SPATIALLY CONSTRAINED FOREST PLANNING TO AID INTEGRATED RESOURCE MANAGEMENT

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INTRODUCTION

In 1991, a 3-year contribution agreement was signed between the Canadian Forest Service (then Forestry Canada) and the University of British Columbia under the Economics and Social Analysis Program of FRDA II. The funded project, titled "Spatially constrained forest planning to aid integrated resource management" was focussed on developing a computer-based harvest scheduling model capable of handling explicit spatial constraints such as adjacency and green-up rules. The resulting model, called **ATLAS** (A Tactical Landscape Analysis System), is now operational and has been used on a number of projects of assess the economic impacts of timber harvesting constraints associated with integrated resource management.

OVERVIEW

ATLAS is a simulation model which allows the examination of short- and long-term effects of spatial harvesting restrictions and silviculture treatments. **ATLAS** enables the examination of forests on a block-by-block basis rather than by the traditional, aspatial timber-strata approach. By treating the forest as a patchwork of discrete units rather than as an amalgam of large, broadly-defined forest types, the spatial resolution of each unit is maintained throughout the planning horizon. **ATLAS** reports timber volumes harvested, areas harvested, a complete history of treatments for each polygon, road network activity and delivered wood costs. Polygon attributes, treatment schedules and road network activity can be quickly displayed in graphical mode.

The landbase is categorized by a hierarchy of 3 area-based units: 1) access units, 2) zones, and 3) polygons. All except polygons are subdividable. Other broad data categories are resource emphasis rules, and stand groups. These data categories are defined in the **ATLAS** user manual which constitutes the bulk of this report.

ATLAS harvests all polygons within a zone, goes to the next zone until all zones within this access unit are harvested, at which point harvests move to the next access unit, and the process is repeated. Polygons are harvested until: 1) all timber over the minimum harvest age is liquidated, 2) a harvest flow constraint becomes binding, or 3) some other constraint such as adjacency or forest cover requirements becomes binding. **ATLAS** checks each block for age limits, AAC targets, and resource emphasis rules before the block is actually harvested.

ATLAS has been designed to handle large forest planning problems. Theoretically, there are no limits on the number of access units, zones, polygons, resource emphasis rules, and stand groups.

However, solution times will be slow with extremely large data sets. Data sets with 500-1500 polygons give good results in terms of detail and solution times. When **ATLAS** was run with a 14,000 polygon data set, solution time was approximately 10 minutes.

The length of the planning period and number of periods in the planning horizon are flexible. This allows the user to define problems ranging from detailed annual plans up to multiple rotation plans covering several hundred years.

MAJOR ACCOMPLISHMENTS

The **ATLAS** Model

ATLAS has been through several revisions, and it is now an excellent tool for analyzing complex forest planning problems. The graphical displays provide a fast and effective method for checking input data and viewing results. Execution times have improved dramatically over the past year, allowing analysis of very large planning problems. The modular design of **ATLAS** provides maximum flexibility for future modifications and interfacing with other models (e.g. habitat suitability, hydrology, etc.).

Completed Projects

Three main projects were completed during the last 3 years using **ATLAS**. These projects required spatial modelling in order to capture the economic impacts of existing and proposed timber harvesting constraints in British Columbia. These projects are summarized below:

1. Cost of Coastal Timber Harvesting Regulations. This study modelled 5 harvesting guidelines on 2 study sites: 1) the Tsitika Valley, and 2) Hardwick Island. Impacts on timber supply, road network activity, delivered wood costs, and conversion returns were measured over the short- and long-term.

2. Spatial Analysis of Timber Harvesting Guidelines in the Revelstoke TSA. In a cooperative research initiative with the B.C. Forest Service, a spatial timber supply analysis was done for the entire Revelstoke TSA. This culminated in an **ATLAS** model with 14,000 harvest units, 18,000 road links, and 4 harvest scenarios projected over a 120 year planning horizon. Timber supply, road network

activity, and delivered wood costs were forecast under different harvest constraints, such as adjacency/green-up, wildlife cover, and visual restrictions.

3. Cost and Timber Supply Impact Assessment of the Coastal Biodiversity Guidelines. Proposed coastal biodiversity guidelines were modelled on 3 coastal forests: 1) the Tsitika Valley, 2) Hardwick Island, and 3) the Nahmint drainage. Four beginning inventories were replicated for each site in order to capture a range of short-term impacts. Permanent, replacement, and selection connectors were also modelled for each site. Impacts on timber supply and delivered wood costs were then measured for each scenario.

Current Projects

Development and testing of **ATLAS** continues. The following are some current initiatives:

1. Investigation of the suitability of simulated annealing and genetic algorithms for spatially constrained forest planning is being done. Preliminary results are very promising, and it is expected these algorithms will improve initial solutions generated by the simulation model.

2. Modules to calculate landscape statistics (e.g. edge/interior forest rations, etc.) are being added as reporting modules to **ATLAS**. These indicators will provide additional information about the effectiveness of forest management practices for habitat and ecosystem health. These indicators will provide an understanding of how well existing harvest constraints achieve their intended objectives, and if necessary, offer a method to develop more effective constraints.

3. Modules are being developed to monitor road deactivation and reconstruction. These factors can form a significant component of delivered wood costs, especially where constraints disperse the harvest across the landscape. Also related to dispersed harvests is the amount of roaded area within the forest. Harvest constraints may be designed to create suitable habitat. However, human access to this habitat may be detrimental to wildlife populations.

4. Within the Revelstoke TSA, zoning options are being tested to determine the impacts of single versus multiple land use. This is an attempt to quantify the economic and environmental impacts of concentrating the timber harvest within certain zones of the forest (single use) against the practice of dispersing the harvest throughout the entire forest (multiple use). Initial work on this project suggests that there are both economic and environmental benefits to single use forestry.

5. The Revelstoke TSA is also being analyzed to determine the appropriate size for sustained yield units. Compartments are being aggregated into sustained yield units, and the resulting harvest levels, forest structure, roaded areas, delivered wood costs, and access implications for wildlife and forest operations are being investigated.

6. Multiple criteria decision methods are being explored as a way to prioritize the harvest queue, so that multiple objectives can be satisfied at every iteration in the scheduling process.

AVAILABILITY

ATLAS is sold for a fee of $10 (payable to the University of British Columbia), which covers distribution costs. Source code is also available upon request for those wishing to modify the program. Comments and suggestions on how **ATLAS** can be improved would be appreciated. See the user manual for contacts and addresses.

A 486 DOS machine with 4 MB of RAM, 5 MB of hard disk space, and a mouse is recommended.

APPENDIX

ATLAS: A TACTICAL LANDSCAPE ANALYSIS SYSTEM

Version 1.2 User Manual

developed
by

J.D. Nelson
Mark Hafer
Tim Shannon
David Gizowski

January 31, 1994

ATLAS is sold for a fee of $10 (payable to the University of B.C.), which covers our distribution costs. Source code is also available upon request for those wishing to modify the program. We would appreciate your comments and suggestions on how ATLAS can be improved. A 486 DOS machine with 4 MB of RAM, 5 MB of hard disk space, and a mouse are recommended. Short courses on the use of ATLAS may be arranged upon request.

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CHAPTER 1: SYSTEM OVERVIEW

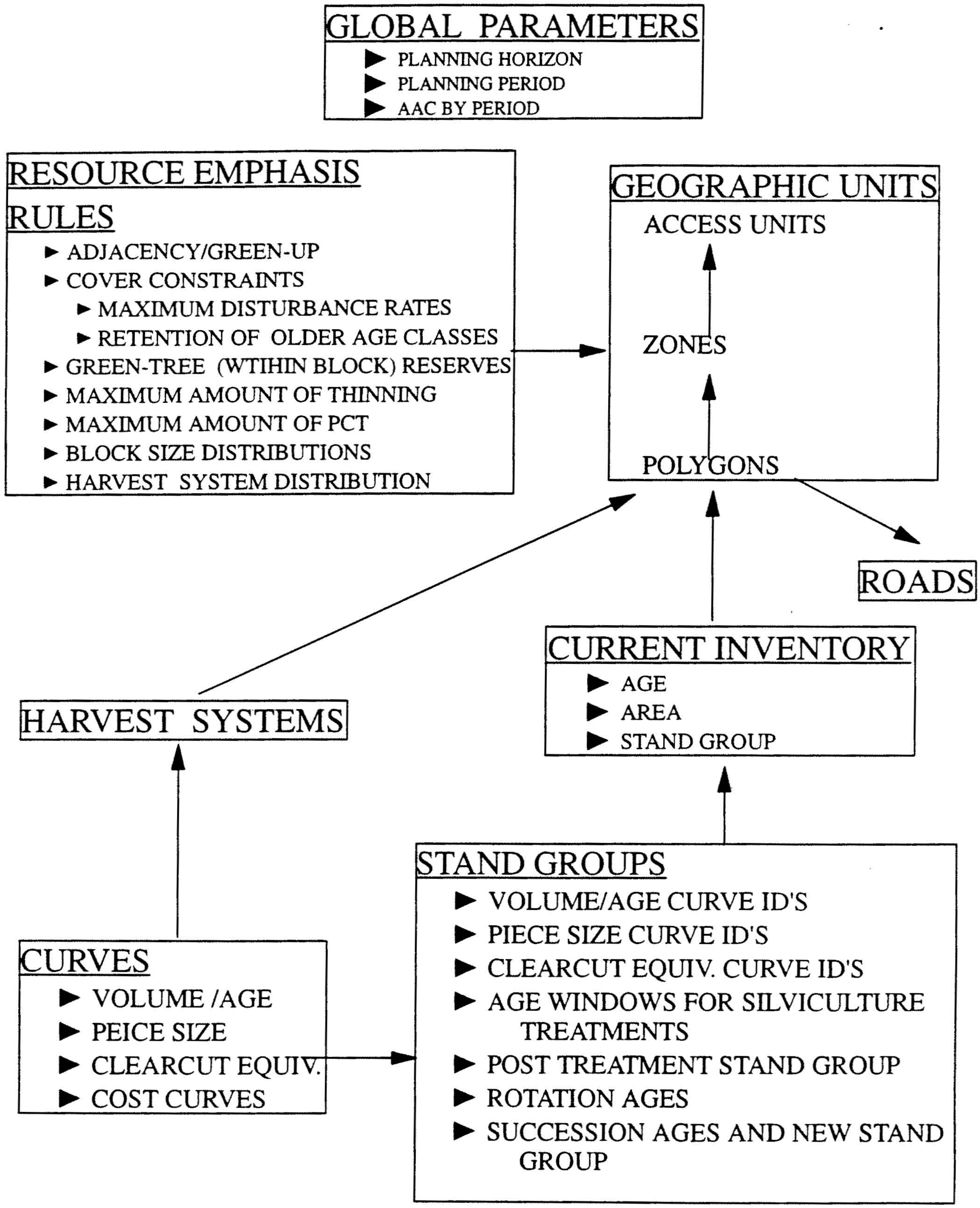
ATLAS (A Tactical Landscape Analysis System) is a simulation model which allows you to examine the short- and long-term effects of spatial harvesting restrictions and silviculture treatments. ATLAS enables you to examine forests on a block-by-block basis rather than by the traditional, aspatial timber-strata approach. By treating the forest as a patchwork of discrete units rather than as an amalgam of large, broadly-defined forest types, the spatial resolution of each unit is maintained throughout the planning horizon. ATLAS reports timber volumes harvested, areas harvested, a complete history of treatments for each polygon, road network activity and delivered wood costs. Polygon attributes, treatment schedules and road network activity can be quickly displayed in graphical mode

The landbase is categorized by a hierarchy of 3 area-based units. These are: 1) access units, 2) zones, and 3) polygons (cut blocks or harvest units). Access Units are large geographic areas, such as entire drainages or sub-drainages. Zones are sub units of the drainage which share common resource management objectives. For example, a visual quality area, or a riparian area would be classed a zone. Individual polygons or harvest units belong to a zone. A Polygon is the smallest area-based element, and it cannot be subdivided. Polygon boundaries are established by forest engineers during the total resource planning process. They are not created by the ATLAS program. Harvest priorities and rules can be placed on all three of these geographic levels.

In addition to these spatial categories, there are two other broad data categories used in ATLAS. First, a set of Resource Emphasis Rules is used to define how harvesting will be constrained within the zones. The resource emphasis rules describe things like adjacency rules, green-up periods, and age-class constraints. Each zone has a resource emphasis rule that describes how harvests will be regulated. A resource emphasis rule can (and usually does) apply to more than 1 zone. For example, a resource emphasis rule can be made for partial retention VQO's, and this rule would apply to all VQO zones in the forest. Second, stand growth, rotation ages, silvicultural treatments, and post treatment yield curves are defined in the Stand Groups. Each polygon must be assigned to a stand group in order to model its stand dynamics through time.

Global harvesting parameters define the project being analyzed, the planning period, the planning horizon, and the annual harvest targets. Many other attributes of the above categories are included in ATLAS, and these will be described in subsequent sections. If desired, a road network that links the polygons can also be defined.
Figure 1 summarizes the basic ATLAS structure.

FIGURE 1. ATLAS OVERVIEW



Within ATLAS, the user defines the harvest priorities for access units, zones, and polygons. As a default rule, the minimum distance to the mill is used, meaning that polygons closest to the mill are harvested before distant polygons. This order can be altered by harvest priorities. The order in which polygons are harvested is as follows:

1. begin with the first ranked access unit
2. within this access unit, start with the first ranked zone, and
3. within this zone, begin with the first ranked polygon.

ATLAS harvests all polygons within a zone, goes to the next zone until all zones within this access unit are harvested, at which point harvests move to the next access unit, and the process is repeated. Polygons are harvested until: 1) all timber over the minimum harvest age is liquidated, 2) a harvest flow constraint becomes binding, or 3) some other constraint such as adjacency or forest cover requirements becomes binding. An option does exist to use a random order for harvesting polygons within the zones. ATLAS checks each block for age limits, AAC targets, and resource emphasis rules before the block is actually harvested.

ATLAS has been designed to handle large forest planning problems. Theoretically, there are no limits on the number of access units, zones, polygons, resource emphasis rules, and stand groups. However, solution times will be slow with extremely large data sets. We have found that data sets with 500-1500 polygons give good results in terms of detail and solution times. When ATLAS was run with a 14,000 polygon data set, solution time, was approximately 10 minutes.

The length of the planning period and the number of periods in the planning horizon is flexible. This allows the user to define problems ranging from detailed annual plans up to multiple rotation plans covering several hundred years.

This remainder of this manual is organized as follows. Chapter 2 describes how to install ATLAS on your computer. Chapter 3 presents an overview of the menu system and a description of the input data files. Chapter 4 describes the procedures needed to make different simulation runs by altering the input files and control parameters. Chapter 5 provides some guidelines for creating your own data sets.

For users of ATLAS V1.1 the basic changes in V1.2 are: 1) a faster scheduling module, 2) a faster road module, 3) new reporting modules, and 4) modified display module, and 5) removal of the network builder routines and the network files n1.lib and road.lib.

CHAPTER 2: INSTALLING ATLAS ON YOUR COMPUTER

A 486 DOS machine with 4 MB of RAM, 5 MB of hard disk space, and a mouse are recommended. ATLAS will run on 386 machines, but solution times are slow. You will need a main directory called ATLAS and two sub-directories, one for the input data files, and one for the solution files. For clarity, it is useful to name the data and results sub-directories after the project in question; for instance, hard and hardres respectively, for the Hardwick Island project. The basic directory structure is:

C:\ATLAS (executable files) (copy atlasv12.exe to this directory)
\hard\ (data input files) (copy hard.exe to this directory)
\hardres\ (solution files)

One disks is supplied with self extracting zipped files (atlasv12.exe, and hard.exe). Create this directory structure on your hard disk, and copy the zipped files (*.exe) from the floppy disk to the directories on your hard disk, as shown above. Then unzip the files within each directory by typing the file name and hitting return. A list of the exploded files is presented below. When ATLAS is run, random access files (*.id), schedule files (sched*.dbf), and report files will be created.

Directory	Sub-directory	Sub-directory
ATLAS	harddata	hardres
AT_DATA.EXE	access.dbf	sched*.dbf
ATD.EXE	stnd_grp.dbf	*.rpt
ATLAS.EXE	zone.dbf	*.pcx
AT_BROWSE.EXE	curves.dbf	*.txt
AT_CHECK.EXE	hvsystem.dbf	
BUILDER.EXE	linkclas.dbf	
DBEDIT.EXE	map.dvc	
HARVCOST.EXE	map.vec	
AT_STATS.EXE	polyadj.txt	
PRJPATH.TXT	polygon.dbf	
ROADCOST.EXE	roadlink.dbf	
ROADS.EXE	roads.bin	
SCHEDULE.EXE	Re_rules.dbf	
REPORTS.TXT	control.txt	
ATLAS.PCX	roadlink.txt	
DWC.EXE	distage.txt	
	trancost.txt	

With your files and directories set up as described above, switch to the ATLAS directory. You start the model by typing **ATLAS.**

Increased speed can be achieved by placing the data and results directories in a ram drive. Simply copy the directories up from your hard drive to the ram drive, and modify the batch and project files to recognize the ram drive.

CHAPTER 3: ATLAS MENUS AND DATA FILES

ATLAS initially requests information on the project path (the directory where the input data is stored). The main menu lists the following items:

Project	Data	Schedule	Reports	Roads	Map	Slideshow	Help	Exit

First, an overview of these menu items will be presented, and second, each will be described in detail. All menu items can be accessed with the mouse, or by holding down the ALT key and typing the highlighted letter within the menu title, or by using the arrow keys. F10 will always return you to the main menu. The **Project** defines the project being analyzed and the global harvesting parameters. **Data** accesses the input files for editing, checks validity of the data, builds random access files, and provides general file management. **Schedule** is the main harvest simulation module that forecasts harvest according to global parameters and harvesting constraints. **Reports** is a series of modules that provide different summary reports of the harvest schedule. **Roads** is a module that schedules road network activity (construction and maintenance) once the harvest schedule has been generated by the schedule module. **Map** will bring up a graphic display of the polygons, and when present, the road network. The map module is capable of displaying a number of polygon attributes (age class, zone, stand group, treatment schedule, etc.). The data base files can also be graphically updated using a screen painting technique within the map module. **Slideshow** is a module that can quickly display screen images captured when in the map module. **Help** will be developed into a on-line help system, however, at this time it is not functional. To exit ATLAS, click on the **Exit** menu.

3.1 THE PROJECT MENU

Within the project menu, the following items will appear:

Select New Project
Control Parameters
Flow Control
Exit

Select New Project will bring up a directory tree. To select a new project, double click the mouse on the directory that contains the desired input data files.

Control Parameters will bring up a menu where you specify:

-project name (just a label)
-output directory (path and directory for solution files)
-planning horizon (number of planning periods) Theoretically unlimited, but computationally difficult. We recommend that you examine schedules for at least 1 rotation.
-planning period length (years) This is flexible. You can choose 1-year, 5-years, 10-years or any other value for the period length without altering the other input files. We recommend that the period length be some multiple of the green-up or exclusion period.
-activities
- -Pre-commercial thinning
- -Thinning
- -Rehabilitation (converts NSR land into productive land)
- -Succession (shifts polygons to new stand groups after a certain age is reached, e.g. stand collapse)

To activate any of these activities, you must click on them with the mouse (or use the space bar) until an X appears in the box beside them. The timing and details of each of these activities are defined within the stand groups. At this stage, unless an X is beside an activity, it will be ignored during the harvest simulation. Details of these activities will be explained under the section on stand groups.

Flow control

Set the annual harvest level in cubic metres per year that you wish to be applied to each planning period. ATLAS then converts this annual flow target to match the planning period length. The flow target is an upper bound on the harvest. ATLAS harvests up to this upper bound, at which time no further harvesting will take place in the current planning period. Because of the discrete nature of the harvest polygons (they cannot be split), ATLAS will harvest slightly over the flow target. If there is a timber supply shortage in the current period, ATLAS will harvest all it can, and then advance to the next period. It is the users's responsibility to examine the solution to determine if the harvest target was met in all periods. If you are searching for an even-flow solution throughout the planning horizon, then use a manual binary search approach to find the harvest target that meets this objective.

Placing a **-1** in a field and clicking on the **fill** option will fill all fields with the last real entry. The flow value in the last field specified (eg period 20) will be applied to all subsequent fields (eg 21 - 40+) when long planning horizons are specified by the user.

These control parameters are stored in the file control.txt.

3.2 THE DATA MENU

Clicking on the data menu brings up the following sub-menu:

Reindex
ReFresh Indices
Check Input Data
Browse
Edit
Build Poly Network (no longer necessary)
Zap Indices
Zap Networks
Zap Pictures

For processing speed, ATLAS generates indexed, random access files from the dbase input files. These files can be identified by the extension *.id, and they will be generated every time the dbase input files are modified. The **Reindex** module builds a new set of random access files (for all input *.dbf files) needed for validating input data, scheduling, and map displays. **ReFresh Indices** only updates the random access files for those files that were altered since the last run. **Check Input Data** will bring up a sub-menu that allows the user to check that adjacency relationships are complete and correct, plus it will check the input data files to ensure that polygons, zones, stand groups, etc. are complete and correctly specified.

Browse and **Edit** provide types of file editors. They both access the same files, however, Browse has a dbase editor appearance while Edit has an ascii editor appearance. For files with many fields and few records, such as the RE_Rules file, the Edit mode is preferable to the browse mode. For other files with few fields and many records, such as the Polygon file, the Browse mode is preferable. It is the user's choice as to which editor is used. Clicking on either browse and edit will bring up a menu of 9 dbase files that can be edited. These are described in the next section of the manual.

The **Zap** modules are for file maintenance, and they will erase *.id, and *.pcx files. These modules provide a quick way to free disk space.

3.2.1 DESCRIPTION OF INPUT DATA FILES

Browse and edit can access 9 dbase files which are described below. The Browse mode has rather cryptic field labels which are defined here. The edit mode offers more verbose field headings, and a "comment" window at the bottom of the screen.

Access Units
Zones
Polygons
Polygon Special
Resource Emphasis Rules
Stand Groups
Curves
Harvest Systems
Link Classes
Road Links

3.2.1.1 THE ACCESS UNIT FILE

Access units are large geographic areas, such as a watershed or an entire drainage. The purpose of the access unit is to control harvests within large areas. Harvest priorities, year of first entry, minimum harvest flow, and a number of other constraints can be placed on access units. Access units are also used as a basis for generating harvest reports. Access units are comprised of zones, and their boundaries can be altered through the assignment of zones. <u>When considering access unit boundaries keep in mind that adjacency rules are not recognized across access unit boundaries</u>. Each access unit is specified with a record in the file access.dbf. Each record contains the following fields:

LABEL	alpha-numeric label (user's choice)
ACCESS_ID	the sequential number (id) of the access unit specified as an integer, starting at 1.
FIRSTENTRY	the year of first entry, measured from the start of the planning horizon
MINFLOW	the minimum annual volume flow that must be available before any harvesting will take place (metres/year)
MINSILAREA	the minimum number of hectares of stands that must be available for treatment before any silviculture (pre-commercial thinning, thinning, rehabilitation) will be carried out.
THPRIORITY	Thinning priority relative to final cut/regeneration harvests. In V1.1, this field should only contain an "F".
HVPRIORITY	the harvesting priority of the access unit relative to other access units (lowest numerical value first)
OVPRIORITY	a harvesting priority that will over-ride HVPRIORITY (ie for salvage operations) When this field is set to a value other than the default (-1), the FIRSTENTRY field will be ignored.
OVDURATION	the number of years from the start of the planning horizon for which the over-riding priority will be in effect
SEED_ID	a random number generator seed for randomized harvest schedules. The default value of -1 should not be altered.

The FIRSTENTRY field is typically set to 1 to allow harvesting in the first period of the planning horizon, but may be set to any other value should you wish to defer the harvest for any reason. The MINFLOW field default is 0 m^3, indicating that harvesting can take place in the specified access unit no matter how small a volume is eligible for harvest. You may wish to set this field to a non-zero value, say 5,000 m^3, if, when an access unit has minimal eligible volume, you do not wish to incur infrastructure costs. A similar constraint can be placed on the minimum amount of area that must be available for treatment before any silviculture activities are done (MINSILAREA). Commercial thinnings can be set to precede or follow final regen harvests with the THPRIORITY field (thinning module not operational in V1.1).

The HVPRIORITY field is necessary for assigning the harvesting priority for the access units. Lowest number are harvested before higher numbers. These harvest priorities can be over-ridden by a new set of priorities (OVPRIORITY) for any length of time beginning at time zero (OVDURATION) to cope with special circumstances, such as salvage of threatened or damaged stands.

3.2.1.2 THE ZONE FILE

Zones are geographic units that are contained within the access units, and where specific resource emphasis rules apply. A zone can range in size from only several polygons to several hundred or more polygons. Resource emphasis rules are applied to each zone, so exercise caution when defining very small zones. Zone boundaries are determined through the assignment of individual polygons. The map module offers a screen painting utility that can quickly change zone boundaries by updating the polygon attributes. Each record in zone.dbf refers to a specific geographic zone. Each record contains the fields:

LABEL	alpha-numeric label
ZONE_ID	the number (ID) of the zone. Integer starting at 1
RULE SET_ID	the number (ID) of the resource emphasis rule applicable to this zone
ACCESS_ID	the number of the access unit (ID) to which this zone belongs
DELTAT	the maximum difference in age allowed before two polygons can be aggregated into a larger block. This is for the block builder module which is not fully operational in V1.1.
HVPRIORITY	harvest priority for this zone relative to the other zones. Lowest value first.
OVPRIORITY	an over-riding harvest priority for this zone
OVDURATION	the duration (years from time 0) for which the over-riding priority will be in effect.
OV_RULESET_ID	the resource emphasis rule that will be used during the over-ride duration. When the default value (-1) is used, the value in the RULESET_ID field is applied. Thus you can over ride harvest priorities for the zones without having over riding rule sets.

The OVDURATION field sets the length of time during which the override will be in effect and the OV_RULESET_ID field specifies the number of a rule set in the RE_Rules.dbf file. During the override period, the zone will be harvested according to the rule specified in the overriding rule set field.

3.2.1.3 THE POLYGON FILE

The polygon file lists all polygons in the forest, along with their attributes. It essentially describes the beginning forest inventory (areas, ages, stand groups, etc.) plus additional attributes like the zone it belongs to, the harvest system to be used and its current state. Polygon adjacency relationships are retained in a separate file named polyadj.txt, and need not be modified. This file is produced during data preparation prior to running ATLAS (see Chapter 5). In the file polygon.dbf, each polygon is entered as a separate record, with the following fields:

LABEL	alpha-numeric label
POLY_ID	polygon ID (integer)
ZONE_ID	number of the zone (ID) to which this polygon belongs
STD_GRP_ID	number of the stand group (ID) to which this polygon belongs
AGE	the age of the stand on this polygon (years) at time 0
DISTANCE	distance to the mill. Used for ranking the order in which polygons are harvested. Lowest values first.
AREA	polygon area in hectares
HS_ID	the number of the harvesting system (ID) for this polygon
STATE	WLD for wild (no constraints), EXC for temporarily excluded, RSV for permanently reserved. RSV polygons are included when forest cover constraints are being checked. More states to be added in future versions of ATLAS.
VLINK_ID	a (virtual) linkage to the road network assigned during data preparation. Do not alter.

3.2.1.4 POLYGON SPECIAL

Polygon special is only a viewing option that selects certain fields from different *.dbf files. Its purpose is to view different fields related to the polygons that are not found simultaneously within any one file. You must reindex the files before this option will work. Records for each polygon are shown with the following fields:

ZONE_ID
RULE_SET_ID
ACCESS_ID
AREA
HS_ID

3.2.1.5 THE RESOURCE EMPHASIS RULES FILE

The file RE_rules.dbf contains the harvesting rules that are to be applied to specific zones. These rules describe adjacency/green-up rules, plus 4 forest cover constraints. The cover constraints can be used to control maximum disturbance ages and rates, plus minimum percentages of the zone that must be retained in older age classes. Other constraints applicable are within-block reserves, clearcut equivalency rules, plus limits on the amount of thinning and pre-commercial thinning allowed. The RE_Rules in future versions of ATLAS will also have the ability to aggregate polygons into larger blocks and the ability for harvest system and road class distribution assignments at the zone level. The RE_RULES are applied to <u>each zone, independent of other zones which may share the same RE_RULE.</u> **The edit mode is much preferred to the Browse mode when examining RE_RULES.** Each RE_RULE is entered as a record in the file, with the following fields:

LABEL	alpha-numeric label
RULE_SET_ID	number of the rule set (ID)
MINAACTHN%	minimum % of the AAC coming from thinnings in this zone
MAXAACTHN%	maximum % of the AAC coming from thinnings in this zone
MAXAREAPCT	the maximum area per year (ha) of precommercial thinning that will be allowed in the zone
MAX1AREA	maximum block size for block size category 1. For the block builder module which is not fully operational in V1.1.
MAX2AREA	" block size category 2 "
MAX3AREA	" block size category 3 "
MAX4AREA	" block size category 4 "
MAX5AREA	" block size category 5 "
MAX1PC	maximum percent of zone area in block size category 1
MAX2PC	" category 2
MAX3PC	" category 3
MAX4PC	" category 4
MAX5PC	" category 5
EXCLYEARS	the exclusion period or green-up time in years for this zone. When the leave strip width is set at 1, a polygon will only be harvested when all its adjacent neighbours are at least as old as the exclusion period.

LEAVEWIDTH	the width of the leave strip, expressed as the number of polygons. A value of zero means progressive clearcutting. A value of 1 is the standard adjacency problem. At this time, ATLAS is not able to model leave strip widths greater than 1.
CLASS_ID	the road class for all roads in this zone. In most cases each road link is assigned a road class, and this field is ignored. The purpose of this field is to allow for the ability to quickly examine the economic impacts of potential regulations affecting road construction standards. Not fully operational in V1.1.
HS_OVRRIDE	In most cases each polygon is assigned a harvest system, however, this field allows the user to over-ride these assignments,in which case a distribution of logging systems can be assigned to the zone. The purpose here is again for rapid policy analysis of potential regulations affecting harvesting system use. Not fully operational in V1.1.
HS1_ID	the number (ID) of harvest system 1
HS2_ID	" system 2
HS3_ID	" system 3
HS4_ID	" system 4
HS5_ID	" system 5
HS6_ID	" system 6
HS1_PC	percent of zone harvest assigned to harvest system 1
HS2_PC	" system 2
HS3_PC	" system 3
HS4_PC	" system 4
HS5_PC	" system 5
HS6_PC	" system 6
THNCOST_ID	cost curve ID for thinning in this zone. Not fully operational in V1.1.
RSVAREA%	the percent of area set aside for within block reserves, such as new forestry and green-tree retention. This percentage is applied to each polygon within the zone, and adjusts the vol/ha at harvest accordingly.

MAXDISTAGE	the maximum disturbance age, which refers to the age at which a polygon is still considered disturbed. Typically this is the green-up or exclusion age. At or below the green-up age, the area is considered disturbed. Stands older than the green-up age would not be considered "disturbed". Note that ATLAS treats any stand as disturbed when its age is less than or equal to the maximum disturbance age (not just less than). Therefore if the MAXDISTAGE is 20-years, and the planning period is 10-years, harvesting will occur every 30-years, not every 20-years. If you want to harvest every 20-years (2 periods), then set MAXDISTAGE = 19-years.
MAXDISTPC	the maximum percentage of the zone area that can be in a disturbed state (under green-up). For unconstrained scenarios (harvest everything), we recommend setting MAXDISTPC=100.1 to ensure every polygon is cut.
MINMATAGE	the minimum "mature" age. The minimum age at which a stand is considered to be in mature class 1.
MAXMATAGE1	the maximum age at which a stand is still considered to be in mature class 1
MAXMATAGE2	the maximum age at which a stand is still considered to be in mature class 2
MAXMATAGE3	the maximum age at which a stand is still considered to be in mature age class 3
MINMATPC1	the minimum percentage of area that must be constantly maintained in mature class 1
MINMATPC2	the minimum percentage of area that must constantly be maintained in mature class 2
MINMATPC3	the minimum percentage of area that must constantly be maintained in mature class 3
CCEQUIVPC	the (total) clear cut equivalency percent allowed for the zone. This allows the advanced user to reduce the impact of clear cuts as young stands age. A clear cut equivalency curve ID can be defined in the Stand Group file, and entered in the curve file. This option is primarily for hydrological modelling. The default value of 100% should be used by all others.

3.2.1.6 THE STAND GROUP FILE

The stand group file defines and describes how stands will grow and be treated over time, eg. stand dynamics. Silviculture treatments, minimum harvest ages, plus transfer rules from one stand group to another are specified here. The stand groups identify yield curves that are to be used for various silvicultural treatments. Yields curves, such as volume/age curves are specified in the curves file. Every polygon is assigned to a stand group which determines its stand dynamics. A polygon may only belong to one stand group. The map module has a screen painting utility that can quickly modify stand group assignments. Each record in the std_grp.dbf file specifies a stand group, with the following fields as attributes:

LABEL	alpha-numeric label
STD_GRP_ID	number of the stand group (ID) ..integer
VOLUME_ID	number (ID) of the volume age curve in curves.dbf
PIECESIZ_ID	number (ID) of the piece size curve (relative to age) in curves.dbf. Not considered in harvest constraints.
CCEQUIV_ID	number (ID) of the clearcut equivalency curve in curves.dbf
USERAGE_ID	number (ID) of the user defined curve (relative to stand age) in curves.dbf. Not considered in harvest constraints.
USERPSZ_ID	number (ID) of the user defined curve (relative to pieces size, as defined by the piece size curve) in curves.dbf. Not considered in harvest constraints.
PCTCOST	the cost per hectare of pre-commercial thinning
PCTMINAGE	minimum stand age (years) for pre-commercial thinning
PCTMAXAGE	maximum stand age (years) for pre-commercial thinning
PCTNWSGID	new stand group following pre-commercial thinning. The default value of -1 means no change in the stand group.
THNCOST	commercial thinning cost per hectare
THNMINAGE	minimum stand age (years) for commercial thinning
THNMAXAGE	maximum stand age (years) for commercial thinning
THNNEWSGID	new stand group following commercial thinning. A value of -1 means no change in the stand group.
FCRCOST	cost per hectare for regeneration following the final (clear) cut
FCRMINAGE	minimum stand age (years) for the final (clear) cut. Use this to set minimum rotation ages.
FCRNEWSGID	new stand group following the final clear cut.
REHCOST	rehabilitation (convert NSR land) cost per hectare

REHMINAGE	minimum age of stand (years) for rehabilitation
REHMAXAGE	maximum age of stand (years) for rehabilitation
REHNEWSGID	new stand group following rehabilitation. -1 means no change in stand group.
RETIREAGE	retirement age (years) of the stand. This is when the stand collapses and can no longer be considered part of its original stand group.
SCCNEWSGID	successional new stand group. The stand group that we transfer to after the retirement age (collapse).

FCRMINAGE specifies the minimum age (years) at which the stands are harvested (Final Cut and Regeneration). The FCRNEWSG_ID (Final Cut Regeneration - NEW Stand_Group_ID) field allows you to enter a different stand group number which will take effect after the final harvest of the existing stand. This can be used when there is a species conversion or managed stand yields are used following the final harvest.

Stands can also be transferred to a new stand group following pre-commercial thinning, commercial thinning, and rehabilitation. Note that the commercial thinning options are not operational in V1.1.

The RETIREAGE and SCCNEWSG_ID fields work in concert to cope with stands that may collapse after a period of time. The retireage function is primarily intended for use in analysis of certain eastern forests which demonstrate this phenomenon. As a British Columbia example, though, you may want to set the retireage function to 200 years for lodgepole pine stands. The SCCNEWSG_ID field comes into effect when the stand collapses, thereby transferring the stand to a new stand group. The new stand group must be specified in the stnd_grp.dbf file, complete with volume, piece size, etc. curves in the file curves.dbf. In the case of collapsed stands, a new volume curve would typically start with a positive volume at age zero.

3.2.1.7 THE CURVES FILE

This file plays a very important role in the model because many parameters can be entered as curves. Primarily, the file contains volume curves, piece size information, and harvesting system costs. In addition, you may store information for your own user-defined curves such as crown canopy over age or piece size over age etc. Each curve is entered as a record in curves.dbf, with the following fields:

LABEL	alpha-numeric curve label
CURVE_ID	number (ID) for this curve (integer starting at 1)
DELTAX	the increment for points on the X axis (dependent axis) of the curve. For age dependent curves, DELTAX would be specified in years, for piece size dependent curves, such as a cost curve, DELTAX would be in cubic metres.
X_01	first X coordinate on the curve (equal to DELTAX). Note: the X and Y origins of the curves (X_0, Y_0) are always 0.
Y_01	first Y coordinate on the curve (at X_01). Note: any Y value for an X value less than X_01 is 0.
Y_02	second Y coordinate on the curve (at X_02, which would be twice DELTAX)
...	**Note: a value of -1 in any field will force the value in the preceding field to be applied to all subsequent fields.** This option is useful for quickly altering curves, or curves that have only a few coordinates.
...	
Y_30	thirtieth Y coordinate on the curve (at X_30, which would be 30 times DELTAX). The value in Y_30 will be used for any calculations beyond this value (eg Y_31....Y_50).

ATLAS will use linear interpolation to find Y values at points between the Y coordinates specified in the curve. Thus planning period length, etc. can be changed without altering the curve file. **All curve data are integer values.** You can always change units (multiple by 10) if you need finer resolution for your curves.

If piece size relationships are not available, then just enter a "1" in the first field, followed by a "-1" in the next field. This will produce a flat piece size curve at 1 cubic metre. Harvest cost curves can then be entered in a similar manner. For example if the tree-to-truck cost is \$50/metre^3, then enter 50 in the first field followed by a -1 in the next field. This produces a flat curve at \$50/metre^3. The combination of these two curves will then give a constant tree-to-truck cost of \$50 for every cubic metre harvested by this logging system, regardless of the stand age at harvest. When tree-to-truck costs are calculated, the polygon's harvest system and stand group define the cost and piece size curves, respectively.

3.2.1.8 THE HARVEST SYSTEM FILE

The harvest system file, hvsystem.dbf, defines the harvest systems used for tree-to-truck logging costs in the reporting modules. Harvest systems are specified for each polygon in the polygon.dbf file. The harvest system file identifies a cost curve for tree-to-truck costs that is based on piece size. Therefore a piece size curve must exist. The piece size curve would be identified in the stand group file, and exist in the curves file. Up to <u>six</u> harvest systems can be entered. The fields are:

LABEL	alpha-numeric label for the harvest system
HS_ID	number (ID) of the harvest system (integer starting at 1)
COSTCRV_ID	cost curve ID. this curve must exist in curves.dbf **<u>Note that this cost curve is based on piece size, and therefore a piece size curve must also exist.</u>**

3.2.1.9 THE ROAD LINK CLASS FILE

Up to <u>six</u> road classes can be specified in the road link class file (linkclas.dbf). Each road link in the road network must be assigned to a road class. Road classes are used in tracking construction and maintenance costs. Each road class is entered as a record, which has the following fields:

CLASS_ID	the number (ID) for this road class (integer starting at 1)
CONST_COST	construction cost per linear metre
MAINT_COST	maintenance cost per linear metre

3.2.1.10 THE ROAD LINKS FILE

The road link file (roadlink.dbf) identifies and describes all road links contained in the road network. Each link is entered as a record, with the following fields:

LABEL	alpha-numeric label for the road link
LINK_ID	number (ID) of the road link (integer starting at 1)
LENGTH	length of the link (metres)
CLASS_ID	the road class for this link (see linkclas.dbf)
ZONE_ID	the zone in which this link is found (optional)
BUILT	a YES/NO field indicating whether or not the link is built at time 0.

The predecessor link information needed for road network connectivity is contained in the file roadlnk.txt, and should not be altered by the inexperienced user. This file is created during the data preparation stage at UBC (see chapter 5).

3.3 THE SCHEDULING MENU

Clicking on the scheduling menu will cause the simulation module to run. First, if any input files have been recently edited, they will be re-indexed (*.id). At this point, the scheduling module begins by displaying the period, harvest target, and the harvest achieved. Periodic harvests are reported for each access unit. As described earlier, the harvest priority begins with access units, then zones within the access unit, and finally polygons within the zones. This priority is usually based on the minimum distance to the mill, however, these priorities can be altered by the user. **Note that you can interrupt the schedule module by simultaneously hitting the <ctrl> and break keys.**

For advanced users, there is an option to randomize the order in which the blocks are harvested within the zone. In this option, the queue of eligible polygons within the zones is randomly shuffled, allowing the user to examine different solutions. Access unit and zone priorities are not affected by this randomizing process. Refer to chapter 4 for more details on this option.

ATLAS harvests all eligible polygons until one or more constraints become binding. The model then ages the timber inventory by the number of years which constitute a period, and moves on to the harvest for the next period, and so on through the entire planning horizon.

The results of the schedule module are stored in a series of files in the results directory you specified in the control parameters. For each period in the planning horizon, a dBase file is produced. This file is named sched*.dbf where the "*" represents the number of the appropriate period, e.g files sched1.dbf through sched12.dbf for a 12 period simulation. The sched*.dbf files list all polygons and indicated their attributes. The file includes fields which show the polygons current age, stand group, state, treatment, within block reserved %, volume harvested, piece size, userage value, and userpiece size value. **Note: the reserved% is not printed correctly in V1.2. Volume deductions are correctly made within ATLAS, but this reserved% is not written to the sched*.dbf files.** The detailed solution files provide a complete history of treatments and attributes for each polygon. These solution files can then be used by other programs or modules to independently analyse and interpret different forest values, such as economics, wildlife habitat, and biodiversity.

3.4 THE ROAD MENU

The road module reads the output of the schedule module (sched1.dbf, sched2.dbf, etc.) and "builds" the necessary road segments for each harvested block. First, a schedule is prepared for each road link. This information is written to an ascii file called link.txt, that places a 1 or 0 in each link for each planning period, depending on whether or not the link was used during that period. Second, the road module writes a summary report of the total number of kilometres of active road, and the total number of constructed roads, plus the associated costs. This information is stored by road class and by period in a file called roads.dbf.

The second menu item, road costs, will access the report module to prepare an ascii file (roads.txt) that summaries the total kilometres and costs for all construction and maintenance by period.

ATLAS prototype modules are available (upon request) that tract deactivation and re-construction costs for the road network.

3.5 THE REPORT MENU

The report menu access two sub-menus: 1) schedule reports, and 2) other reports. The schedule reports will access the solution files from the schedule module (sched*.dbf) and from the road module (roads.dbf). Clicking on "Other Reports" will access an additional report module that offers choices for:

Harvest Summary Report
Logging Cost Report
Road Cost Report
Delivered Wood Cost Report
Areas Treated Report
Polygon Summary Report.

These options will produce short reports in ascii file format that can be readily imported in spreadsheets for presentation as graphs and tables. All report files are written to the results directory. When the reports are run, output is also written to a screen window. To view these windows, click in the window, and then use the green highlighted markers to expand/contract, move or exit the window.

The Harvest Summary report produces a listing of the total area and total volume harvested by period. This is similar to the output produced on the screen by the simulation module. Results are written to the file **harvstat.rpt**

The Logging Cost report produces a summary of the harvest by logging system, for each access unit. Tree-to-truck costs ($/cubic metre) are calculated for each period as a weighted average of the logging systems. Results are written to the file **hvreport.txt**

The Road Cost report lists the length of roads open and constructed during each period, plus the total costs of construction and maintenance. Results are written in the file **roads.txt**.

The Delivered Wood Cost report combines tree-to-truck, hauling and road costs to produce a total delivered wood cost report. The file **trancost.txt** is used to sepecify overhead costs and the hauling cost for each zone. Results of the delivered wood costs are written to the file **dwc.txt**

The Areas Treated report produces periodic age class distributions (age classes in 20-year groups) by access unit, and a summary of total areas cut over the planning horizon by zone. Results are contained in the file **area.rpt**. Note that the delivered wood cost report requires the areas treated report be run first in order to determine the volume harvested in each zone.

The Polygon Summary report summaries the polygon inventory at time 0, by age class, zone, stand group, and polygon state. It also lists the total number of polygons plus the minimum, maximum and average size. Results are found in the file **polygon.rpt**.

In the "other reports" menu an edit option exists to allow you to run multiple reports in batch mode. Any field in the file reports.txt with a yes will be run when the report module is run in batch mode (refer to tips for advanced users in chapter 4).

3.6 THE MAP MENU

This option will provide a graphical display of the polygons, roads, and the harvest schedule. You must run the schedule module to generate sched*.dbf files prior to clicking on the map module. Note that a mouse is required for the graphics. To obtain instructions for the graphical interface, click on the help menu found in the upper right hand corner of the graphics screen. On the left side of the screen are a series of buttons for zooming, panning, displaying roads, etc. Click on these button with the left mouse to activate them (they will then darken). Use the right mouse or the esc key to exit the button. Color legends are located on the right side of the screen. Across the top of the screen are a series of menu options for displaying different themes, modifying data files, road display options, legends, and the size of the paint brush used for painting polygons and updating files. Brief instructions are written at the bottom of the screen.

3.7 THE SLIDESHOW MENU

Images captured during the map display (saved as *.pcx files) can be viewed in the slideshow module. This is a convenient way to quickly observe solutions or attributes without loading the map module. The *.pcx files can also be imported into other graphic software packages (Windows, Freelance, Corell Draw, etc.) for modification and printing.

CHAPTER 4: MODIFYING FILES TO GENERATE HARVEST SCENARIOS

4.1 THE BASIC STEPS IN MAKING A RUN

The basic steps in making any ATLAS run are:

1. Set project control parameters:
   - -directories
   - -planning period length
   - -planning horizon
   - -treatment activities

2. Set the AAC target. Remember this is an annual harvest. ATLAS will make the necessary AAC adjustments for period length. Multiplying the mai at harvest age times the total number of hectares provides a good starting guess for even-flow solutions.

3. Edit data files to set up the run. Usually this means assigning RE-Rules to the zones and/or modifications to the stand groups, and/or modification for reserve status in the polygon file.

4. Re-index the files to generate indexed, random access files (*.id).

5. Select the schedule module to simulate the harvest. You can interrupt the schedule module by simultaneously hitting the <ctrl> and break keys.

6. Select the report modules for summary and cost reports on the harvest.

7. Optional. If desired, select the road module to analyse road network activity.

8. Select the map module to view the solution. If you are not satisfied with the solution, return to step 1 or step 3. Note that you can display and alter many polygon attributes within the map module. To display attributes, select the themes menu at the top of the screen. It may be necessary to reset the screen (R button) when viewing different attributes. To alter attributes, use the data menu at the top of the screen.

4.2 CHANGING HARVEST CONSTRAINTS (RESOURCE EMPHASIS RULES)

You can change adjacency, green-up, and cover constraints with the RE_rules. From experience, our advice is to produce a comprehensive list of resource emphasis rules. Once assembled, these rules can then be quickly assigned to the zones to evaluate timber supply impacts. A sample set of RE_Rules similar to the ones provided in the data set (RE_Rules.dbf) are shown in the table below. In the zone file, simply enter the RE_RULE_ID that you wish to be applied to each zone. This method is the fastest and safest, since the polygon file does not need to be altered.

You will probably have to search for new harvest flow levels every time a new set of RE_Rules are used. Use a binary search approach to finding the new even-flow harvest.

SAMPLE RESOURCE EMPHASIS RULES FOR THE REVELSTOKE TSA

RE_RULE	LABEL	DESCRIPTION
1	UNCONSTRAINED	no constraints
2	BASIC TIMBER	adjacency and 20-year green-up, maximum disturbance rate - 40%, disturbance age - 20-years, retain 30% of area in height class 2 (40-years or older).
Note: All subsequent RE_RULES are incremental to the BASIC TIMBER rule.		
3	WILDLIFE CLASS 1	retain 60% in height class 3 (stands 80-years or older)
4	WILDLIFE CLASS 2	retain 40% in height class 3
5	WILDLIFE CLASS 3	retain 52% in height class 3
6	MODIFICATION VQO	maximum disturbance rate of 25% . Green-up age 40-years.
7	MOD. VQO plus WILDLIFE 1	maximum disturbance rate - 25%, green-up - 40-years, plus retain 60% in height class 3
8	MOD. VQO plus WILDLIFE 2	maximum disturbance rate - 25%, green-up - 40-years, plus retain 40% in height class 3
9	MOD. VQO plus WILDLIFE 3	maximum disturbance rate - 25%, green-up - 40-years, plus retain 52% in height class 3
10	PARTIAL RETENTION VQO	maximum disturbance rate of 10%, green-up - 40-years
11	PARTIAL RETENTION VQO plus WILDLIFE 1	maximum disturbance rate of 10%, green-up - 40-years, plus 60% retained in height class 3

12	PARTIAL RETENTION VQO plus WILDLIFE 2	maximum disturbance rate of 10%, green-up=40-years, plus 40% retained in height class 3
13	PARTIAL RETENTION VQO plus WILDLIFE 3	maximum disturbance rate of 10%, green-up=40-years, plus 52% retained in height class 3
14	RETENTION VQO	NO LOGGING

4.3 RESERVING POLYGONS FROM HARVEST

There are a number of ways to reserve polygons from harvest. First, you can reserve them on a block-by-block basis using the RSV state in the polygon file. Use the screen painting utility in the map module for this. This is a convenient way to set aside permanent reserves.

Second, you can assign blocks to a zone, and then use a no logging RE_rule for this zone. The easiest way to create a "no harvest" RE_Rule is to set the maximum disturbance percent to zero.

Third, you can assign the blocks to a stand group where the minimum harvest age (FCRMINAGE) is very high, eg. 999-years. This is a fast way to examine various reserve options, since you only need to change FCRMINAGE to turn the reserve polygons on and off.

Finally, you can also "turn off" entire access units by setting the first entry year to a very high value (eg. 999). This is a useful technique for analyzing subsets of large data sets, without having to modify the original data.

4.4 SILVICULTURAL TREATMENTS

Silviculture treatments like pre-commercial thinning, thinning, rehabilitation, and succession can be specified in the stand group file. Here you can specify the age windows during which treatments are feasible, plus transfer rules to new stand groups following treatment. New yield curves need to be referenced here, and appended to the curve file. Also note that you need to activate these activities in the control parameters found under the project menu. In addition, you can specify minimum and maximum treatment areas in the access and RE_Rule files. Please note that the commercial thinning module is not operational in V1.2.

4.5 HARVEST SYSTEMS

Harvest systems are defined for each polygon, so the easiest way to alter harvest system assignments is through the screen painting utility in the map module. This will update the polygon.dbf file. Harvest systems, along with a cost curve ID are defined in the file hvsystems.dbf. Cost curves are specified in the curves.dbf file, and they are dependent on the piece size curve specified in the stand group that is assigned to the polygon.

4.6 ROADS

Road classes along with construction and maintenance costs are specified in the linkclas.dbf file. Specific information about each link in the road network is contained in the roadlink.dbf file. The road class and built fields in this latter file can be modified with the screen painting utility found in the map module.

4.7 PARTIAL CUTTING SCENARIOS

Partial cutting (uneven-aged management) is not explicitly defined in ATLAS V1.1, however, these scenarios can be modelled using a few tricks. You need to define two new stand groups, and two new yield curves. Your first stand group will be used to make one cut on the existing stand, and the second will control all subsequent cuts. The yield curves need to be modified so that they contain <u>only the volume available for harvest</u>. If you propose to remove 30% of the stand every 25 years, then the yield curve will only show 30% of the total volume on the site. The minimum rotation age would then be set to 25 years in the new stand group. For the existing stands, leave the minimum harvest age high (so you don't cut 25-year old plantations), but use only 30% of the total volume in the yield curve. Following the first cut, these stands then transfer to the new stand group. It is possible to run the polygons though several stand groups if you wish to model a more complex conversion from even to uneven-aged management.

When modelling uneven-aged management, you will probably want to modify the RE_Rules to turn off adjacency and a few other cover constraints.

4.8 TIPS AND TRICKS FOR THE ADVANCED USER

Sometimes the adjacency rules (RE_Rules) that apply to every polygon within a zone are too rigid, and because the zone is relatively small, further subdivisions are not reasonable. In this case, you can modify the adjacency file (polyadj.txt) to treat certain blocks differently. For example, polygons on opposite sides of a river may not be adjacent, but you don't want them harvested at the same time. Edit the polyadj.txt file and make them adjacent. You can also do the reverse, and make neighbouring polygons "un-adjacent" (larger blocks).

In other cases, there may be several small, geographically isolated zones that share a common RE_rule. Applying the RE-rule to each zone may be overly restrictive in terms of cover constraints. In this case, it is possible to place each of the geographically isolated zones into a single zone. Just be careful of the access unit boundaries, since adjacency rules do not apply along these boundaries.

Floating corridors that require extended green-up periods and long rotations can be scheduled by using stand groups and zone over-ride rules. This is quite a complex procedure, requiring double wide corridors. Call us for more information.

For large, repetitive jobs, it is possible to run ATLAS in batch mode. Any module can be run in batch by typing the executable name followed by space /b. For example, to run the schedule module in batch, type schedule /b. To run a series of executable in batch, write a dos batch files to run the desired modules. For example, to run the schedule, roads, and report modules, your batch file should contain the following commands:

```
schedule /b
roads /b
reports /b
```

In batch mode, ATLAS gets the basic run parameters from the files projpath.txt, control.txt and reports.txt. Running in batch mode can be a great time saver for the analyst, however, it also requires a high degree of system expertise.

In addition, there is a set of data base tools that allow you to quickly alter the input data. The program AT_TOOLS.EXE can be run outside the ATLAS shell, and it does the following:

- -bump the zone id...Useful for making a large data set out of several smaller data sets
- -bump the stand group id...Useful for making a large data set out of several smaller data sets
- -adding/deleting/modifying adjacency relationships in the file polyadj.txt....Useful for selection harvest where adjacency is not important, or adding adjacency

relationships across rivers
-trim the map.vec file to exclude polygons not in the polygon.dbf file. Useful for making a smaller data set out of a large data set.
-trim road links to exclude road links not in the file roadlink.dbf. Useful for making smaller data sets from a large data set.

4.8 New Modules not Released

We are constantly working on new reporting modules that examine different indicators of the state of the forest. As these become refined, they will be incorporated into new releases of ATLAS. At this time we have test versions that report on road deactivation and re-construction, amount of area that is accessible by active roads, and the percent of area in edge (as opposed to primal forest). These modules can be obtained upon request.

CHAPTER 5: CREATING YOUR OWN DATA SET

Creating your own data set involves some specialized data processing, especially in terms of the graphical displays. You should contact us as soon as possible should you wish to set up the model for your local area. The fundamental starting point is a total resource plan of your forest. This must identify the polygon boundaries, and the polygon attributes identified in the file polygon.dbf If roads are to be considered, the links in the road network must also be identified, along with the attributes in the file roadlink.dbf.

Data sets can be in the form of paper maps showing polygons and roads, or in digital form produced by a GIS. Graphic line work from a GIS needs to be provided to us in a DXF format. Other polygon attributes should be presented in dbf or ascii format. Other than these minimal file format requirements, ATLAS is designed to be independent of commercial software packages (including GIS's). Paper maps will be digitized at UBC and adjacency relationships (polyadj.txt) derived from this. If your data set is in digital format, you should provide us with adjacency relationships, from which we will produce the polyadj.txt file.

Some general guidelines are:

-avoid large polygons. Design polygons for the smallest harvest unit you anticipate. Units can be aggregated, but they cannot be split.

-avoid long, thin polygons around creeks. Split them into smaller units.

-add lots of small polygons around the riparian zones. They can be reserved, or if appropriate, the can be designated as selection harvest blocks. Small units provide this flexibility, whereas large units do not.

-weed the digital data. We only need enough polygon points to draw the polygon shape (5-15 points).

-each road link needs a predecessor, and each polygon should list the last road link(s) needed to access it.

<u>We will be happy to answer any queries regarding how to set up the data set for your total resource plan so that it is compatible with ATLAS.</u>