

Introduction

This project is to address issues related to integrated management of industrial activity with aquatic ecosystem and watershed conservation in the Weldwood FMA. The goal is to continue industrial activity in ways that support and ensure the conservation of aquatic ecosystem and watershed values.

This is a multiple-year project with an initial expected term of 3 years. There are 4 sub-projects:

1. Inventory and classification
2. Models and Management Applications
3. Indicators and Monitoring
4. Research

Purpose

The purpose of this project is to:

1. Develop a classification system and obtain inventory information for selected aspects of aquatic ecosystems and watersheds on the Weldwood FMA.
2. Use the information to develop and implement forest management plans that include aquatic ecosystem and watershed conservation strategies.
3. Select indicators and monitor management activities and the response of aquatic ecosystems and watersheds to management activities, to determine natural variation and the success of sustainable forest management strategies.
4. Evaluate, through research, the effects of management practices on aquatic ecosystems and watersheds.

Background

Conservation of aquatic ecosystem and watershed values is a key component of sustainable forest management. This is recognized in the existing regulatory, policy, and planning framework, and practices employed to conserve aquatic/watershed values. The Canada Fisheries Act provides strong protection for aquatic ecosystems and organisms. Watershed protection is the single highest priority of the Alberta Eastern Slopes Policy, and Integrated Resource Plans affirm that ranking. The Weldwood Harvest Planning and Operating Ground Rules describe goals, standards, and operating practices intended to conserve these values.

Programs to recognize and address aquatic systems issues within the Weldwood FMA have been underway for decades. The long-term Tri-Creeks Watershed study is the best-known example. Since 1993, through the Foothills Model Forest program, Weldwood, Alberta Environmental Protection, and other partners have been developing a framework to address aquatic systems values. The two main components addressed so far are a fish and stream inventory program started in 1995 and a watershed assessment program started in 1993. As part of Weldwood's commitment to address multiple resource values in a new Forest Management Plan, Weldwood engaged Golder Associates, starting in 1996, to provide a framework for incorporating hydrologic assessment and modelling into the FMP. Weldwood also has initiated internal programs to improve integrated management of timber and aquatic systems values. These include a stream crossings program and a new watercourse corridor management program.

Rationale

Improvements to forest resources

This project will improve integrated management of industrial activity, aquatic ecosystems, and watersheds on the Weldwood FMA, including conservation of aquatic ecosystem and watershed values. The project addresses the primary purpose of FRIP - to "enhance management activities and the level of understanding of all forest resources."

Application of results

Information obtained from this project will be used to develop, assess, and improve sustainable forest management of the Weldwood FMA. Information will be incorporated into management plans and will also contribute to improving understanding of aquatic ecosystems and watersheds for application elsewhere.

Company responsibilities

This work relates to the conservation and management of aquatic systems and watersheds, a responsibility that rests exclusively with the Alberta Government. Weldwood is not the responsible agency for aquatic systems and watershed management under the terms of any legislation, regulation, forest tenure, policy, specific agreement, or general practice. Weldwood is responsible for ensuring that the impacts of company activities do not contravene the requirements of the existing regulatory framework.

Impacts

This project is not anticipated to have any adverse impact on any other forest resource values. The project has support of the land management agency involved (Alberta Environmental Protection).

Fair Market Value

Work will be undertaken using a combination of contractors and project staff who will be paid fair market value for work of this nature, considering the respective categories. The established administration procedures and valuation of work of the respective organizations undertaking the work will be followed.

Objectives

Objectives are listed here by sub-project. Additional objectives may be developed as the program progresses.

1. Inventory and classification

This includes continuation of the fish and stream inventory program started in 1995, stream classification, and watershed delineation.

- 1.1. Continue the existing fish/stream inventory program using established electroshocking protocols (Johnson 1998, Johnson et al. 1998). Supplement the program to fill identified gaps, including small streams, medium-sized streams and rivers, and lotic ecosystems (ponds, lakes).
- 1.2. Identify aquatic systems indicators, document existing information, and develop data collection protocols where necessary. Develop and implement inventory programs for new aquatic

systems indicators and collection of data to calibrate and refine hydrologic models (see below).
Collect data to calibrate and refine hydrologic models.

- 1.3. Develop/adopt an ecologically-based stream classification system, analogous to the ecosite classification system used for terrestrial systems (Beckingham et al. 1996). Evaluate the Rosgen stream classification system (Rosgen 1996) to see if it is suitable for identified needs, and others (stream order, Weldwood Ground Rules system, etc) if necessary.
- 1.4. Decide which classification system to use, and modify the selected system if needed to make it applicable to the watercourses of the FMA landbase. Produce a classification field guide. Use the stream classification system to classify survey sites, streams in monitoring watersheds, and eventually all streams on the FMA. A schedule to complete the classification will be developed. At this time we propose to complete a preliminary classification in 2000. Classification will be based on the inherent morphological characteristics of the stream, plus development stage related to stability or time since major disturbance.
- 1.5. Refine existing watershed delineation using analysis tools developed through the Foothills Model Forest (FMF, 1998). Delineate watersheds for all drainage basins on the FMA, using a hierarchy of small watersheds nested within larger watersheds.

2. Models and Management Applications

This includes hydrology models (eg. sediment, temperature, dissolved oxygen, pH, inorganic nutrients, annual water yield, snowmelt peak flow, summer peak flow, low flow, flood levels), fish habitat models, and ecologically-based management interpretations and applications.

- 2.1. Build on the hydrology modelling capability developed through the Foothills Model Forest by acquiring/developing a set of integrated models to predict changes in hydrologic variables (water yield, temperature, suspended sediment, snowmelt peak flow, summer peak flow, low flows, flood levels) and their effect on three measurement endpoints (fish habitat, stream geomorphology, and infrastructure). Use Golder Associates (1998a) recommendations as a starting point.
- 2.2. Develop and calibrate a decision framework and modelling capability for assessing effects of management activities on aquatic ecosystems, aquatic species, and watershed values. This includes 3 activities:
 - 2.2.1. A set of response curves, one for each hydrologic variable, that predict low, medium, or high impact based on proposed management activity. The response curves will be used to assess implications of proposed harvest scenarios developed in Compartment Operating Plans, and to assist with design of stream crossings. Calibrate the set of preliminary response curves developed by Golder Associates (1998b).
 - 2.2.2. An analysis system that uses response curves to evaluate forest-level harvest scenarios developed as part of Forest Management Plans.
 - 2.2.3. Capability to use calibrated hydrology models to do detailed assessments of harvest scenarios for individual watersheds where additional detail is needed (e.g. where analysis using response curves suggests a high impact). This will be done by acquiring models recommended by Golder Associates and calibrating them for local conditions
- 2.3. Develop and implement management interpretations and guidelines (e.g. stream crossing design and installation, watercourse corridor designation and management, mitigation, restoration, maintenance).

3. Indicators and Monitoring

This includes a monitoring program for aquatic ecosystem and watershed indicators, which will be identified as part of the overall program. The indicators will include management activity indicators and resource state indicators. Establishing relationships between management activity indicators and resource state indicators may make it possible to monitor management activity indicators as a primary focus, with periodic confirmation of the relationships with state indicators.

- 3.1. Identify a set of aquatic ecosystem and watershed indicators to use to set management objectives and monitor specific and cumulative effects of management activities. Work on this phase is underway through the Foothills Model Forest local indicators and Biomonitoring projects, and an internal Weldwood indicators project
- 3.2. Select a sample of representative reference watershed basins and develop a monitoring protocol to be used for long-term monitoring of indicators. Extend the sample of representative reference watershed basins used for the 1998 fish/stream program to include watersheds in the Upper Foothills and Lower Foothills Natural Regions. We will also build on the existing Weldwood monitoring program, which includes road/stream inspections, forest management audits, etc.
- 3.3. Through partnerships, implement the monitoring program over several years by extending the work started in 1998.
- 3.4. Report monitoring results and incorporate findings into the management system, including revisions to plans and forest operations.

4. Research

This includes research intended to evaluate the effects of forest management on aspects of aquatic ecosystems and watersheds, and evaluation of practices designed to improve the integration of terrestrial and aquatic systems management.

- 4.1. Evaluate the effects of specific practices and cumulative effects of forest management on selected aspects of aquatic ecosystems and watersheds.
- 4.2. Evaluate practices designed to improve the integration of terrestrial and aquatic systems management.
- 4.3. Identify issues and research priorities through partnership discussions, and coordinate development of research proposals with specific research questions.
- 4.4. Develop research partnerships and implement research projects.
- 4.5. Report research findings and incorporate new knowledge into management system.

Location

This project will be conducted on the Weldwood FMA landbase. Selected aspects may be extended to portions of the Foothills Model Forest landbase outside the FMA.

Partnerships

Other Companies

No other forest industry companies are involved as partners at this time. However, discussions are planned with Sunpine Forest Products to see if a partnership is appropriate. Other companies may become involved in the project as it develops.

Partners

Weldwood recognizes that company activities have impacts on aquatic ecosystem and watershed conservation values. The activities of others (companies, communities, individuals, etc) also impact these values. The company has demonstrated leadership in providing funding and participating in the partnership established for this program. This proposal reflects the company's commitment to address the issues, but Weldwood is neither able nor willing to take on a disproportionate share of the entire cost associated with a comprehensive conservation program, particularly in the areas of monitoring and research. Weldwood will pay a fair share of the costs, but we wish to stress that the overall success of this program will depend on cooperative cost-sharing with others.

Other organizations that will be partners in this project are the Foothills Model Forest, Alberta Environmental Protection, and the Alberta Conservation Association. In 1999, the Foothills Model Forest will contribute funding of \$70,000 for salary and support for one fish biologist, and \$5,000 (portion of local indicators program) for indicator development. The Alberta Conservation Association will contribute \$40,000 for the field program. Additional partners will be solicited (eg. Trout Unlimited, Hinton Fish and Game Club, other companies). Additional funding will also be solicited (eg. Environmental Enhancement Trust Fund).

Potential exists to expand the scope of this project in future years and use the proposed partnership to directly address species conservation issues. Alberta Environmental Protection is responsible for population management, and they are interested in addressing population management issues within the framework of this program. For example, this could include an investigation of the effects of angler access and fishing regulations on fish populations.

Methods

General Approach

The general approach for this project is described in the Objectives section above.

Design

The main goal of the current proposal is to conclude, consolidate and coordinate existing initiatives and design new components to complement existing projects and fit within an overall framework (see table). The intended result is a coordinated and comprehensive program designed to address, or provide the capability to address, all aquatic/watershed aspects of sustainable forest management. The major elements of the program have been identified and are described in this proposal, but detailed design of sub-projects and individual activities has not yet been done. This will be included as a first task in the 1999 work plan, and it will be completed for individual activities before the activities are implemented.

Project design is at different stages for each of the four sub-projects. Several components have been started previously. The design for the ongoing fish/stream inventory is complete. A pilot monitoring program using the fish/stream inventory protocol for fish sampling was started in 1998 on a sample of front ranges watersheds. Hydrology model development has occurred through the Foothills Model Forest program (now complete) and the work Golder Associates is doing for the 1998 Weldwood FMP. Indicator definition is underway through the FMF Local Indicators and Biomonitoring projects and an internal Weldwood process.

Program Framework

Inventory and classification	Models and management applications	Indicators and monitoring	Research
Completed Programs			
Bull trout inventory	FMF Watershed GIS tools	Monitoring basin pilot program	Tri-Creeks study
Hydrologic regime report	WRNSFMF water yield model		
Preliminary basin delineation	Watercourse crossings course		
Rosgen classification pilot	Preliminary response curves		
Ongoing Programs			
Fish/habitat inventory	FMP hydrology assessment	FMF indicators project	Sediment intrusion study
Stream order classification	Stream crossings remediation	Stream crossings monitoring	
Database		Roads catalog	
		Monitoring protocols	
New Programs			
Stream classification guide	Calibrated hydrology models	Aquatic/watershed indicators	Issues and research priorities
Classification inventory	Revised response curves	Monitoring program design	Research partnerships

Revised basin delineation	Operations planning process	Monitoring partnerships	Research programs
	Stream crossings guide	Monitoring program	

Additional detail is provided in the 1999 work plan (attachment).

Methods

Methods for existing projects are described in the attached program documentation. Additional information is provided in the 1999 work plan (attachment). Methods for future activities will be developed and submitted as part of future work plans and project proposals.

Contracts

This project will be implemented through contracts and cooperative partnerships. These have not been confirmed at this time. The existing partnership with the Foothills Model Forest and the existing contract with Golder Associates will continue pending program scoping and agreements.

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Review

This proposal has received internal review and approval and it has been discussed with existing project partners, the Foothills Model Forest and Alberta Environmental Protection.

Existing components of the program have been professionally reviewed by fisheries biologists, hydrologists, and foresters within partner organizations and consultant Golder Associates Ltd. Review has also been provided by the Alberta Conservation Association, which is a funding partner for the fish/stream inventory program, and by the FMF partnership. FMF projects on Local Indicators and Biomonitoring have a large review network of professional experts, organizations, and interested individuals.

As this proposal includes development of a program framework and individual components, Weldwood plans to seek additional review through the partnership that forms to undertake the work, plus external review of various aspects. Weldwood will also develop a communication program related to this proposal, to solicit additional review and input as results are reported.

Approvals

This project involves fish capture. Relevant permits for the existing fish/stream inventory program are in place and will be renewed in 1999. The project has received Weldwood management approval and support from Alberta Environmental Protection, Land and Forest Service, which is the land manager for the Weldwood FMA landbase.

Schedule and Deliverables

Project Management

Rick Bonar and Hugh Lougheed will be the Weldwood project managers for this project. Most of the work will be conducted by others through partnership or contract arrangements. Names of responsible organizations and contacts will be provided as they are confirmed.

Project schedule

Sub-project 1: Inventory and Classification

Activity	Start	Complete	Deliverable
Report summarizing fish/stream inventory program to end of 1998	Jan 99	Jul 99	Report
Fish/stream inventory program gap analysis, 3-year work plan	Jan 99	May 99	Report
1999 fish/stream inventory program	May 99	Oct 99	Field program and database
1999 fish/stream inventory annual report	Sep 99	Dec 99	Report
Stream classification and water basin delineation	Jan 99	Dec 99	Classification system, watershed map
Database review and re-design	Jun 99	Dec 99	Database structure
2000 annual work plan, program, and annual report	Jan 00	Dec 00	Work plan, program, report
FMA stream classification	Jan 00	Dec 00	Classification inventory
Data transfer and entry	Jan 00	Dec 01	Database
2001 annual work plan, program, and annual report	Jan 01	Dec 01	Work plan, program, report

Sub-project 2: Models and Management Applications

Activity	Start	Complete	Deliverable
Hydrologic model selection	Jan 99	Dec 99	Model assessment report
Acquire/calibrate models	May 99	Jun 99	Models
Model calibration data scoping and plan	Jul 99	Dec 99	Plan
1999 Annual Report	Oct 99	Dec 99	Annual report
2000 Work Plan	Oct 99	Dec 99	Work plan
Revise preliminary response curves	Jan 00	Jun 00	Revised response curves
Revise compartment planning process to use response curves	Jul 00	Dec 00	Revised COP process
2000 Annual Report	Oct 00	Dec 00	Annual report
2001 Work Plan	Oct 00	Dec 00	Work plan
Develop management interpretations and guidelines	Jan 00	Dec 01	Interpretations and guidelines – reports
Final report	Dec 01	Mar 02	Final report

Sub-project 3: Indicators and Monitoring

Activity	Start	Complete	Deliverable
Indicator selection	Jan 99	Dec 99	Indicator list
Indicator protocols	Jun 99	Dec 99	Protocols
Monitoring program design	Jan 99	Dec 99	Monitoring program
Monitoring basin selection, 1999 program	Apr 99	May 99	1999 monitoring basins
1999 Monitoring program	May 99	Dec 99	Field program
1999 Indicators/monitoring annual report	Oct 99	Mar 00	Annual Report
2000 Work Plan	Sep 99	Dec 99	Work Plan
2000 Monitoring program	May 00	Dec 00	Field program
2000 Indicators/monitoring annual report	Oct 00	Mar 01	Annual Report
2001 Work Plan	Sep 00	Dec 00	Work Plan
2001 Monitoring program	May 01	Dec 01	Field program
2001 Indicators/monitoring annual report	Oct 01	Mar 02	Annual Report

Sub-project 4: Research

Activity	Start	Complete	Deliverable
Identify issues and research priorities	Jan 99	Dec 99	Research priority list
Develop research proposals	Sep 99	Dec 00	Research proposals
Research projects	Jan 00	Dec 01	Research projects
Research reports	Dec 00	Dec 01	Research project reports

Payment schedule

Funding sources, 1999 program

Weldwood (FRIP)	\$250,000
Foothills Model Forest (FMF)	\$75,000
Alberta Conservation Association (ACA)	\$40,000
Total	\$365,000

Anticipated 1999 costs by sub-project and funding source

Sub-project	FRIP	FMF	ACA	Total
Inventory and Classification	\$110,000	\$35,000	0	\$145,000
Models and Management Interpretations	\$100,000	\$5,000	0	\$105,000
Monitoring	\$40,000	\$35,000	\$40,000	\$115,000
Research	0	0	0	0
Total	\$250,000	\$75,000	\$40,000	\$365,000

1999 payment schedule for FRIP component (see 1999 work plan)

Sub-project	Mar 31	Jun 30	Sep 30	Dec 31
Inventory and Classification	\$27,500	\$27,500	\$27,500	\$27,500
Models and Management Interpretations	\$25,000	\$25,000	\$25,000	\$25,000
Monitoring	\$10,000	\$10,000	\$10,000	\$10,000
Research	0	0	0	0
Total	\$62,500	\$62,500	\$62,500	\$62,500

Program costs and payment schedules for 2000 and 2001 programs will be developed as part of the annual work plans.

Deliverables

Reports

A field guide to the classification of streams in west-central Alberta will be produced. Quarterly and annual project progress reports will be submitted in accordance with FRIAA reporting requirements. Final reports will be prepared for each program component in accordance with a deliverables list and schedule provided as part of each annual work plan.

Other

Information obtained will be incorporated into Weldwood forest resource information system and used as part of the company's sustainable forest management system. Copies of the information will be available to others through data sharing agreements.

Distribution of knowledge

Knowledge will be distributed within the organizations participating in this project using their existing communication programs and data sharing agreements. Knowledge will be distributed outside organizations through their external communication programs. In particular, the Foothills Model Forest and the Alberta Conservation Association have existing communication programs specifically designed to distribute new knowledge.

Publications in peer-reviewed journals will be prepared for all aspects of the project that produce publishable knowledge by the persons conducting the research.

References

- Johnson, C. F. 1998. Operational fish and stream inventory – 1997 annual report. Foothills Model Forest, Hinton, Alberta, Canada.
- Johnson, C. F., P. Jones, and S. C. Spencer. 1998. A guide to classifying selected fish habitat parameters in lotic streams of west central Alberta. Foothills Model Forest, Hinton, Alberta, Canada.
- Johnson, C. F., and S. C. Spencer. 1999. 1998 operational fish and stream inventory annual report and summary for 1995-98. Foothills Model Forest, Hinton, Alberta, Canada.
- Golder Associates Ltd. 1998a. Hydrologic resource issues review and recommendations. Golder Associates, Calgary, Alberta, Canada.
- Golder Associates Ltd. 1998b. Strategic planning tools for hydrologic resources Phase 2 study. Golder Associates, Calgary, Alberta, Canada.
- Rosgen, D. L. 1996. Applied river morphology. Wildland Hydrology Books, Pagosa Springs, Colorado, USA.

Appendices

Appendix 1

1999 Work Plan

Aquatic Ecosystem and Watershed Conservation

1999 Work Plan

Introduction

This work plan describes the work proposed for the first year of a 3-year program. We propose to use the Foothills Model Forest and a consultant to implement the program in 1999. A number of the components in this work plan include first preparing a situation assessment and a more detailed plan depending on the assessment results, so this work plan does not include specific methods. As they are developed, these will be supplied with quarterly reports.

Sub-project 1: Inventory and Classification

Fish Inventory

Inventory (fish presence/absence, distribution, relative abundance, growth rates, etc) is needed to design watercourse crossings, identify high-value streams, and monitor effectiveness of practices designed to conserve aquatic ecosystems. Phase 1 electrofishing inventory of FMA streams started in 1995 and surveyed 765 sites as of the end of 1998 (Johnson and Spencer 1999). It would be prohibitively expensive to collect Phase 1 fish inventory information for all streams, but there will be need for additional Phase 1 inventory to use in developing Compartment Operating Plans. In 1999, we propose to summarize and review the existing inventory, compare availability of information in relation to upcoming planning needs (Weldwood Development Plan) and identify inventory needs for the next several years. After this is done the 1999 field program will start to fill identified gaps.

The backpack electrofishing inventory methods used on smaller streams are not suited to larger watercourses (eg Wildhay River, Gregg River, lower Oldman Creek). Float electrofishing was used to sample 67 sites on larger watercourses in 1998. The float electrofishing program will be reviewed in early 1999 and may be continued depending on the review findings.

There is no fish inventory information for many FMA ponds and lakes. Alberta NRS has information for larger lakes, but smaller waterbodies are largely unknown. In 1999, we propose to do a gap analysis to see which lakes inventory information is already available for, and which areas should be surveyed. If warranted, an inventory program will be developed and implemented in 2000.

The electrofishing method used doesn't provide information on the extent of watercourses that are accessible to fish. We can assume fish are found downstream of sample points, but not that movements are unrestricted. Distribution information above survey points and movement barrier information is unavailable. This is an issue when designing watercourse crossings. In 1999, we propose to collect fish distribution information for watershed basins selected for the monitoring program. Fish distribution information will be collected as needed in future (eg, when designing watercourse crossings or deciding if stream crossing remediation is warranted).

Existing information about which tributary streams are important spawning and rearing sites for migratory fish that only enter the tributaries to spawn is limited. Some information about bull trout is available from a 1993 survey (Brewin 1996). Distribution of juvenile fish is fairly well known through electrofishing work, but little is known about spawning runs. We propose to add main-stem spawning run determination to reference watersheds selected for the monitoring program and for any other key watersheds as they are identified. This work will probably not start until 2000 but may be implemented on a pilot basis in the fall of 1999.

The existing knowledge base about important fish species (at risk, ecological importance, economic importance) should be documented and updated. In 1999, we propose to include fish as part of a project to assess the status of all FMA vertebrates and selected species groups from other taxa. This will lead to consideration of additional work that may be needed to address important species issues in future years. Action will be incorporated into the main inventory/monitoring program, and specific inventory or research activities will be developed where a need is identified.

Stream Classification

Streams can be classified using stream order, the Rosgen (1996) classification based on stream morphology, or other methods (eg the Weldwood Harvest Planning and Operating Ground Rules system). Classification supports stratification to increase efficiency of inventory and monitoring programs and provides a basis for developing management interpretations that is similar in concept to the ecological classification used for terrestrial sites (Beckingham et al. 1996). Stream classification based on morphology, and changes through time, can be used to compare natural disturbance with management impacts in aquatic ecosystems. Weldwood's long-term goal to develop a stream classification system, classify all FMA streams, and use the classification to guide management of aquatic ecosystems on an ecological basis in a manner similar to the system developed for terrestrial ecosystems.

Fish inventory sites are being classified using stream order, and morphological measurements and photographs are available for most sites. Golder Associates classified 20 streams at road crossings using the Rosgen classification in summer 1997, and did a preliminary classification for an additional 10 streams in 1998.

In 1999, we propose to investigate the suitability of the Rosgen stream classification system. We will also consider other classification systems and choose the system that best meets management needs. Once the stream classification system is selected, we will develop a stream classification field guide to complement the terrestrial ecosite guide (Beckingham et al. 1996), and we will use the classification system to classify sites where stream crossings are being considered, existing inventory sites, and monitoring basins. All new field programs will be based on the stream classification system, and future management interpretations will be developed using the system. The expectation is that the classification system will be hierarchical, with increasing level of detail possible depending on the level of inventory and management needs. We intend to do a forest-level classification of all FMA watercourses in 2000.

Watershed Basins

Delineation of watershed basins is needed as a base for management evaluations and monitoring, but basins have not been identified for the FMA. For the FMP review, Golder Associates prepared a preliminary basins map using digitized hand-drawn basins. The FMF watershed GIS tools will generate basins, but the process is not automated and requires supervision by a GIS technician. This process has been used to delineate some basins for stream crossing design and the fish/stream inventory program.

The existing provincial basemap hydrography layer has a number of deficiencies that complicate the automated process of basin delineation. Many of these problems are expected to be resolved through a new digital provincial basemap, which has been completed and will be acquired by Weldwood. In 1999, we propose to use the FMF GIS tools to revise the preliminary basin delineation for watersheds selected for monitoring or other field work. The revision of delineation for remaining basins will be completed in future years.

Database

Historic information and information collected since 1995 has been entered into a Microsoft Access database. However, the database is not linked to the Weldwood GIS and database content for historic

information is incomplete. This makes it easily accessible to only a few users. In 1999, we propose to review database needs, develop a database specification, investigate available database applications, and either modify the existing database application or acquire a new one. Data will be transferred to the revised/new application and the new application will be used to meet future database needs.

Subproject 1. Inventory and classification, 1999 work plan.

Activity	Start	Complete	Deliverable
Report summarizing fish/stream inventory program to end of 1998	Jan 99	Jul 99	Report
Fish/stream inventory program gap analysis, 3-year work plan, and 1999 work plan	Jan 99	May 99	Report
1999 fish/stream inventory program	May 99	Oct 99	Field program and database
1999 fish/stream inventory annual report	Sep 99	Dec 99	Report
Fish movements project design and long-term work plan	Mar 99	Aug 99	Problem assessment and work plan
Fall fish movements field program (possible)	Aug 99	Oct 99	Field program
Fish species status	Apr 99	Dec 99	FMA species status report
Identify and compare existing stream classification protocols	Jan 99	Jun 99	Internal analysis
Acquire/calibrate a stream classification system (choose best available option that meets management needs)	Jun 99	Dec 99	Calibrated stream classification system (documentation)
Implement a pilot stream classification program	Aug 99	Dec 99	GIS analysis + possible field program
Evaluate the pilot program and develop a forest-level classification program for all FMA streams, to be completed in 2000	Oct 99	Dec 99	Stream classification 2000 work plan
GIS-based watershed delineation for priority watersheds	Feb 99	Dec 99	New digital basin layer in GIS
Review database needs and scope available applications	Feb 99	May 99	Database needs analysis
Upgrade database application, transfer data, and use the new application for future data entry	May 99	Dec 99	Database (application and data)

Sub-project 2: Models and Management Applications

Hydrology Models

The FMF hydrology program developed a package that includes GIS tools for watershed basin identification and a calibrated model called WRENS-FMF that predicts changes in annual yield of water for a specified basin (Swanson and Associates 1997a, 1997b; Traynor 1997). Some of the GIS tools have been used to identify basins for the fish/stream inventory program, but in general the FMF products have not been integrated into the Weldwood planning system.

Golder Associates prepared a review of available hydrological models in 1998 and is also conducting a review of the 1998 FMP using available information. Golder Associates made a series of recommendations about hydrological models, planning tools, and monitoring (Golder Associates 1998a). They recommended that Weldwood select a series of hydrological models, calibrate them, and use them to identify a series of response curves that could be used for general operational planning, plus be available for more detailed basin modelling where needed (eg Solomon Creek basin). Golder Associates

developed a preliminary set of response curves for 10 basins using WRENSS-FMF and Golder expertise for use in the FMP evaluation project (Golder Associates 1998b).

In 1999 we propose to review the recommended models, decide which models provide the best options (cost/benefit), and finalize the hydrology modelling approach. We will then proceed to acquire the models and have them calibrated. Revised response curves will be developed and incorporated into the Weldwood Compartment Operating Plan process in either late 1999 or early 2000. The set of calibrated models will also provide the capability for detailed hydrological modelling on an as-needed basis.

The reliability of the hydrology models needs to be improved over time by collecting additional monitoring data and using it to re-calibrate the models (Golder Associates recommendations). Monitoring data collected for this purpose will also assist with documentation of basin changes and understanding of cause/effect, which helps to evaluate the predictive performance of the models. In 1999/2000, after the model suite is selected, we propose to scope the kind of data needed to improve the models, and to develop a long-term plan for collecting additional data to re-calibrate the models. The data collection program will be integrated into the monitoring program (see below) and implemented in 2000 or later.

Management Interpretations

Golder Associates described three management endpoints that were of interest in a hydrological modelling program: fish habitat, stream geomorphology, and infrastructure. Preliminary work has been done on each of the endpoints (e.g. a peak flow component of WRENSFMF that can be used for culvert size design). In 1999 we plan to identify key aspects of the management endpoints and design a long-term work program to develop relationships between variables and endpoints. Work to develop management relationships will be started in 2000.

We will also begin to develop a process to use the preliminary response curves in the Compartment Operating Plan process in 1999.

Sub-project 2: Models and management applications, 1999 work plan.

Activity	Start	Complete	Deliverable
Model assessment and selection	Apr 99	Jul 99	Assessment report
Acquire and calibrate models	Jul 99	Dec 99	Calibrated models
Modelling program framework	Oct 99	Dec 99	Strategic direction report

Sub-project 3: Monitoring

There is a need for long-term monitoring of aquatic/watershed indicators to demonstrate that planning and management is effective. There are two main related tasks. First, select appropriate indicators, which are likely to be combinations of management activity indicators and state indicators. Some indicators may be measured at large scales and others within a series of representative watershed basins. Second, set up a monitoring program consisting of periodic re-measurement of the indicators on monitoring sites.

Indicators

The process of defining aquatic/watershed indicators is well underway. Preliminary indicators have been developed through the FMF Local Indicators project (Dempster 1998), Weldwood, and the pilot monitoring program started in 1998 (Johnson 1998). Golder Associates provided additional indicator recommendations in their hydrologic resource issues review (Golder Associates 1998a). The FMF Biomonitoring project is also working to define and describe aquatic/watershed indicators. In 1999 we propose to decide upon a final set of indicators as a result of the above processes, and to provide a definition and measurement protocol for each selected indicator. We may also start the process of providing a current situation assessment for some indicators using available information, but the main

part of this component will begin in 2000. Most of this work is associated with the FMF indicators program.

Monitoring

A pilot fish monitoring program was started in 1998 as part of the 1998 fish/stream program on front range watersheds of Solomon Creek, Moon Creek, McKenzie Creek, Eunice Creek, Wampus Creek, and Deerlick Creek (Johnson 1998). In 1999 we will complete a preliminary analysis of all FMA watershed basins and select a representative sample of basins for a long-term monitoring program. We will also prepare a long-term monitoring framework and plan. For field work, we propose to extend the fish monitoring program to additional basins representing Upper Foothills and Lower Foothills watersheds. As new indicators are developed, a monitoring program for them will be designed and implemented, on the same basins selected for the fish monitoring project. Some of this work may occur in 1999, but the main program will probably begin in 2000.

We stress again that Weldwood is prepared to pay a fair share of the costs of a comprehensive monitoring program for aquatic ecosystem/watershed resource values. After an appropriate indicator set is defined, Weldwood will develop, at a minimum, objectives and a monitoring program for indicators that relate directly to company activities and responsibilities. However, it would be more appropriate to cooperate with government and other users to address on a more comprehensive basis the cumulative effects of human activities on aquatic/watershed resource values. Through the partnerships established for this program, Weldwood will initiate and participate in discussions toward a cost-shared cooperative program with shared indicators, objectives, strategies, and monitoring.

Sub-project 3: Monitoring, 1999 work plan.

Activity	Start	Complete	Deliverable
Finalize indicators, including rationale for links to management	Jan 99	Jun 99	Indicator list
Indicator measurement protocol	Jan 99	Sep 99	Indicator protocols
Basin delineation and classification	Apr 99	Dec 99	Updated basin map
Basin selection (add to program started in 1998)	Apr 99	May 99	Monitoring basin list
Monitoring program design and long-term work plan	Apr 99	Dec 99	Program design and work plan
Implement 1999 monitoring program	May 99	Oct 99	Field program
Annual report	Oct 99	Dec 99	Report

Sub-project 4: Research

Research is needed to evaluate the effects of specific practices and cumulative effects of forest management on selected aspects of aquatic ecosystems and watersheds, and to evaluate practices designed to improve the integration of terrestrial and aquatic systems management. In 1999 we propose to identify issues, and develop research proposals with specific research questions. We will also start the process of developing research partnerships. Research projects will be implemented in future years, pending the development and confirmation of cost-shared research partnerships.

Sub-project 4: Research, 1999 work plan

Activity	Start	Complete	Deliverable
Research needs analysis and strategy	Feb 99	Dec 99	Research strategy

Budget

Funding sources, 1999 program

Weldwood (FRIP)	\$250,000
Foothills Model Forest (FMF)	\$75,000
Alberta Conservation Association (ACA)	\$40,000
Total	\$365,000

Anticipated 1999 costs by sub-project and funding source

Sub-project	FRIP	FMF	ACA	Total
Inventory and Classification	\$110,000	\$35,000	0	\$145,000
Models and Management Interpretations	\$100,000	\$5,000	0	\$105,000
Monitoring	\$40,000	\$35,000	\$40,000	\$115,000
Research	0	0	0	0
Total	\$250,000	\$75,000	\$40,000	\$365,000

1999 payment schedule for FRIP component

Sub-project	Mar 31	Jun 30	Sep 30	Dec 31
Inventory and Classification	\$27,500	\$27,500	\$27,500	\$27,500
Models and Management Interpretations	\$25,000	\$25,000	\$25,000	\$25,000
Monitoring	\$10,000	\$10,000	\$10,000	\$10,000
Research	0	0	0	0
Total	\$62,500	\$62,500	\$62,500	\$62,500

Contract 1: Foothills Model Forest (FRIP portion only)

Inventory, classification, indicators, and monitoring	1999
Wages, 1 biologist for 12 months	\$48,000
Wages, 2 seasonal staff for 14 months	\$40,000
Equipment, electrofishing and field equipment rental	\$15,000
Equipment, fish fence rental	\$10,000
Equipment, vehicle and ATV rental	\$13,000
Equipment, helicopter rental	\$5,000
Supplies and expenses	\$5,000
Administration, office costs	\$4,000
Administration, GIS and consulting fees	\$10,000
Total	\$150,000

Note: The total FRIP budget allocated for this contract is fixed, but the breakdown figures above are estimates. The amount allocated for seasonal staff may be increased by half (3 seasonal staff) if we decide not to rent fish fence equipment for 1999 field work (we may be able to borrow a fish fence from the ACA). The decision will be made by May 1999 and a revised budget will be submitted if appropriate. The Foothills Model Forest will prepare a more detailed work plan, which will be provided with one of the quarterly reports.

Contract 2: (to be determined) (FRIP portion only)

Models and Management Interpretations	1999
Contractor	\$100,000
Total	\$100,000

Note: A detailed project proposal will be prepared and submitted for this component before it commences. The maximum amount of the contract will be \$100,000.00.

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