment sheared (clean-cut) parallel strips horizontally through the surface organic layers removing the established brush and grass, slash, stumps and residuals impeding the treatment pattern. The strips were double width (2 passes from opposite directions) averaging approximately 6.5 net metres. Inter-pass windrows were approximately 4 metres wide. An organic layer averaging 8 centimetres remained after treatment.

Straight Plant

The trees were planted directly into soil to a depth of two centimetres above the container plug.

Straight Plant and Vegetation Mat

The trees were planted directly into soil to a depth of two centimetres above the plug
A 1 metre by 1 metre vegetation mat was applied around each tree following planting.

Scalp

The organic and loose debris was be removed manually.
A 30 x 30 centimetre patch was created at a 2 metre x 1.8 metre spacing.

Vision - (Selective)

A one metre wide continuous band of Vision at 4 litres A.I. (Active Ingredient) per net hectare in a 250 litre/ha water mix was applied with the ForCan 500 applicator.

Velpar L - (Selective)

A selective ground treatment of Velpar L at 16 litres A.I. (Active Ingredient)/ha in a 250 litres per hectare solution was applied using a backpack sprayer.
The pattern was 10 square metre circular treatment spots spaced approximately 2 metres by 2 metres apart.

TABLE 2: DESCRIPTION OF THE VARIOUS TREATMENTS AND MICROSITES (cont'd)

Vision - (Broadcast) and Disc Trencher

A broadcast ground treatment of Vision at 4 litres A.I./ha in a 250 litre/ha water mix was applied using a cluster nozzle applicator. Continuous furrows were created approximately 3 weeks after chemical application using a Donaren 180D powered disc trencher. The furrows created a mineral soil/organic berm (elevated pile) above the initial ground level.

Disc Trencher and Vision - (Selective)

Continuous furrows were created using a Donaren 180D powered disc trencher with simultaneous Vision application in 1 metre bands on the berm of the furrows at 4 litres A.I./ha in 250 litres/ha water mix using the ForCan 500 Applicator.

Disc Trencher and Velpar - (Selective)

This was the same as previous treatment except the chemical used was Velpar L.
The application rate was 16 litres of Velpar L A.I. per net hectare in a 250 litre total solution.

Bracke Intermittent Scalp and Vision - (Selective)

Intermittent scalps of mineral soil and organics inverted and displaced onto the adjacent undisturbed ground were created with the Bracke. Vision was applied simultaneously in 1 metre wide bands over the scalp rows at 4 litres A.I./ha in a 250 litres/ha water mix using the Bracke Herbicider.

GRIZZ Powered Mixer

Continuous 1 metre profiled beds of mixed mineral soil and organics mounded over an undisturbed centre portion were created with the Grizz powered mixer.

A-2 Forester Rototiller

Continuous one metre wide horizontal beds of mixed mineral soil and organic to a depth of approximately 26 centimetres were created with the high speed (320 rpm) A-2 Forester Rototiller. Beds were spaced 2 metres centre to centre.

TABLE 2: DESCRIPTION OF THE VARIOUS TREATMENTS AND MICROSITES (cont'd)

Disc Trencher

Continuous furrows were created using a Donaren 180D powered disc trencher creating a mineral soil/organic berm (elevated pile).

Ripper Plow

A crawler mounted plow was used to create continuous V-shaped rows to a depth of approximately 50 centimetres. The plowing action cut a trench tapering from the centre of the plow to the outside inverting the lower material up into berm piles, resulting in two rows of elevated organics or mineral soil/organic.

Excavator Mounding

Intermittent mounds of organics were created by scalping into the ground with a mounding bucket mounted on an excavator. The mounds were approximately 20 centimetres tall, 1.6 metres by 1.6 metres in dimension and were spaced approximately 1.6 metres apart.

Meri Crusher

The Meri Crusher mounted on a skid steer or farm tractor created one metre horizontal beds of mixed mineral and organic soil.

Mini Mounding

The intent of this treatment was to try and simulate the bracke mounder. Intermittent mounds of mineral soil and organics were created by scalping into the ground with a 36 cm bucket mounted on a small excavator. The mounds were approximately 60 cm by 100 cm in dimension.

FIGURE 6

In addition to taking measurements, two soil pits were dug at each site and detailed organic and mineral soil profiles were recorded. Only one pit was dug on the Broadlands site due to frozen ground conditions which made digging impossible.

Once the first assessment was completed, secondary treatments were carried out. This was immediately followed by a post secondary treatment assessment. Using the established baselines, measurements across the treated strips were taken. Disturbance width, inter row width and interpass width were first measured. Microsite type percentages (based on area disturbances of one metre on each side of the baseline) were then evaluated for each disturbance strip. All microsite types were tallied in 10 percent increments and categorized into one of the eight possible site type categories. The eight categories were exposed mineral soil, compactable organics, fine mineral-organic mix, crude mineral-organic mix, inverted mineral-organic soil over organic, non-compactable soil-debris, no disturbance and vegetative disturbance. Elevation and depth for each microsite type was recorded.

Vegetation assessments were done along the baseline, estimating percent cover for a range of vegetation types. This was followed by a plantibility assessment which was completed on the first and third row of every treatment ten metres on each side of the baseline. Potential planting spots (total of ten) were assessed at 2 metre intervals and classified as being plantable or not plantable[2]. Only plantable microsites were tallied and categorized by microsite type.

Additional sampling was completed on intermittent treatments (bracke and excavator mounder). The two nearest scalps and berms along the baseline were selected and average scalp and berm width, length, height and depth were recorded.

Once post treatment assessments were completed, planting was carried out. This was followed by establishment measurements of height and root collar diameter (rcd) of each seedling. Heights were taken to the nearest half centimetre and rcd was taken to the nearest millimetre.

Sample tallysheets used for the post primary and secondary treatment assessment, as well as seedling establishment measurements, are provided in Appendix A. The data collected for this study

[2] *For intermittent treatment, ten scalps were assessed.*

was entered on computer and averages were calculated using MS-Works for Windows spreadsheet program.

4.0 RESULTS

Soil texture analysis carried out in the field indicated that the Beaver Creek site was composed of fine textured clay - clay loam soils. The Belair site had much coarser sandy loam soils. The Broadlands site was predominately organic with a silt clay base. The Trans Licence site was composed of deep organic soils.

Detailed soil analysis carried out in the CFS lab in Edmonton indicated that the Belair site had the highest pH range (7.1 - 7.7), followed by the Beaver Creek and Broadlands sites (5.1 - 5.7). The Trans Licence site had the lowest pH range at 4.3 to 4.7. Nitrogen analysis indicated that the total nitrogen percentages were much high on the lowland sites than the mixedwood sites.

Cross sectional soil profiles for each site are presented in Figure 7.

Table 3 summarizes shearblade averages by replicate for each site. The shearblading quality (measured as shear efficiency percentage) was highest among the lowland sites. Shear quality was low on the mixedwood sites primarily because the surface organic layer was left intact and only the slash was removed. Ideally an effective shearblading treatment should remove the surface organic layer which consists mostly of vegetation and woody debris.

Net disturbance percentage which is a percentage of the area taken up by the sheared strip and also an indicator of percent plantable area, was slightly higher on the lowland sites. This can be attributed to the smaller windrows found on these sites. The percentages were lower on the mixedwood sites because of the heavier slash loads which created larger windrows.

FIGURE 7 - CROSS SECTIONAL SOIL PROFILES

TABLE 3: SHEARBLADE ASSESSMENT SUMMARIES BY REPLICATE FOR EACH SITE

REP #	STRIP WIDTH (cm)	DUFF DEPTH (cm)	SHEAR EFFICIENCY %	CANOPY COVER %	WINDROW	UNDISTURBED	NET DISTURBANCE %
					width height (cm)(cm)	width height (cm) (cm)	
Site: Beaver Creek							
1	600	5	27	7	49667	107 5	50
2	596	6	20	14	50459	127 6	49
3	583	5	15	8	64453	191 5	41
4	608	5	9	6	64339	327 6	39
Overall Average	597	5	18	9	57255	188 6	45
Site: Belair							
1	664	9	39	4	37853	84 9	59
2	640	9	29	6	44268	97 10	54
3	655	10	41	5	48770	112 10	52
4	667	10	40	4	44067	26 9	59
Overall Average	657	10	37	5	43765	80 9	56
Site: Broadlands							
1	634	12	80	4	30832	129 23	59
2	639	14	69	2	33033	139 21	58
3	675	11	83	1	27329	148 19	62
4	681	14	81	1	29121	226 21	57
Overall Average	657	13	78	2	30028	160 21	59
Site: Trans Licence							
1	663	3	95	1	28431	105 10	63
2	633	3	87	1	30041	76 11	63
3	660	4	92	0	27133	63 11	66
4	658	4	81	1	28335	95 11	64
Overall Average	654	4	89	1	28435	85 11	64

A summary of the secondary treatment field assessments is listed in Table 4. Although it is still too early in the study to determine which treatments are the most effective, some observations are worth mentioning. The plantable spots per hectare figures listed in the third column, tend to be lower for intermittent treatments. The average gross disturbance percentage which includes both negative and beneficial disturbances ranged from 23% for the bracke herbicider to 77% for the excavator mounder. The average net disturbance which includes only the beneficial disturbances ranged from 6% for the disc trencher to 68% for the Meri Crusher.

The information from Table 3 and 4 was used in creating detailed microsite profile diagrams presented in Figures 8 through 12. These diagrams show the inter-pass spacing, mound height, trench depth and other features associated with the different treatments.

A summary of the initial crop tree measurements is listed in Tables 5 through 8 for each of the sites. As would be expected the bareroot stock was larger than the container. Average height and rcd for bareroot was 22.3 cm and 3.6 mm for black spruce and 18.7 cm and 3.6 mm for the white spruce. Average height and rcd for container stock black spruce was 13.8 cm and 1.6 mm, and 17.0 cm and 1.9 mm for the white spruce.

It is important to note that the bareroot stock was browning and losing its needles following planting. The exact cause of this is unknown, however, this may lead to a serious problem if mortality rates are too high. Although it is still to early to determine what effect this will have on the trial, some adjustments may be necessary if mortality rates are too high. The container stock was healthy and starting to flush immediately after planting.

Since this is only an establishment report, no relevant comparison between treatments can be completed until crop growth and survival information is available.

TABLE 4 - POST SECONDARY ASSESSMENT AVERAGES

FIGURE 8 - SHEARBLADE MICROSITE FOR ALL SITES

FIGURE 9 - SECONDARY TREATMENT MICROSITES FOR BEAVER CREEK

FIGURE 9 - CONTINUED

FIGURE 10 - SECONDARY TREATMENT MICROSITES FOR BELAIR

FIGURE 10 - CONTINUED

FIGURE 11 - SECONDARY TREATMENT MICROSITES FOR BROADLANDS

FIGURE 12 - SECONDARY TREATMENT MICROSITES FOR TRANS LICENCE

FIGURE 12 - CONTINUED

TABLE 5

AVERAGE CROP TREE RCD AND HEIGHT FOR BEAVER CREEK SITE

TREATMENT (RCD mm)											
REP	**STOCK TYPE**	**CONTROL**	**VISION (Selective)**	**VISION (Broadcast) DISC TRENCHER**	**DISC TRENCHER**	**DISC TRENCHER VISION (Selective)**	**DISC TRENCHER VELPAR L (Selective)**	**BRACKE HERBICIDER**	**GRIZZ**	**A - 2**	**MINI MOUNDER**
1	Bareroot	2.9	3.8	3.4	3.1	3.3	3.2	3.2	3.2	3.4	3.3
	Container	1.7	1.8	1.9	1.8	1.9	1.8	1.8	1.8	1.9	1.9
2	Bareroot	4.1	3.4	3.8	3.4	4.0	4.0	3.3	3.2	3.2	3.8
	Container	1.8	1.9	1.8	1.9	1.7	1.8	1.8	1.8	1.9	1.8
3	Bareroot	4.1	3.8	3.7	3.9	3.7	3.6	3.7	3.7	4.2	4.1
	Container	2.1	2.6	2.6	2.7	2.3	2.1	2.0	2.0	2.6	2.7
4	Bareroot	3.5	3.8	3.2	3.8	3.1	3.9	3.3	3.5	3.4	3.7
	Container	1.8	1.8	1.9	1.8	1.8	1.9	1.9	1.7	1.8	1.7
	Bareroot	3.7	3.7	3.5	3.6	3.5	3.7	3.4	3.4	3.6	3.8
AVERAGE	Container	1.8	2.0	2.0	1.9	1.9	1.9	1.9	1.8	2.0	2.0
HEIGHT (cm)											
1	Bareroot	16.8	18.2	21.4	16.2	18.3	18.5	17.9	17.1	18.1	16.6
	Container	16.4	16.5	19.8	16.0	17.6	16.5	16.4	17.6	17.5	15.8
2	Bareroot	20.7	17.5	18.9	19.6	19.0	19.5	17.3	19.8	17.3	18.8
	Container	18.2	18.5	17.0	17.9	16.4	15.7	17.4	16.3	17.2	17.9
3	Bareroot	22.0	19.3	18.8	20.5	18.8	19.5	18.7	20.6	19.4	18.7
	Container	16.5	18.0	16.7	18.5	17.5	17.5	14.8	15.3	18.0	18.1
4	Bareroot	19.3	19.1	17.1	17.5	17.1	20.0	18.2	19.9	18.2	18.1

	Container	16.8	16.2	16.3	17.4	16.4	16.7	17.2	17.0	17.7	15.3
	Bareroot	19.7	18.5	19.1	18.5	18.3	19.4	18.0	19.4	18.3	18.1
AVERAGE	Container	17.0	17.3	17.5	17.5	17.0	16.6	16.5	16.6	17.6	16.8

TABLE 6

AVERAGE CROP TREE RCD AND HEIGHT FOR BELAIR SITE

TREATMENT (RCD mm)										
REP	**STOCK TYPE**	**CONTROL**	**VISION (Selective)**	**VISION (Broadcast) DISC TRENCHER**	**DISC TRENCHER**	**DISC TRENCHER VISION (Selective)**	**BRACKE HERBICIDER**	**GRIZZ**	**A - 2 MERI CRUSHER**	**MINI MOUNDER**
1	Bareroot Container	4.5 2.1	3.6 1.2	4.2 1.4	3.5 1.3	3.6 1.5	3.8 1.5	4.2 1.6	4.0 1.4	3.6 1.3
2	Bareroot Container	4.0 1.4	-- --	3.4 1.4	3.7 1.6	4.2 1.6	3.9 1.7	3.8 1.6	3.6 1.6	4.1 1.5
3	Bareroot Container	3.7 1.6	3.7 1.5	3.9 1.5	3.6 1.3	3.7 1.6	3.6 1.6	3.4 1.5	3.6 1.6	3.3 1.5
4	Bareroot Container	3.4 1.6	3.3 1.4	3.6 1.5	3.3 1.3	3.4 1.5	3.2 1.3	4.4 1.4	3.4 1.6	3.5 1.5
AVERAGE	Bareroot Container	3.9 1.7	3.5 1.4	3.8 1.5	3.5 1.4	3.7 1.6	3.6 1.5	4.0 1.5	3.7 1.6	3.6 1.5
HEIGHT (cm)										
1	Bareroot Container	21.8 14.1	22.0 13.9	23.8 14.2	20.8 13.5	21.6 14.5	21.9 14.3	26.3 14.8	22.8 14.0	23.2 13.7
2	Bareroot	24.0	--	21.3	22.3	23.0	21.1	24.5	21.5	22.2

	Container	15.4	--	13.4	13.6	14.7	15.1	14.8	14.0	13.3
3	Bareroot Container	24.4 14.7	23.5 14.5	23.6 15.2	23.4 13.4	21.9 14.4	23.4 16.0	20.4 13.5	23.0 14.3	20.8 14.2
4	Bareroot Container	22.0 13.0	22.7 12.6	22.2 12.3	21.6 11.3	21.3 12.3	21.8 11.8	24.9 13.3	20.5 13.0	21.0 13.7
AVERAGE	Bareroot Container	23.1 14.3	22.7 13.7	22.7 13.8	22.0 13.0	22.0 14.0	22.1 14.3	24.0 14.1	21.9 13.8	21.8 13.7

TABLE 7

AVERAGE CROP TREE RCD AND HEIGHT FOR TRANS LICENCE SITE

TREATMENT (RCD mm)									
REP	**STOCK TYPE**	**CONTROL**	**MERI CRUSHER**	**VEGETATION MAT**	**VELPAR L (Selective)**	**RIPPER PLOW**	**EXCAVATOR MOUNDING**	**DISC TRENCHER (Selective)**	**MINI MOUNDER**
1	Bareroot Container	3.3 1.4	3.3 1.4	3.5 1.5	3.3 1.6	3.2 1.4	3.7 1.5	3.1 1.5	-- --
2	Bareroot	3.4	3.8	3.6	3.5	3.5	3.6	3.4	4.2

	Container	1.6	1.7	1.7	1.5	1.8	1.5	1.6	1.8
3	Bareroot Container	3.5 1.6	3.8 1.5	3.2 1.4	3.3 1.4	-- --	2.9 1.7	3.9 1.9	4.4 1.9
4	Bareroot Container	3.6 1.5	3.9 1.6	3.3 1.7	3.5 1.7	-- --	3.4 1.6	3.5 1.4	3.3 1.6
AVERAGE	Bareroot Container	3.5 1.5	3.7 1.6	3.4 1.6	3.4 1.6	3.4 1.6	3.4 1.6	3.5 1.6	4.0 1.8
HEIGHT (cm)									
1	Bareroot Container	21.2 15.6	22.4 14.9	23.3 15.1	21.6 15.1	22.3 13.4	24.9 14.4	24.0 14.3	-- --
2	Bareroot Container	20.8 14.6	22.9 14.3	23.2 14.9	23.6 14.9	22.8 14.2	23.9 14.9	22.8 15.0	23.0 14.8
3	Bareroot Container	24.3 15.2	24.1 14.3	21.4 14.6	24.8 13.9	-- --	21.6 13.3	22.2 14.6	23.1 14.5
4	Bareroot Container	24.7 11.8	24.5 13.1	25.0 12.8	26.4 12.3	-- --	20.9 12.3	22.8 12.0	22.3 11.9

AVERAGE	Bareroot Container	22.8 14.3	23.5 14.2	23.2 14.4	24.1 14.1	22.6 13.8	22.8 13.7	23.0 14.0	22.8 13.7

TABLE 8

AVERAGE CROP TREE RCD AND HEIGHT FOR BROADLANDS SITE

TREATMENT (RCD mm)						
REP	**STOCK TYPE**	**CONTROL**	**EXCAVATOR MOUNDING (sheared)**	**MERI CRUSHER (Sheared)**	**MERI CRUSHER (unsheared)**	**EXCAVATOR MOUNDING (unsheared)**
1	Bareroot Container	3.7 1.7	3.4 1.3	3.4 1.7	3.1 1.3	3.4 1.6
2	Bareroot Container	3.1 1.8	3.4 1.5	3.7 1.7	3.2 1.7	3.6 1.7
3	Bareroot Container	3.2 1.5	3.5 1.9	-- --	3.3 1.6	3.6 1.7
4	Bareroot Container	2.7 1.1	3.4 1.4	-- --	3.3 1.1	3.7 1.2

AVERAGE	Bareroot Container	3.2 1.5	3.4 1.5	3.6 1.7	3.2 1.4	3.6 1.6
HEIGHT (cm)						
1	Bareroot Container	21.7 15.2	21.1 12.3	19.5 13.6	21.6 11.2	20.6 15.4
2	Bareroot Container	22.6 13.8	19.9 13.1	23.3 12.6	21.0 13.9	21.5 12.3
3	Bareroot Container	19.7 15.3	21.8 14.7	-- --	19.6 13.4	22.5 13.5
4	Bareroot Container	22.0 11.4	17.9 12.2	-- --	20.5 12.1	18.1 11.7
AVERAGE	Bareroot Container	21.5 13.9	20.2 13.1	21.4 13.1	20.7 12.7	20.7 13.2

5.0 DISCUSSIONS AND FOLLOW-UP

Project partners have scheduled three years to establish and complete initial evaluations in this project. To date, the trial layout has been established, shearblading has been carried out, the secondary treatments are done, planting, pinning and labelling are done and initial field assessments are completed. Permanent signs will be erected on each of the sites and re-measurements are scheduled for the fall of 1996 and a final report is due in 1997. At this time project partners have shown an interest in extending the research trial beyond 1997, but this will depend on available funding.

A P P E N D I X A

Sample Field Assessment Tally Sheets

A P P E N D I X B

Planting Sequences for each Treatment

SITE:BEAVER CREEK

PANTING ORDER:

Replicates 1 and 3 bareroot was planted in rows 1 and 2, container was planted in rows 3 and 4. Replicates 2 and 4 bareroot was planted in rows 3 and 4, container was planted in rows 1 and 2.

NUMBER OF TREES PLANTED PER TREATMENT:

In most cases 25 white spruce seedlings were planted in each row (100 seedlings per treatment). Exceptions are as follows:

- Rep 1 Treatment 3: 24 seedlings were planted in row 3

- Rep 1 Treatment 8: contains 2 rows
  25 bareroot seedlings were planted in row 1
  25 container seedlings were planted in row 2

- Rep 2 Treatment 8: contains 2 rows
  25 container seedlings were planted in row 1
  25 bareroot seedlings were planted in row 2

- Rep 2 Treatment 9: 24 seedlings were planted in row 1

- Rep 3 Treatment 4: 24 seedlings were planted in row 1

- Rep 3 Treatment 8: contains 2 rows
  25 bareroot seedlings were planted in row 1
  25 container seedlings were planted in row 2

- Rep 4 Treatment 7: 24 seedlings were planted in row 2
  23 seedlings were planted in row 3

- Rep 4 Treatment 8: contains 3 rows
  27 container seedlings were planted in row 1
  21 container seedlings were planted in front of the centre row
  15 bareroot seedlings were planted in back of the centre row
  34 bareroot seedlings were planted in the last row

SITE:BELAIR

PLANTING ORDER:

Replicates 1 and 3 bareroot was planted in rows 1 and 2, container was planted in rows 3 and 4. Replicates 2 and 4 bareroot was planted in rows 3 and 4, container was planted in rows 1 and 2.

NUMBER OF TREES PLANTED PER TREATMENT:

In most cases 25 black spruce seedlings were planted in each row (100 seedlings per treatment). Exceptions are as follows:

- Rep 1 Treatment 6: 21 seedlings were planted in row 1
  22 seedlings were planted in row 2
  20 seedlings were planted in row 3
  19 seedlings were planted in row 4

- Rep 1 Treatment 7: contains 2 rows
  25 bareroot seedlings were planted in row 1
  25 container seedlings were planted in row 2

- Rep 1 Treatment 8: contains 3 rows
  25 bareroot seedlings were planted in row 1
  13 bareroot seedlings were planted in back of the centre row
  15 container seedlings were planted in front of the centre row
  27 container seedlings were planted in the last row

- Rep 2 Treatment 3: 24 seedlings were planted in row 2

SITE:BELAIR (continued)

- Rep 2 Treatment 5: 15 seedlings were planted in row 2
  17 seedlings were planted in row 3

- Rep 2 Treatment 6: 23 seedlings were planted in row 3
  22 seedlings were planted in row 4

- Rep 2 Treatment 7: contains 2 rows
  25 container seedlings were planted in row 1
  25 bareroot seedlings were planted in row 2

- Rep 2 Treatment 8: contains 3 rows
  28 container seedlings were planted in row 1
  12 container seedlings were planted in front of centre row
  13 bareroot seedlings were planted in back or the centre row
  24 bareroot seedlings were planted in the last row

- Rep 2 Treatment 9: tree 4 is missing in row 3

- Rep 3 Treatment 6: 24 seedlings were planted in row 2
  22 seedlings were planted in row 3

- Rep 3 Treatment 7: contains 2 rows
  25 bareroot seedlings were planted in row 1
  25 container seedlings were planted in row 2

- Rep 3 Treatment 8: contains 3 rows
  32 bareroot seedlings were planted in row 1
  16 bareroot seedlings were planted in back of the centre row
  17 container seedlings were planted in front of the centre row
  31 container seedlings were planted in the last row

- Rep 4 Treatment 4: 23 seedlings were planted in row 1
  24 seedlings were planted in row 4

SITE:BELAIR (continued)

- Rep 4 Treatment 5: 22 seedlings were planted in row 1
  23 seedlings were planted in row 4

- Rep 4 Treatment 6: 22 seedlings were planted in row 1
  20 seedlings were planted in row 2
  18 seedlings were planted in row 3
  20 seedlings were planted in row 4

- Rep 4 Treatment 7: contains 2 rows
  25 container seedlings were planted in row 1
  25 bareroot seedlings were planted in row 2

- Rep 4 Treatment 8: contains 3 rows
  27 container seedlings were planted in row 1
  13 container seedlings were planted in back of the centre row
  15 bareroot seedlings were planted in front of the centre row
  27 bareroot seedlings were planted in the last row

SITE:TRANS LICENCE

PLANTING ORDER:

Replicates 1 and 3 bareroot was planted in rows 1 and 2, container was planted in rows 3 and 4. Replicates 2 and 4 bareroot was planted in rows 3 and 4, container was planted in rows 1 and 2.

NUMBER OF TREES PLANTED PER TREATMENT:

- Rep 1 Treatment 2: contains 3 rows
  31 bareroot seedlings were planted in row 1
  19 bareroot seedlings were planted in front of the centre row
  16 container seedlings were planted in back of the centre row
  33 container seedlings were planted in the last row

- Rep 2 Treatment 2: contains 3 rows
  34 container seedlings were planted in row 1
  16 container seedlings were planted in front of the centre row
  16 bareroot seedlings were planted in back of centre row
  33 bareroot seedlings were planted in the last row

- Rep 2 Treatment 5: contains 2 rows
  25 container seedlings were planted in row 1
  25 bareroot seedlings were planted in row 2

- Rep 2 Treatment 8: contains 1 row
  13 bareroot seedlings are planted in front
  12 container seedlings were planted in back

SITE:TRANS LICENCE (continued)

- Rep 3 Treatment 2: contains 3 rows
  33 bareroot seedlings were planted in row 1
  17 bareroot seedlings were planted in front of the centre row
  16 container seedlings were planted in back of the centre row
  33 container seedlings were planted in the last row

- Rep 4 Treatment 2: contains 3 rows
  34 container seedlings were planted in row 1
  12 container seedlings were planted in front of the centre row
  16 bareroot seedlings were planted in back of the centre row
  33 bareroot seedlings were planted in the last row

- Rep 4 Treatment 7: tree 21 is missing

SITE:BROADLANDS

PLANTING ORDER:

Replicates 1 and 3 bareroot was planted in rows 1 and 2, container was planted in rows 3 and 4. Replicates 2 and 4 bareroot was planted in rows 3 and 4, container was planted in rows 1 and 2.

NUMBER OF TREES PLANTED PER TREATMENT:

In most cases 25 black spruce seedlings were planted in each row (100 seedlings per treatment). Exceptions are as follows:

- Rep 1 Treatment 1: 24 seedlings were planted in row 4.

- Rep 1 Treatment 3: contains 3 rows.
  22 bareroot seedlings were planted in row 1
  13 bareroot seedlings were planted in front of the centre row
  12 container seedlings were planted in back of the centre row
  25 container seedlings were planted in the last row

- Rep 1 Treatment 4: contains 3 rows
  20 bareroot seedlings were planted in row 1
  12 bareroot seedlings were planted in front of the centre row
  12 container seedlings were planted in back of the centre row
  20 container seedlings were planted in the last row

- Rep 2 Treatment 3: contains 3 rows
  25 container seedlings were planted in row 1
  10 container seedlings were planted in front of the centre row
  12 bareroot seedlings were planted in back of the centre row
  20 bareroot seedlings were planted in the last row

SITE: BROADLANDS (continued)

- Rep 2 Treatment 3: contains 3 rows
  25 container seedlings were planted in row 1
  10 container seedlings were planted in front of the centre row
  12 bareroot seedlings were planted in back of the centre row
  20 bareroot seedlings were planted in the last row

- Rep 2 Treatment 4: containes 3 rows
  25 container seedlings were planted in row 1
  14 container seedlings were planted in front of the centre row
  12 bareroot seedlings were planted in back of the centre row
  15 bareroot seedlings were planted in the last row

- Rep 3 Treatment 4: contains 3 rows
  23 bareroot seedlings were planted in row 1
  7 bareroot seedlings were planted in back of the centre row
  15 container seedlings were planted in front of the centre row
  17 container seedlings were planted in the last row

- Rep 3 Treatment 5: 24 seedlings were planted in each row

- Rep 4 Treatment 1: several trees are missing
  Trees 1,2,3,4,5,6,8,10,15,17,19,20,23,24 and 25 are missing in row 1
  Trees 7,8,10,11,17,18,19,20,21,22,23,24 and 25 are missing in row 2
  Trees 23 and 25 are missing in row 3
  Trees 20, 22 and 23 are missing in row 4

- Rep 4 Treatment 2: 24 seedlings were planted in each row

- Rep 4 Treatment 4: contains 3 rows
  24 container seedlings were planted in row 1
  9 container seedlings were planted in front of the centre row
  9 bareroot seedlings were planted in back of the centre row
  15 bareroot seedlings were planted in the last row

A P P E N D I X C

Photographs of Various Treatments

Sheared strip at Belair . Heavy competition from perennial and tree vegetation dominate the site.

Ground sprayer mounted on a skidder. This type of broadcast application is commonly used throughout the Model Forest as a means of site preparation.

ForCan 500 applying a one metre band of Vision at Belair. The skidder is also equipped with a Donaren powered disc trencher. Both the ForCan 500 and Donaren may be used separately or simultaneously.

A strip at Belair three weeks after is was selectively sprayed with Vision using the ForCan 500. Only the vegetation within the spray band is killed. Notice that vegetation between rows remain

intact. A broadcast application would have killed all the vegetation in the strip.

Donaren powered disc trencher making furrows at Belair. Trenching is the most commonly used site preparation tool in the Model Forest and the province.

Bracke Herbicider applying Vision and mounding at Beaver Creek. This type of treatment is

commonly used by the Department of Natural Resources.

Rear view of the A-2 Forester Rototiller working at Belair. This treatment is not commonly used in Manitoba.

Komatsu crawler excavator creating mounds at Broadlands. Like the A-2, this type of treatment is seldomly used.

Meri Crusher at Belair. This machine creates a similar microsite as the A-2 however, the mix is much finer. This type of treatment is ideal for sensitive sites such as riparian zones.

Close up view of the meri crusher mounted on a skid steer tractor.

Field staff laying out vegetation mats at Trans License.

Ripper plow microsite. This treatment can only be carried out during the winter. Although not used in the Model Forest, it is used frequently in Northern Manitoba on areas which are difficult to access during the summer.

White spruce seedling planted on a sheared strip at Beaver Creek. Notice that the woody debris has been screef off.

Small excavator creating mini mounds at Trans License site. Although impractable in a forestry operation, the intent was to try and simulate a bracke mounder.

March 21, 1995

Mr. Mike Waldram
General Manager
Manitoba Model Forest
P.O. Box 10
Pine Falls, Manitoba
R0E 1M0

Dear Mike:

RE: MODEL FOREST PROJECT #94-3-06
ENHANCED REGENERATION OF DIFFICULT SITES

As agreed to in our conversation of March 20th, we are sending you a copy of the draft Establishment Report for the above noted project. The final report will be finished and submitted once the secondary site preparation treatments and subsequent field measurements are completed. We anticipate that the field work and report should be finished by June 30th, at the latest.

Yours truly,

G. Ardron
Partner

GA/jl

Encl(s).

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