

Forest Resource Improvement Association of Alberta

FRIP Open Funds Program

Enhanced Management of Lodgepole Pine

Proposal Prepared by:

W.R. Dempster Ph.D., R.P.F.

Submitted by:

Foothills Growth and Yield Association

Foothills Model Forest
P.O. Box 6330
Hinton, Alberta
T7V 1X6

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Table of Contents

1. Proposal Overview.....	3
1.1. Project Title	3
1.2. Applicant	3
1.3. Background of Applicant and Partners.....	3
1.3.1. Foothills Growth and Yield Association	3
1.3.2. Collaborating Agencies	4
1.3.3. Foothills Model Forest.....	4
1.3.4. Key Project Personnel	4
1.4. Site Selection.....	5
1.5. Potential Application of Results	5
1.6. References	7
1.7. Proposal Summary Application Form	8
2. Proposal Objectives	8
2.1. Forest Resources and Resource Management Aspects Improved	8
2.2. Relationship to Company Responsibilities.....	8
3. Project Information.....	10
3.1. Objectives in Relation to FRIP Program Objectives	10
3.2. Project Design and Methods.....	10
3.2.1. Scope Assessment.....	10
3.2.2. Site and Stand Assessment.	10
3.2.3. Experimental Treatment Plots	11
3.2.4. Diagnostic Fertilizer-Response Testing.....	13
3.2.5. Response Forecasting and Management Interpretations.....	13
3.2.6. Creation of Opportunities for Demonstration and Linked Research	13
3.2.7. Inputs from Related Projects	13
3.3. Scientific and Peer Review.....	14
3.4. Funding Requested and Overall Budget.....	15
3.5. Other Funding Applied to the Project.....	16
3.6. Subcontracting.....	17
3.7. Detailed Schedule of Activities	17
3.8. Project Management.....	17
3.9. Authorization Requirements.....	18
3.10. Impacts on Other Resources and Users	18
3.11. Project Deliverables	18
3.12. Availability of Deliverables for General Public Use.....	19
4. Schedules.....	19
4.1. Progress Reporting Schedule.....	19
4.2. Proposed Payment Schedule.....	19
4.3. Work Schedule / Work Plan	19
Appendix 1. Letters of Support	21
Figure 1. Map of Study Area.....	6
Figure 2. Basic Configuration of an Experimental Treatment Cluster	12
Table 1. Members of the Foothills Growth and Yield Association	3
Table 2. Proposal Summary Application Form	9
Table 3. Site Classes to be Evaluated	11
Table 4. Requested Funds (\$) Summarized by Year	15
Table 5. Estimated Costs per Site and Total Costs by Activity	15
Table 6. Requested Funds (\$) Summarized by Activity and Year.....	16
Table 7. Indicative Cost of Additional Project Contributions	16
Table 8. Work Schedule by Fiscal Year and Quarter	20

1. Proposal Overview

1.1. Project Title

Enhanced Management of Lodgepole Pine

1.2. Applicant

The Applicant is the Foothills Growth and Yield Association (FGYA). The Association consists of 11 member organizations. Names, contact persons (Steering Committee members), technical representatives (Technical Committee members), and telephone numbers are provided in Table 1.

Table 1. Members of the Foothills Growth and Yield Association

Agency	Contact (Steering Committee)	Technical Representative
Alberta Newsprint Company	J. McCammon (780) 778 7000	P. Fluet (780) 778 7940
Blue Ridge Lumber	M. Summers (780) 648 6325	C. Scott (780) 648-6200
Canfor	D. Weeks (780) 538 7745	P. Ewing (780) 538 7729
Foothills Model Forest	R. Udell (780) 865 8181	C. Weik (780) 865 8290
Government of Alberta	D. Sklar (780) 422 4590	D. Price (780) 422 0329
Millar Western Forest Products	J. Russell (780) 778 2221	T. McCready (780) 778 2221
Spray Lakes Sawmills	G. Lehn (403) 932 2234	E. Kulcsar (403) 932 2234
Sundance Forest Industries	J. Huey (780) 723 3977	K. MacDonald (780) 723 3977
Sunpine Forest Products	K. Branter (403) 638 4482	R. Held (403) 638 4482
Weldwood of Canada	H. Loughheed (780) 865 8191	S. Meredith (780) 865 6654
Weyerhaeuser Canada	R. Watson (780) 539 8251	G. Behuniak (780) 539 8207

The Project will be administered on behalf of the Association by the:
Foothills Model Forest
Hinton Training Centre
Box 6330
Hinton, Alberta
T7V 1X6
Telephone: (780) 865-8330

This Proposal was prepared by:
W.R. (Dick) Dempster, Ph.D., R.P.F.
Director
Foothills Growth and Yield Association
(postal address as above)
Telephone: (780) 424-5980
Mobile: (780) 984-2590
E-mail: dick_dem@telusplanet.net

1.3. Background of Applicant and Partners

1.3.1. Foothills Growth and Yield Association

The FGYA represents a unique and innovative approach to project implementation and to promoting the enhanced management of the forest resources of Alberta. Nine companies holding Forest Management Agreements with the province of Alberta (see forest management areas in Figure 1) cooperate in the Association as voting members and sponsors (see Table 1). The

Alberta Land and Forest Division of Alberta Sustainable Resource Development (ASRD) and the Foothills Model Forest (FtMF) participate as non-voting members, with the FtMF acting as the coordinating agency. The Association and its projects are governed by a Memorandum of Agreement (MOA) among the members, and a Steering Committee consisting of the contact persons listed in Table 1. Member agencies provide qualified technical representatives to assist in the development, implementation and application of projects.

The FGYA is committed to enhancing forest resources and their management, improving sustainable yields, providing a rational basis for integrated resource management, and ensuring that lodgepole pine forests continue to provide benefits to a broad portion of Albertans.

1.3.2. Collaborating Agencies

In addition to the organizations listed in Table 1, a number of other agencies have entered into formal and informal collaborative arrangements with the FGYA. Of particular relevance to this Project:

- The Canadian Forest Service (CFS) has a formal arrangement with the FGYA and ASRD to cooperatively maintain, measure, and analyze historic field trials already established to research enhanced management of lodgepole pine. Analysis and interpretation of these trials by CFS experts will form a valuable contribution to this Project.
- Leading experts in silviculture and forest nutrition from the Alberta Research Council and University of Alberta evaluated the opportunities and information gaps for nutrition and density management of lodgepole pine in Alberta, as a basis for this Project proposal.
- The FGYA has established an ongoing dialogue with researchers at the BC Ministry of Forests Research Branch, which will ensure that this Project will benefit from a large amount of relevant work undertaken in that province.

1.3.3. Foothills Model Forest

The FtMF will administer the Project, overseen by the FGYA Steering Committee. As a member of the FGYA, and consistent with the MOA among members, the FtMF will waive its normal administrative fee of 7.5%. Apart from providing effective project administration services at no cost to the Project, the FtMF involvement will provide multidisciplinary collaboration and input to the Project, as already being provided to the FGYA e.g.

- The *Climate Change Project*, under the leadership of Dr. D. Price, CFS, will provide input on the impact of climate change on forest growth;
- The *Local Level Indicators Project* will continue to provide input on required and relevant indicators for monitoring sustainable forest management;
- The *Extension and Communications Program* will provide advice and direct assistance (e.g. web services) in the dissemination of Project information;
- The *Natural Disturbance Program*, under the leadership of Dr. D. Andison, will provide input on managed disturbance, fire and mountain pine beetle effects;
- The *GIS Program* will provide key inputs on Project data management.

1.3.4. Key Project Personnel

Technical direction, field coordination, and data analyses will be provided by a core technical team.

The *Project Manager* and analyst will be W.R. (Dick) Dempster, Ph.D., R.P.F. He is an expert in resource assessment and forest planning, with considerable experience in analysis of growth and yield data, and undertaking projects and programs in enhanced forest management.

Fieldwork will be supervised by the FGYA *Field Coordinator*, Rand McPherson, RPFT. Mr. McPherson has a strong background in field services supervision and quality and cost control.

Data management services will be provided by Mr. Christian Weik, RPFT, *GIS Coordinator* for the FtMF. Mr. Weik has 11 years of forest sector experience in GIS and data management, and will be responsible for data base design and the secure storage of Project data.

Mr. Murray Hubscher, B.Sc., R.P.F. will act as a *Technical Advisor* to the Project Manager and Field Coordinator. He has extensive experience in establishing and measuring thinning and fertilization field trials.

Project inputs by members are an integral part of how the FGYA operates, and will be coordinated and / or directly provided by the 11 technical representatives listed in Table 1.

1.4. Site Selection

Lodgepole pine extends throughout much of western Alberta, and is most predominant in the Foothills and Sub-alpine natural sub-regions of the province. The Project will be conducted throughout the natural range of Lodgepole pine in Alberta (see Figure 1).

1.5. Potential Application of Results

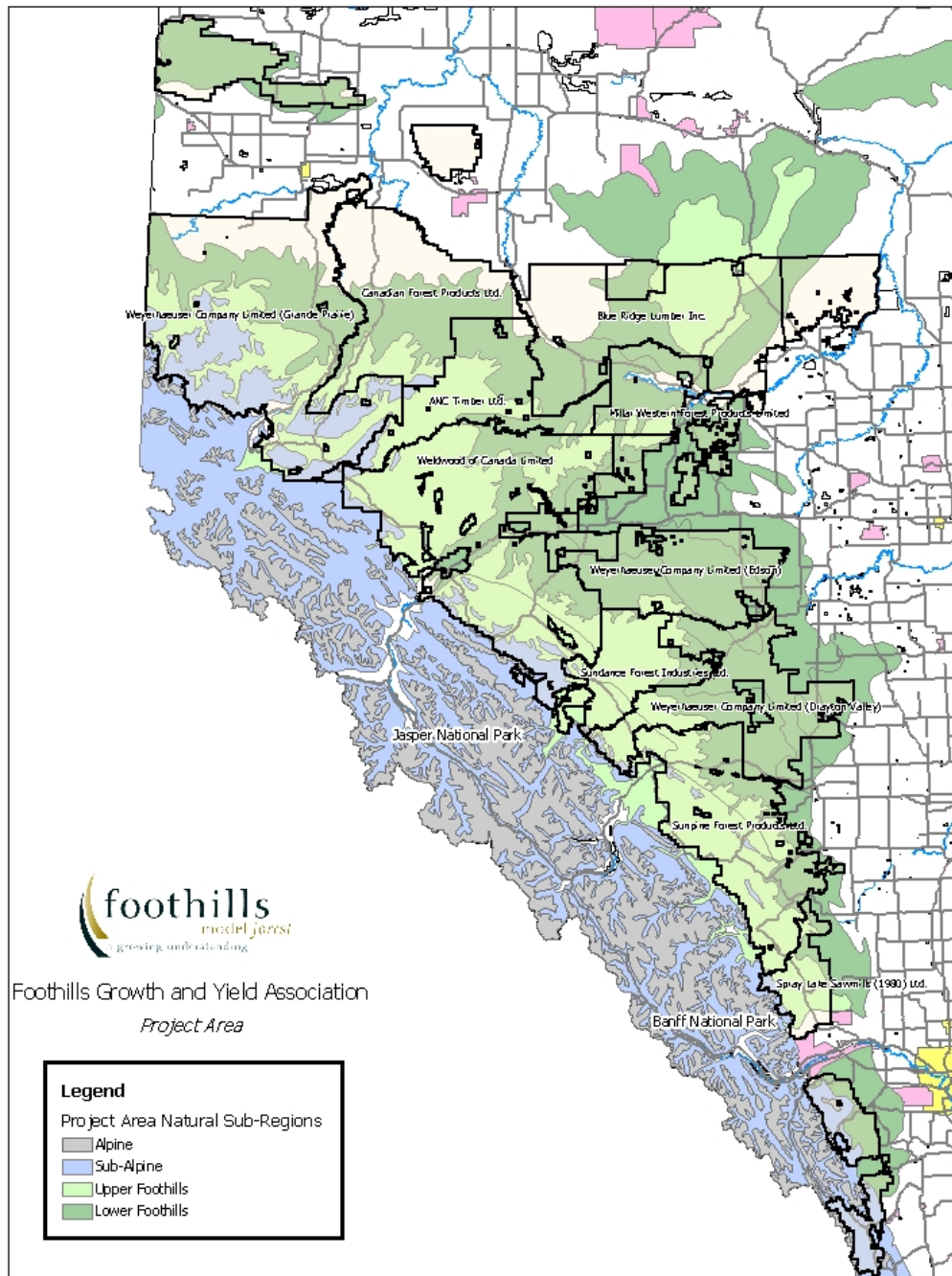
In spite of considerable interest in, and an established need for, enhanced forest management (EFM), Alberta has no accepted system for predicting managed stand development (e.g. “managed stand yield tables”), verification of yields resulting from enhanced practices, or for linking silvicultural practice to EFM objectives (e.g. silvicultural assessment guidelines and interpretative criteria). The Project will address this gap.

Lodgepole pine is recognized as Alberta’s official tree, based on its role in Alberta’s economic development, broad distribution and utilization, and regenerative capacity. However, lodgepole pine forests are particularly subject to intensifying land-use pressures, threats, and uncertainty. Informed and enhanced management of lodgepole pine is essential to overall enhancement of the forest resources of Alberta, providing benefits to a broad portion of Albertans, and promoting integrated resource management.

Application of the Project’s results are expected in the following areas.

- *Enhanced management of the forest resources of Alberta.* Objectives-based management planning and silvicultural decision-making are currently severely limited by an inability to link management practices to subsequent stand development. The Project will provide managed stand yield tables as an improved basis for management planning, and assessment guidelines and interpretative criteria as an improved basis for silvicultural prescriptions and standards. Techniques developed, while focused on lodgepole pine, will be applicable to other Alberta tree species.
- *Promoting integrated resource management.* Stand-management practices have major impacts on the wide range of values and benefits afforded by forests. The Project will provide information on, and demonstrations of, the impacts of EFM practices with respect to stand structure, vegetative composition, biodiversity and habitat.
- *Risk management.* Objectives and criteria for applying enhanced management practices will increasingly be dominated by considerations of risk. The Project has been innovatively designed to incorporate quantitative assessment of the impacts of stand treatments on risks associated with fire and pathogens.

Figure 1. Map of Study Area



1.6. References

The FGYA has already identified and assembled considerable information and expertise relevant to the Project. In particular:

- The FGYA commissioned the Alberta Research Council (ARC) to evaluate the opportunities for nutrition and density management of lodgepole pine in Alberta.¹ The work was undertaken by leading experts in silviculture and forest nutrition from the ARC and University of Alberta.
- Simulation models have been developed for predicting the impact of stand density management on yield and other attributes. Although validation is limited, particularly in fire-origin stands, these will be used for initial categorization of potential thinning response.² Pioneering work by the Alberta government on modeling lodgepole pine growth and yield in Alberta has not yet incorporated thinning and fertilization effects, but it has great potential to do so.³ The Project will support enhancement of the GYPSY growth and yield projection system, and will benefit from these enhancements.
- The B.C. Ministry of Forests Research Branch is willing to make its TASS and TIPSY growth and yield models available to the Project. The Branch expects to complete an initial version of TIPSY incorporating lodgepole pine fertilization by March 31, 2004.⁴ The preliminary model will assist the Project to categorize the response potential of candidate sampling sites (see Section 3.2.2).
- A foliar interpretative system has recently been developed in B.C. for lodgepole pine, that diagnoses specific nutrient deficiencies and formulates corrective fertilizer prescriptions. This will form the basis for initial interpretation of the proposed foliar analyses.⁵
- Published results are available for a variety of thinning and fertilization trials in Alberta⁶ and B.C.⁷
- Weldwood of Canada undertook re-measurements and analysis of historical research trials, some installed over half a century ago along the Eastern Slopes.⁸
- Weldwood of Canada has initiated an Enhanced Forest Management program, including FRIAA-supported thinning and fertilization trials on selected sites.⁹
- Work has been undertaken by a number of agencies in Alberta¹⁰ and elsewhere¹¹ to relate tree and stand variables to wood quality in lodgepole pine.

¹ White, J.B. (editor) 2002. Evaluating the opportunities for nutrition and density management of fire origin lodgepole pine in Alberta: an opinion paper. Alberta Research Council Inc., Vegreville, AB.

² e.g. Di Lucca, C.M. 1999. TASS/SYLVYER/TIPSY: Systems for predicting the impact of silvicultural practices on yield, lumber value, economic return and other benefits. In: Stand density management: using the tools, proceedings of a conference held November 23 & 24, 1998 in Edmonton, Alberta, Canada, Alberta Environmental Protection.

³ Huang, Shongming et al. 2001. GYPSY, a growth and yield projection system for natural and regenerated stands within an ecologically-based enhanced forest management framework. ASRD Pub. No. T/485.

⁴ Di Lucca, C.M. Personal communication, October 22, 2003.

⁵ Brockley, R.P. 2001. Foliar analysis as a planning tool for operational fertilization. In: Enhanced forest management: fertilization and economics, proceedings of a conference held March 1 & 2, 2001 in Edmonton, Alberta, Canada, Clear Lake Ltd.

⁶ e.g. Yang, R.C. Foliage and stand growth responses of semi-mature lodgepole pine to thinning and fertilization. 1998. Can. Journal of Forest Research, volume 28, no. 12.

⁷ e.g. Farnden, C. and L. Herring. 2002. Severely repressed lodgepole pine responds to thinning and fertilization: 19-year results. Forestry Chronicle, volume 78, no. 3.

⁸ e.g. Navratil, S. 2002. A lodgepole pine commercial thinning trial in Kananaskis, Alberta: 58-year results. Canadian Forest Service, Northern Forestry Centre.

⁹ Braun, T. and S. Navratil. 2001. Development of an operational fertilization program in mid- to late-rotational lodgepole pine stands. In: Enhanced forest management: fertilization and economics, proceedings of a conference held March 1 & 2, 2001 in Edmonton, Alberta, Canada, Clear Lake Ltd.

- The CFS, in association with international fire researchers, has developed a model for predicting crown fire initiation and spread from stand variables that will be assessed in this Project, including those impacted by practices such as thinning.¹²

1.7. Proposal Summary Application Form

Table 2 contains the completed proposal summary application form.

2. Proposal Objectives

The overall purpose of the Project will be to provide and promote the necessary knowledge for enhanced, sustained-yield, and integrated management of the Alberta's lodgepole pine forest resource. Currently, major gaps exist in the knowledge and ongoing monitoring required to rationalize silvicultural treatments and investments, and to justify assumptions regarding the impacts of such treatments on timber supply and other forest benefits.

The Project will achieve the overall goal by meeting the following objectives:

1. Develop techniques to predict the growth response of stands to density and nutrition management practices with potential for enhancing timber volume, economic value, and / or forest health.
2. Produce managed-stand yield tables, forecasting growth and stand development over a wide range of sites, treatments and stand conditions.
3. Establish a scientifically sound and statistically defensible network of sample plots for demonstrating and monitoring actual versus predicted response, and for continual improvement of predictive techniques.
4. Assess impacts of enhanced forest management practices on stand composition, structure, biodiversity, susceptibility to fire and insect damage, and wood quality.
5. Produce stand assessment guidelines and interpretative criteria for selecting silvicultural treatments.

2.1. Forest Resources and Resource Management Aspects Improved

As described in Section 1.5, the Project will enhance Alberta's lodgepole pine forests and their sustained yield, improve forest resource management, promote integrated resource management, and support the management of risks of catastrophic losses.

2.2. Relationship to Company Responsibilities

The objectives of this Project, and their achievement, are not the responsibilities of the member companies of the FGYA under legislation, regulation, forest tenure, policy, specific agreement, or generally accepted practice.

¹⁰ Dempster, W.R. and G. Burkell. 2002. Weldwood Alberta fibre quality forecasts. Technical report prepared for FRIAA, July, 2002.

¹¹ Middleton, G.R. and B.D. Munro. 2000. Preliminary characterization of Yukon lodgepole pine in terms of utilization potential. Report prepared for the Government of Yukon Department of Economic Development by Forintek Canada Corp., Vancouver, B.C.

¹² Cruz, M.G.; Alexander, M.E.; Wakimoto, R.H.. 2002. Predicting crown fire behavior to support forest fire management decision-making. In: D.X. Viegas (ed.) Forest Fire Research & Wildland Fire Safety, Proceedings of the IV International Conference on Forest Fire Research/2002 Wildland Fire Safety Summit (Nov. 18-23, 2002, Luso-Coimbra, Portugal). Millpress Sci. Publ., Rotterdam, Netherlands.

Table 2. Proposal Summary Application Form

PROPOSAL SUMMARY – APPLICATION			
FRIP Open Funds Program (the "Program")			
Applicant Information			
Name of Applicant:	Foothills Growth and Yield Association	Phone	780 424 5980
Mailing Address:	Foothills Model Forest, Box 6330, Hinton, Alberta, T7V 1X6	Fax:	780 865 8331
Contact Person:	W.R. (Dick) Dempster		
Delivery Address:	Foothills Model Forest, Hinton Training Centre, Hinton, Alberta		
Sponsor Information (if applicable)			
A list of FRIAA members sponsoring the Foothills Growth and Yield Association is included in Table 1.			
Project Information			
Type of Project		Term of Project	Amount of Funds Applied For
Inventory/Planning Research	Field Operations (All 3 categories apply)	Applied 5 years (April 1, 2004 – March 31, 2009)	\$442,800
Attachments:			
<u> </u> x	Proposal		
<u> </u> x	Proposed payment schedule		
<u> </u> x	Schedules of financial and technical reports		
<u> </u> x	Other: Appendix 1: Letters of support		
Acknowledged by Applicant and/or Sponsor			
<p>The Applicant (the "Signatory") acknowledges having read and agrees to the terms and conditions described on the schedule to which the Application under the Program is made subject. The Signatory acknowledges and agrees that by its submission of this application it shall be bound by the terms of the Program, FRIAA's policies, procedures, protocols and guidelines. It is also acknowledged and agreed that this application may be accepted by FRIAA on further terms or conditions, which shall be binding on the Signatory once the proposed project is undertaken by the Signatory.</p>			
<hr style="width: 100%;"/> Applicant		<hr style="width: 100%;"/> Sponsor	

3. Project Information

3.1. Objectives in Relation to FRIP Program Objectives

The Project will contribute to all of the objectives of the Forest Resource Improvement Program.

- The silvicultural treatments to be investigated are those with potential for enhancing the forest resources of Alberta, but that are at present insufficiently understood for operational implementation.
- The information developed will provide an improved basis for enhanced forest management and rational decision making.
- The combined forecasting and monitoring approach will facilitate identification of opportunities for increasing yields, but also verify whether the forecast yields are sustainable.
- The approach will promote integrated resource management by assessing the effects of alternative management practices on non-timber values.

3.2. Project Design and Methods

The key elements of the Project are:

- Scope assessment;
- Site and stand assessment;
- Experimental treatment plots;
- Diagnostic fertilizer response testing;
- Treatment response forecasting and management interpretations;
- Creation of opportunities for demonstration and linked research;
- Inputs from related FGYA projects.

3.2.1. Scope Assessment

A scope assessment, including conceptual project design, situational reviews of lodgepole pine timber tenures, detailed literature review, consultation with research authorities and management agencies, and an independent expert review, has already been completed. Although a high level of variability is reported in the response of lodgepole pine to thinning and fertilization, the FGYA has assembled information and techniques for making initial response predictions and for narrowing the range of potential treatments and stand conditions requiring or responsive to treatments. This creates the opportunity for a manageable and economical field trial, assessing and providing forecasts for a wide range of stand conditions, but focusing experimental and monitoring effort on stands with good potential for response.

3.2.2. Site and Stand Assessment.

A total of 60 stands, representing 5 ecosite classes (see Table 3) and 4 stand development stages (with each combination replicated 3 times) will be identified throughout the Lower Foothills, Upper Foothills, and Sub-alpine natural sub-regions of Alberta and within the 9 forest management areas of the FGYA members.

The stand development stages to be assessed are:

1. Fire-origin young (< 30 years);
2. Fire-origin mid-rotation (30 – 70 years);
3. Fire-origin late-stage (> 70 years);
4. Post-harvest young (< 30 years).

Table 3. Site Classes to be Evaluated

	Ecosite	Moisture Regime	Nutrient Regime
1	Bearberry / lichen / hairy wild rye	submesic - subxeric	medium - poor
2	Labrador tea - mesic	mesic	medium - poor
3	Bilberry / cranberry /sarsaparilla / rhododendron	mesic	medium
4	Honeysuckle / fern	subhygric	rich
5	Labrador tea - hygric	hygric	poor

An initial list of up to 300 candidate stands will be assembled by the FGYA Technical Committee based on members' forest inventory data (primarily developed and mapped to Alberta Vegetation Inventory specifications). The candidate list will be filtered down to approximately 120 stands based on local knowledge, supplementary site data, and access. These stands will be reconnoitered and classified in the field, as required to make a final selection of 60 stands. The selection criteria will include actual (as compared to interpreted) stand development stage, site class (ecosite, soil nutrient regime, soil moisture regime, and site index), access (stands should be adjacent to roads), harvest schedules (stands scheduled for harvesting or other disturbances within the next 9 years will be avoided), and stand size and homogeneity. Each selected stand should contain an undisturbed and relatively homogenous area of at least 5 ha (and preferably 10 ha) meeting the target conditions, with no watercourse or water body within 30m.

Tree, stand, foliar, and soil / site variables implicated in response to thinning and fertilization will be measured, as a basis for initial forecasting of growth and treatment potential, and for screening of the sample locations for treatment and further evaluation. For this purpose 5 circular sample plots, each 300m², will be located in each stand. Plot centre locations will be recorded by GPS, and permanently staked. Site and soil conditions will be classified according to published guidelines for forest ecosystems of west-central and south-west Alberta. Tree and stand variables measured will include site index, density, height, diameter, crown radius, percent live crown, and canopy position. Detailed pith-bark profiles of annual ring widths will be measured (using digital scanning and image analysis techniques) from increment cores taken at breast-height from one site tree in each plot (i.e. 5 trees per stand). Foliar analyses will be confined to 3 trees in a 50m² screening sub-plot.

Available models and diagnostic techniques will be used to identify stands with (a) high probabilities for treatment response and suitable for fixed-area experimental treatments (b) uncertain response potential and suitable for continued diagnosis and (c) little probability of response and not meriting further assessment.

3.2.3. Experimental Treatment Plots

Clusters of fixed-area plots will be established in stands with high probabilities for treatment response. Subject to finalization of the Project design following stand and site assessment, approximately 20 such clusters will be installed. The basic design for a cluster will be a 2-factor split plot: control, thinning (and / or brush control), fertilization, thinning, and fertilization), as shown in Figure 2.

The cluster configuration is based on that already used in the FGYA long-term regeneration trial, and is designed to locate the measurement plots as close together as possible while providing adequate buffering between experimental treatments. The measurement plot size will be 0.1 ha (31.6m x 31.6m). The basic treatment plot size will be 0.25 ha (50m x 50m), but as shown in Figure 2 the thinned plot will be expanded to allow a minimum distance of one tree height (a)

between the thinned measurement plots and the unthinned stand, and (b) between the thinned plot and the unthinned measurement plots.

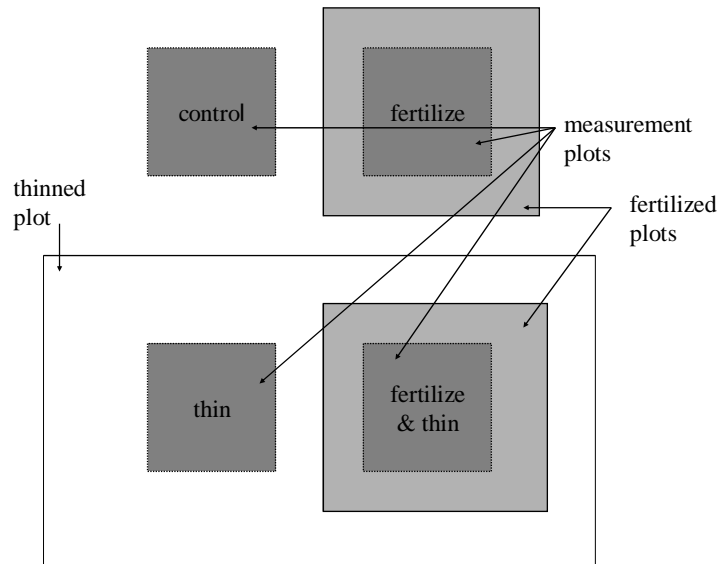


Figure 2. Basic Configuration of an Experimental Treatment Cluster

The cluster design may be adjusted to permit:

- Elimination or replacement of treatment factors where stand conditions are outside ranges for thinning or fertilization response;
- Expansion of clusters to accommodate multiple treatment levels on a sub-set of stands.

For the basic 2-factor / 2-level split plot clusters, the thinning intensities (and / or brushing in the case of young stands) and fertilizer application rates selected will be those most likely to maximize response based on available diagnostic tools. The design and treatment levels will not be finalized until completion of the site and stand assessment.

Tree and stand variables, relevant to timber volume yield, wood quality, economic value, ecosystem health, biodiversity, fire hazard (crown fire initiation and spread), and insect susceptibility will be measured prior to treatment, and at 1, 3, 6, and 9 years following treatment. (Only measurements up to year 3 are included in the current funding request.) Tree and stand variables measured will include site index, density, fuel accumulation, height, diameter, crown radius, height to live crown, percent live crown, canopy position, injury, disease, needle weight, and foliar nutrient concentrations.

Fertilizer will be transported in bulk bags by pick-up truck and / or utility trailer. It will be applied manually in pre-designated swathes. Thinning will be conducted by manual falling and (where applicable) light-mechanical extraction to roadside. Although this is not an operational trial, operationally practical levels of extraction from (versus retention on) the treatment plots will be emulated. This will facilitate assessment and subsequent monitoring of slash accumulation and decomposition.

3.2.4. Diagnostic Fertilizer-Response Testing

Baseline foliage samples will be collected from 15 trees (i.e. 3 per 50m² screening plot located at each of the circular 300m² sample plot centres) in each of the 60 stands initially enumerated. The samples will be taken from near the base of the upper 1/3 of the live crown. An equal number of fascicles from each tree will be combined to provide a composite sample containing at least 150 fascicles per plot. The foliage samples will be properly annotated and shipped for laboratory analysis. The analysis will include needle dry weights, and total concentrations of N, P, K, Ca, Mg, Cu, Zn, Fe, Mn, Al, B, S, plus active Fe and available S.

Based on these analyses, stands will be placed in 3 categories with regard to probability of response to nitrogen fertilizer: high, medium (uncertain), and low. Those with high probabilities of response will be designated for experimental treatment plot installation. Screening plots in stands with either high or uncertain response potential will continue to be evaluated during the remaining project period. (For planning and budgeting purposes, 40 stands are assumed to require such evaluation.) This will involve application of fertilizer to the 50m² plots, and re-analysis of needle weights and nutrient concentrations after 1 and 3 years, relative to baseline levels. Stands with low response probabilities will not be treated further as part of this Project, but may be flagged for linked research aimed at obtaining a better understanding of factors limiting productivity.

3.2.5. Response Forecasting and Management Interpretations

The FGYA has already identified and assembled considerable information and expertise that will assist in the forecasting and evaluation of the responses being studied. The Project will draw upon and complement, rather than duplicate, the information and models assembled.

Initial forecasts and management interpretations will be developed following completion of the site and stand assessments. Significantly improved forecasts and interpretations will be possible by the fifth year of the Project.

3.2.6. Creation of Opportunities for Demonstration and Linked Research

Stand enumeration plots will be permanently demarcated and recorded. Experimental treatment plots will be clearly marked with protective buffers, registered with protective notation in the Provincial land reservation system, and signed for self-directed study.

Where obstacles to accurate forecasting are identified (e.g. limiting factors to tree growth are unknown or poorly understood), input from specialized researchers will be invited. It is anticipated that the venues, opportunities, and challenges created by the Project will attract the involvement and support of related research partnerships.

3.2.7. Inputs from Related Projects

The Association has already designed and initiated the following studies which will contribute to the proposed Project:

- *Lodgepole Pine Regeneration*: forecasting and monitoring the growth and yield of stands regenerated after harvesting, in relation to site, initial spacing of planted stock, natural ingress, mortality, competing vegetation (brush), and density regulation (pre-commercial thinning). This initiative will contribute to the proposed Project by providing an understanding and model of early regeneration dynamics in managed post-harvest stands.

- *Site Index Change*: comparison of pre-harvest and post-harvest site indices to provide credible and reliable forecasts of post-harvest growth rates under altered climatic and management conditions. This initiative will contribute to the proposed project by shedding important light on site productivity potential, which in lodgepole pine has until now been confounded with stand density effects.
- *Cooperative Management of Historic Research Trials*: providing forest managers the continued benefit of long-term field trials established along the Eastern Slopes over the last 50 years, primarily by the Canadian Forest Service (CFS). Re-measurements of these trials by the FGYA, and analyses by the CFS, will provide a critical link for interpreting results of the proposed Project in relation to long-term treatment effects.

3.3. Scientific and Peer Review

This proposal is the result of extensive scientific and peer review. The scientific community provided input through the aforementioned ARC review, as well as through extensive informal contacts by the FGYA Director. The FGYA membership has provided input, from the initial scope and situational assessments (undertaken as part of the organization's business planning), to participation in the development and review of this proposal document. This will continue through direct involvement of the FGYA steering and technical committees in Project planning, implementation, and review. The proposal has been reviewed and endorsed by the Executive Director and appropriate staff of the ASRD Forest Management Branch.

The Association has already designed and initiated four projects (*Lodgepole Pine Regeneration*, *Site Index Change*, *Cooperative Management of Historic Research Trials*, and *Regional Yield Estimators*) to enhance management of lodgepole pine, again with input and review from peers and the scientific community. During 2001 and 2002 the FGYA prepared a comprehensive business plan that was endorsed by all members. In addition to the above projects, it developed a conceptual approach for addressing gaps (not addressed by the above projects or other studies), and commissioned an expert review of critical gaps in knowledge. The review concluded that existing information, research trials, and forecasting procedures are inadequate to support operational management of stand density and nutrition in fire-origin lodgepole pine. In particular:

- Additional research is required to investigate the opportunities for density management of mid- and late-stage fire-origin stands that form the basis of the lodgepole pine timber supply for many decades to come.
- New fertilizer and thinning trials are required to address variable stand responses to management interventions.
- Experimental treatment plots, supported by process-based investigations, should be installed over a wide range of ecosite and stand development stages as a basis for developing required response models.
- The effect of management alternatives on non-timber resource values should be assessed.

FGYA members are also increasingly aware that enhanced stand management strategies must also address threats and uncertainties associated with climate change, fire risk, and biotic damage.

The proposed Project is based on these initiatives. Integrated with the projects already commenced and funded, the proposed Project will provide a comprehensive framework for forecasting and monitoring the development of managed stands, and for selecting silvicultural treatments. It will address major gaps in information currently available for rationalizing silvicultural decisions.

Members of the FGYA have contributed to, reviewed, and endorsed this proposal. Letters of support are included in Appendix 1. The FtMF has confirmed its willingness, as Coordinating Agency for the FGYA, to provide administrative support. The involvement of the FtMF provides an excellent opportunity for multidisciplinary review and application of the Project.

Scientific authorities on silviculture, growth modeling, stand density management, nutrition, wood quality, fire effects, climate effects, and forest health, in Alberta, B.C., and elsewhere, will continue to be consulted during final design and as the Project progresses. Deliverables will include at least one formally peer-reviewed scientific publication.

3.4. Funding Requested and Overall Budget

The requested funding is \$442,800 for the 5-year period commencing April 1, 2004 and ending March 31, 2009. Table 1 shows the break-down by phase and year.

Table 4. Requested Funds (\$) Summarized by Year

Phase / Item	1 (2004-5)	2 (2005-6)	3 (2006-7)	4 (2007-8)	5 (2008-9)	Total
Phase 1: Stand and site assessment	101,400	36,000	0	17,800	0	155,200
Phase 2: Experimental treatment plots	0	99,400	76,800	0	40,400	216,600
Design, analysis and reporting	14,000	14,000	14,000	7,000	22,000	71,000
PROJECT TOTAL	115,400	149,400	90,800	24,800	62,400	442,800

Table 5 shows estimated costs for the Project by site and activity. Table 6 shows the funding requested by year. The FGYA fiscal year starts April 1 and ends March 31. Thus the funding request applies to the period April 1, 2004 to March 31, 2009.

Table 5. Estimated Costs per Site and Total Costs by Activity

Activity	Cost per site (\$)					# of sites	TOTAL \$
	Labour	Material	Lab. analysis	Increment analysis	Total		
Phase 1: Stand and site assessment							
Stand reconnaissance and selection	570				570	60	34,200
Sample plot enumeration	1,020	20	60	20	1,120	60	67,200
Screening-plot fertilization	440	35			475	40	19,000
1-year post-fertilization foliage analysis	365		60		425	40	17,000
3-year post-fertilization foliage analysis	365		60	20	445	40	17,800
Total Phase 1	2,760	55	180	40	3,035		155,200
Phase 2: Experimental treatments							
Installation of plot clusters	880	70			950	20	19,000
Pre-treatment data collection	1,760		240	20	2,020	20	40,400
Thinning treatments	2,000				2,000	20	40,000
Fertilization treatments	1,640	200			1,840	20	36,800
1-year post-treatment measurements	1,760		240		2,000	20	40,000
3-year post-treatment measurements	1,760		240	20	2,020	20	40,400
Total Phase 2	9,800	270	720	40	10,830		216,600
Design, analysis and reporting	71,000						71,000
PROJECT TOTAL							442,800

Table 6. Requested Funds (\$) Summarized by Activity and Year

Activity	1 2004-5	2 2005-6	3 2006-7	4 2007-8	5 2008-9	Total
Phase 1: Stand and site assessment						
Stand reconnaissance and selection	34,200					34,200
Sample plot enumeration	67,200					67,200
Screening-plot fertilization		19,000				19,000
1-year post-fertilization foliage analysis		17,000				17,000
3-year post-fertilization foliage analysis				17,800		17,800
Total Phase 1	101,400	36,000	0	17,800	0	155,200
Phase 2: Experimental treatments						
Installation of plot clusters		19,000				19,000
Pre-treatment data collection		40,400				40,400
Thinning treatments		40,000				40,000
Fertilization treatments			36,800			36,800
1-year post-treatment measurements			40,000			40,000
3-year post-treatment measurements					40,400	40,400
Total Phase 2	0	99,400	76,800	0	40,400	216,600
Design, analysis and reporting	14,000	14,000	14,000	7,000	22,000	71,000
PROJECT TOTAL	115,400	149,400	90,800	24,800	62,400	442,800

3.5. Other Funding Applied to the Project

The requested funds do not include costs associated with the scope assessment already conducted, other studies described in Section 3.2.7 that will contribute to achievement of the Project objectives and deliverables, and project administration. Many of these contributions are or were in-kind, and their value can only be approximated. Table 7 itemizes the contributions, and provides an indicative estimate of their financial value. Contributions by the FGYA steering and technical committees, in providing project oversight and other assistance, are not included.

Table 7. Indicative Cost of Additional Project Contributions

Contribution	Contributor	Estimated Value (\$)
Scope assessment	FtMF	50,000
Financial and general administration	FtMF ¹³	33,200
Project management	FGYA ¹⁴	35,000
Field co-ordination	FGYA	50,000
Database management	FtMF	20,000
Contributing FGYA studies (see Section 3.2.7)	FGYA ¹⁵	960,000
Analysis and interpretation of historic CFS trials	CFS	161,500
	Total	1,309,700

¹³ Estimated as 7.5% of requested Project funding

¹⁴ FGYA expenditures are predominantly FRIP funded

¹⁵ As budgeted for the period 2002-2006 in the FGYA Business Plan

3.6. Subcontracting

Work will be undertaken primarily by contractors retained by the Foothills Model Forest. The following guidelines will be followed by the FGYA and the FTMF.

- Project Manager. The contract rate will be applicable to a senior registered professional foresters with formal post graduate qualifications in forest science and twenty or more years relevant experience, as approved by the FGYA Steering Committee. General administration services provided by the Manager will be absorbed by the FGYA and not charged to the Project. Technical and scientific tasks will be charged to the Project, and have been budgeted at a rate of \$700 per day.
- Field Coordinator. No portion of the Field Coordinator's contract will be charged to this Project.
- Other contractors and field personnel. Prevailing contract or wage rates based on the respective categories of work have been assumed for budgeting purposes. In order to ensure field services are acquired at fair market value, contracts for the activities listed under Phase 1 and 2 will be awarded on the basis of competitive bidding, with the exception of the initial stand reconnaissance, classification and selection work (which will be undertaken by the Technical Advisor). The companies of the Project Manager and the Field Coordinator will not be eligible to bid on these contracts.

3.7. Detailed Schedule of Activities

See Section 4.3.

3.8. Project Management

Consistent with pre-arranged provisions of the LOA among members of the FGYA, the FGYA Steering Committee will:

- Review and approve Project plans, data standards, annual work plans, annual operating budgets, and reports;
- Review and approve contracts for outside services and other business arrangements proposed by the FGYA Director (who will act as Project Manager for the Project);
- Approve assignment to the Association of personnel hired or contracted by the Coordinating Agency;
- Approve the publication and dissemination of information resulting from the Project;
- Resolve any disputes arising among members or staff regarding the design and implementation of the Project.

The FGYA Technical Committee, consisting of qualified representatives from each of the 11 member organizations of the FGYA, will contribute to:

- Design and planning of the Project;
- Identification of candidate sites;
- Coordination and permitting of experimental thinning and fertilization treatments;
- Evaluation of project results.

The Foothills Model Forest will:

- Retain the services of a Director to manage the Project;
- Retain or assign other staff and contract services as required and approved for implementation of the Project;

- Control expenditures in accordance with the approved project plan and generally accepted Canadian accounting practices;
- Maintain books of account of all funds contributed and dispersed on behalf of the Project, in accordance with generally accepted Canadian accounting practices, and subject to independent audit;
- Provide quarterly financial and progress reports on the Project;
- Provide data management services and maintain a secure repository of all Project data.

The Project Manager will assume responsibilities for overall Project management, technical direction, design, analysis, reporting and all deliverables. He will be assisted by the FGYA Field Coordinator, who will be responsible for liaison with the technical representatives of member companies, supervision and administration of sub-contractors providing field services, and quality control for experimental treatments and field measurements. Data management services will be provided by the FtMF GIS Coordinator, who will be responsible for data base design and the secure storage of Project data. The Technical Advisor will provide specific inputs on fertilization and thinning operations, and report to the Project Manager.

3.9. Authorization Requirements

Thinning and fertilization activities will be permitted through the FGYA members' FMA dispositions. The project plan will be submitted to the Manager, Harvesting and Renewal Section, Forest Management Branch, of ASRD, for review, endorsement, and coordinated referral to the Local Area Managers. Local Area Managers will be notified of all Phase 1 activities. The member companies will obtain (from the Local Area Managers) authorizations under their Annual Operating Plans before Phase 2 activities are commenced.

3.10. Impacts on Other Resources and Users

The Project is not anticipated to have any adverse impacts on any other forest resources or the environment. The thinning and fertilization activities will be on a very small scale and widely dispersed. The total area fertilized will be only about 11 ha, and the total area thinned (including buffers) will be approximately 16 ha. No thinning or fertilization operations will be conducted within 30 m of water bodies.

The very small volumes extracted to roadside may preclude FMA holder utilizing wood from some sites. Where possible in such circumstances, these volumes will be made available for public fuel-wood use.

3.11. Project Deliverables

Project outputs will be delivered as follows:

- A detailed project design will be submitted to FRIAA, the FGYA membership, and collaborating experts by the end of the first year (following identification and initial assessment of candidate stands).
- Quarterly and annual financial and progress reports will be submitted to FRIAA and the FGYA, detailing how much money has been spent and how much of the Project has been completed.
- Detailed technical reports will be submitted to FRIAA and the FGYA membership at the end of the second, third and fifth year, including details of trial establishment, techniques applied, diagnoses, responses measured, yields forecast, predictive models developed, and conclusions regarding factors influencing treatment effects. Following review, these reports will be made publicly available for downloading from the FtMF website.

- At least one scientific paper will be prepared for peer review and publication in a recognized scientific journal during the Project period.
- Two information reports will be published, presenting and interpreting results for the benefit of forest managers, planners, and silvicultural practitioners. One, focused primarily on the needs of forest planners, will include managed-stand yield tables providing quantitative predictions of stand development over a wide range of sites, treatments and stand conditions. The other, primarily for the benefit of silvicultural practitioners, will provide stand assessment guidelines and interpretative criteria for selecting silvicultural treatments.
- The experimental sites (see Figure 2), suitable for ongoing monitoring, research, and demonstration of enhanced stand management practices, will be demarcated, documented, interpretively signed, protected, advertised, and maintained by the FGYA.
- A computerized relational database, containing and organizing all Project technical data, will be maintained, periodically updated, and made available to collaborating researchers.

3.12. Availability of Deliverables for General Public Use

Technical reports, scientific papers, and information reports (see Section 3.11) will be available to the general public following review by the FGYA steering and technical committees and scientific peers. Use of the experimental sites will be encouraged by advertisement and interpretive signage.

4. Schedules

4.1. Progress Reporting Schedule

Expenditures and work progress will be reported on a quarterly and annual basis, in reports detailing how much money has been spent and how much of the Project has been completed.

4.2. Proposed Payment Schedule

It is proposed that FRIAA will forward Project funds to the FtMF in advance on an annual basis, subject to:

- Submission of an annual work plan (for the period April 1 to March 31 of the following year);
- Submission of the annual report as per Section 4.1. (not applicable to first-year funding);
- A holdback of 10%, pending submission of the annual report and any other deliverables scheduled for the year.

Table 6 shows the annual schedule of expenditures.

4.3. Work Schedule / Work Plan

Work will be conducted in 2 overlapping phases.

Phase 1, the selection and assessment of 60 sites, will commence in April 2004. The initial enumeration will be completed by September 2005, with follow-up diagnostic response assessments after 1 and 3 growing seasons in stands rated as having high or uncertain response potential. The Phase 1 activities are:

- Stand reconnaissance and selection: April – September 2004.
- Sample plot enumeration: July 2004 – March 2005.
- Screening-plot fertilization: April – June 2005.
- 1st year post-fertilization foliage analysis: October – December 2005.

- 3rd year post-fertilization foliage analysis and diagnostic response assessment: October 2007 – March 2008.

Phase 2, the installation, treatment and measurement of experimental treatment plots, will commence late 2005. Measurements will be completed in the Fall of 2008, and a final report prepared by March 31, 2009. The Phase 2 activities are:

- Installation of plot clusters: September – December 2005.
- Pre-treatment data collection: October - December 2005.
- Thinning treatments: January - March 2006.
- Fertilization treatments: April – June 2006.
- 1st year post-treatment measurements: October – December 2006.
- 3rd year post-treatment measurements: October – December 2008.

Design, analysis, and reporting will be ongoing tasks, the main milestones being:

- Approval of initial design and work plan: by March 31, 2004.
- Detailed project design and database construction: by March 31, 2005.
- First technical report: by March 31, 2006.
- Second technical report: by June 30, 2007.
- Final technical report and information reports: by March 31, 2009.

Table 8 summarizes scheduled tasks by fiscal year and quarter.

Table 8. Work Schedule by Fiscal Year and Quarter

Task	2004-05				2005-06				2006-07				2007-08				2008-09			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Phase 1																				
Stand recon. and selection	x	x																		
Sample plot enumeration		x	x	x																
Screening-plot fertilization					x															
Foliage analysis			x	x			x	x						x	x					
Phase 2																				
Installation of plot clusters						x	x													
Thinning treatments								x												
Fertilization treatments									x											
Measurements							x				x									x
Design, analyses & reporting																				
Detailed design	x	x	x	x																
Analysis		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Technical reports								x						x						x

Appendix 1. Letters of Support

Signed letters of support are attached from the following agencies:

Agency	Signatory	Position Held
Foothills Model Forest	D. Podlubny	General Manager
ASRD Forest Management Branch	D. Sklar	Executive Director
ANC Timber Ltd.	G. Branton	Forestry Supervisor
Blue Ridge Lumber Inc.	D. D'Amico	Management Forester
Canadian Forest Products Ltd.	D. Weeks	Forest Planner
Millar Western Forest Products Ltd.	J. Russell	Chief Forester
Spray Lakes Sawmills	E. Kulcsar	Planning Forester
Sundance Forest Industries Ltd.	J. Huey	Woodlands Manager
Sunpine Forest Products Ltd.	K. Branter	Woodlands Manager
Weldwood of Canada Ltd.	H. Loughheed	Forestry Manager, Hinton Division
Weyerhaeuser Company Ltd.	R. Watson	Forestry Manager, Alberta Operations