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Guide to MAGIS eXpress
(Draft)

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Sullivan Janet; Jones, J. G.; Krueger, Kurt.; Zuuring, H. 2005. A guide to the MAGIS eXpress application. Gen. Tech. Rep., RMRS-000. Ft. Collins, CO; U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. __ p.

Presents a guide to the operation of MAGIS eXpress, a spatial decision support system.This program spatially schedules treatments and road activities for small landscapes to design vegetation management projects. MAGIS eXpress is designed to install and run on personal computers with Windows™ operating system(s). Guide includes user instructions for individual data entry forms, explanation of error messages, and a discussion on data preparation, model building and solving strategies.

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KEYWORDS: project planning, economic analysis, resource economics, forest economics, ecosystem management, GIS, MAGIS, timber sale planning, vegetation management, treatment scheduling, access, road networks, roads, transportation planning, optimization, simulation

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Research Summary

MAGIS eXpress is a microcomputer-based spatial decision support system (SDSS) that enables forest managers to schedule management activities and operational and resource constraints, including the economic consequences of those activities. A MAGIS eXpress solution consists of a schedule of treatments in time and space and the various results of those treatments (costs, revenues, and timber and biomass volume). Solutions can be viewed in GIS or presented in tabular form. MAGIS eXpress allows for spatial considerations in the decision-making process and provides several ways to view and process solutions, either internally or by way of ArcGIS. MAGIS eXpress is a highly flexible tactical/operational planning tool for solving a variety of natural resource management problems. With MAGIS eXpress, vegetation management and road activities can be planned on a temporal and geographic basis.

There are two different applications in the MAGIS family: MAGIS, and MAGIS eXpress. MAGIS eXpress is a streamlined version of MAGIS with its emphasis on vegetation management and road-access. It uses numerous pre-defined variables to simplify the model-building process and has an internal heuristic solver. In comparison, MAGIS has a wider range of flexibility in defining management issues, including various resource effects (non-timber outputs) from treatment units and roads, and uses a more powerful commercial solver.

Data that define the timber management planning problem are added to the model through a series of GIS and other data input screens. ArcInfo GIS coverages and/or shapefiles can be used. Through a comprehensive setup procedure, with several 'wizards' for streamlining the process, a planning model is formulated, a mathematical programming matrix is generated and a schedule of land management and network treatments is computed (or the user is informed of an infeasibility.)

MAGIS eXpress schedules land management and road activities on both a geographic and temporal basis. The focus is on tactical or operational-level planning conducted by an interdisciplinary team. The planning horizon includes five periods of length defined by the user (years, a set number of years, or decades.)

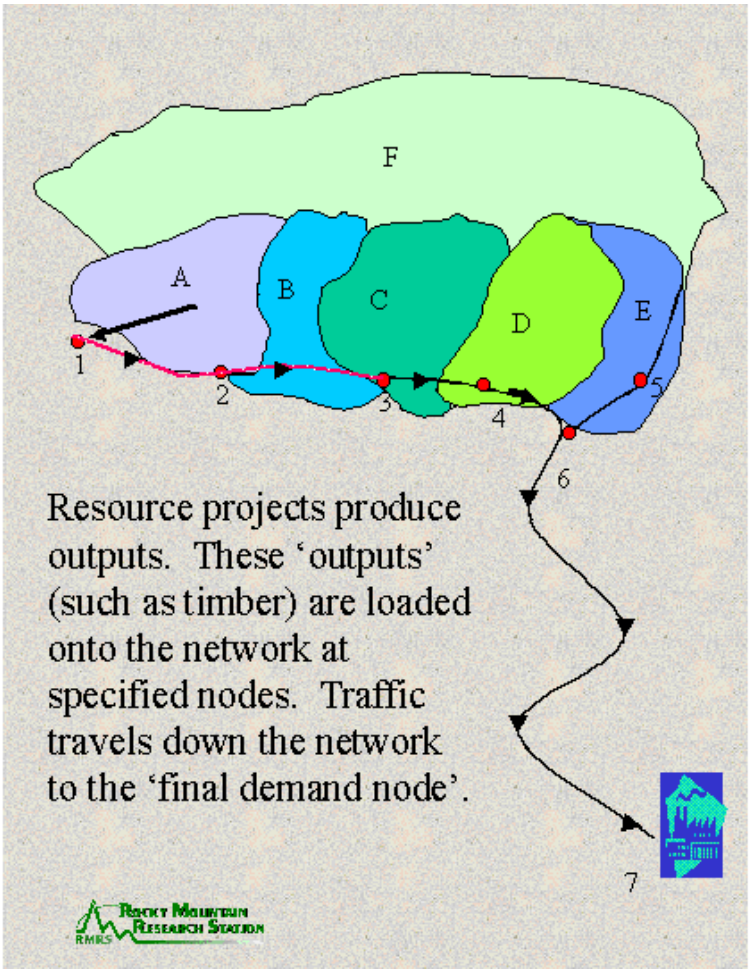
This user's guide provides general direction and detailed, step-by-step instructions for the construction of a MAGIS eXpress model. First, we present an overview of the modeling system menus and requirements for data. Next, each of the menus and data-entry screens accessed via those menus are discussed. Where appropriate, the significance and use of specific data items are identified.

Overview

MAGIS eXpress is a modeling system, and thus can be used to model any geographic area; the user selects an area to be modeled and develops the model assumptions for outputs, costs, revenue calculations, and treatments. The scope of the data that defines outcomes is user-dependent. The user assembles the necessary GIS data and runs a GIS Import Wizard which checks the data and converts it into MAGIS eXpress data.

There are two main spatial components to a MAGIS eXpress model: a *treatment unit* coverage and a *network* coverage. Management Activities on the treatment units may produce timber or create changes to the vegetation or both. Timber products are loaded on to the network at 'loading nodes' and travel down the network until reaching an 'exit' node (this can be the mill site, or represent a link to a mill). This is illustrated in Exhibit 1.

Exhibit 1. Hypothetical Display of Treatment Unit Polygons and Links with an Exit Node



For each treatment unit, management regimes (schedules of activity costs) are assigned as OPTIONS that MAGIS can choose from. Activities designated as timber harvest have one or more logging methods, each of which can have a different set of loading nodes. For example, treatment unit A might have an option to commercial thin via tractor, and load onto the network at node 1. It might also have the option for a group selection via helicopter, and load onto the network at node 3. Thus, a single treatment unit can have one ('no action' is always an option) to many options, depending on the judgment of the management team as to the suitability of management regimes and loading nodes.

Each road segment is assigned one-to-many options called 'road projects'. Road projects include permanent or temporary construction and reconstruction (by road type), closing and reopening (by period), and road decommissioning. Traffic (i.e., logging trucks) originates with a resource project and is routed through the road network to a user-defined 'exit' (final demand or mill) node.

Vegetation change over time is based on vegetative states and pathways that link them. Timber stand growth rates are linked to specific states. All timber products are defined by the user and harvest volumes are calculated as a user-defined percentage of the standing volume, related to specific management activities. Activity costs are defined on either a per unit area basis or a total cost by treatment polygon, or as a value generated from a lookup table.

A MAGIS eXpress planning model consists of defining a planning framework and applying this to a project area. The 'planning framework' includes the activity costs, management regimes, vegetative states and pathways, road types, construction and re-construction options, and fixed road

costs. Spatial data in the form of GIS coverages or shapefiles are to be developed by the user. These data are a polygon coverage (or shapefile), which represents the treatment units, and a road network coverage (or shapefile). The polygon coverage (shapefile) needs to be attributed with vegetation information (dominant species, structure class and density) and any physical or cost characteristics required for user-defined parameters. The road network coverage needs to include any proposed roads and a few specific attributes (the status of a given link as existing or proposed, the length of the link, and the user-defined road option). There is provision for additional information that might be used in the planning model, such as the management history and management zones for treatment. Management options can be assigned using an internal utility, manually, or a combination of the two.

Once a planning model is built, MAGIS eXpress determines the combination and timing of management regimes and road activities that optimize the selected objective (minimum cost or maximum PNV). If desired, the user can select some or all of the management options and instruct MAGIS eXpress to calculate the resulting values in a *simulation* mode. MAGIS eXpress calculates the amount of each output including timber harvest; the flow of traffic to demand nodes (in terms of timber capacity); and totals costs and revenues.

Management objectives and constraints are formulated as Effects Functions. Effects Functions are the mathematical relationships that control decision variables. Examples of these relationships include the volume of timber harvested in period one, or number of acres of old growth in period five, or the present net value (calculated for the entire planning horizon and discounted). There is always a time component associated with each relationship.

In MAGIS eXpress, the user chooses either to maximize present Net Revenue, or minimize Total Costs (both over all 5 periods, discounted). A planning scenario designates one of these choices as the objective function (the overall management goal). Constraints can be imposed using the other Effects Functions. For example, one could maximize total revenue, but limit the number of acres of regeneration harvest activity, or the volume of sawtimber in each period. MAGIS eXpress selects a management option for each treatment unit and link based on its impact on the objective function and effect on the constraints. The user has the option to select some management options instead of having MAGIS eXpress select all of them (this procedure is called “setting decision variables”). Selecting all of the options is equivalent to running the planning model as a simulation.

There are four types of Effects Functions: output, acreage control, activity cost, and net revenue. Output functions calculate the amount of timber harvest volume by product in units defined by the user. Acreage control relations tabulate the area having a specific characteristic such as successional stage or receiving a specific management regime (i.e. acres of prescription burning.) Cost functions compute activity costs and can be discounted (real rates of change). Net revenue functions can include revenues from timber and costs, and may also be discounted.

MAGIS eXpress solutions consist of the schedule of resource projects, the schedule of road projects, and routing of traffic through the network, and can be presented as tabular reports of the values for the Effects Functions and the selected management regimes, or can be viewed graphically in an ESRI™ ArcMap environment.

MAGIS eXpress Directory Structure

But first, a word about the DIRECTORY structure and a little terminology for MAGIS eXpress. MAGIS eXpress is a modeling SYSTEM. The user builds a MODEL, which consists of data stored in numerous databases (as free tables). A MAGIS eXpress model can be stored as a compressed zip file, so that a different model can be worked on, or to share the model with another user. From here on, the folder will be referred to this way: *dbf* , and the file or file type is indicated by its extension: dbf

MAGIS eXpress is installed with the following folders:

magis_x
dbf
    main
    reports
    temp
    zip

For the user, it is really only important to keep TWO folders straight: *dbf* and *zip*. MAGIS eXpress works from the databases in the *dbf* . The first time you start up MAGIS eXpress, the *dbf* folder is empty. You can, at this point, start a new, blank model, or open the tutorial model (or another model). Each of those choices depends on models that are saved or stored in the *zip* folder. A zip file is a compressed file containing all the tables and text files that represent a given set of data, and is referred to in this manual as a MAGIS eXpress planning model. As work proceeds in model building and the files in the */dbf* are modified through the actions of the user, all changes and changes saved using Apply buttons, are saved in the *dbf*. The corresponding zip file in the *zip* is NOT automatically updated. The user is responsible to perform the SAVE operation, or create a NEW zip file if desired.

The other folders, *main*, *reports*, and *temp* are used by the application, and should not be modified by the user.

MAGIS eXpress Menu

The menu for MAGIS eXpress consists of the following main items: File, Model Specifications, Build Model, Scenarios, and Help. The assembly of data into the planning model occurs in the Model Specifications menu, and then the planning model is analyzed from the Scenarios menu. File contains general 'housekeeping' functions, and Help is (hopefully) what it says.

File Menu

New - Create a new blank planning model for MAGIS eXpress in the *dbf* folder. Any current planning model in the *dbf* folder will NOT be saved automatically (the user needs to do that first, before creating a new model.)

Open - Choose a previously saved 'zipped' planning model in the *zip* to unzip into the *dbf* . This option opens a form listing the models that are stored in the *zip* . Click on the desired file (it should be highlighted), then select Restore. The current planning model in the *dbf* folder is NOT automatically saved.

Save - Save the current model in the *dbf* to the *zip* using the existing model name. This procedure uses pkzip25™, to collect all the files in the *dbf* and save them as a single compressed zip file in the *zip*. This procedure overwrites the previous file of that name in the *zip*.

Save As – Both Save and Save As create a zip file of the data associated with the current planning model. This form uses a common Windows dialog box to collect the desired name and location. It is important that this file be saved into the *zip* of MAGIS eXpress. Anywhere else, and MAGIS eXpress will not recognize it as a MAGIS model file. The procedure for creating the zip file runs in DOS mode and may take a few seconds to a few minutes to execute. The zip file appears

on the list of files when Save is selected and when unzipped the name of the zip file becomes the current model name (displayed in the title bar of the main MAGIS eXpress window.)

Delete - Select the zip file in the *zip* to be deleted. This removes the selected planning model (zip file) from the *zip* . Once Delete is invoked that version of the planning model is no longer available. This has no effect on the current model in the *dbf*, even if it is the same model name-but this does mean that the current model in *dbf* is no longer saved in the *zip* directory. If you want to save the current model, you will have to perform the Save or Save As function.

Copy - Copy a zipped planning model in the *zip* to a new name. This will NOT copy the current model in the /*dbf* (if a copy of the current model in *dbf* is desired, it should be 'saved' then use this function to copy the saved file. Select a Previously Saved Model from the list by clicking on it, and then click the Copy button. Enter a new name in the popup form and click 'Save'. If the name of an existing zip file is entered (including the selected name), MAGIS eXpress will ask whether to overwrite it. Click OK to continue, or Cancel to enter a different name.

Exit Exits MAGIS eXpress. The data associated with the planning current model is preserved in the *dbf* when MAGIS eXpress is shut down and will be the active model the next time MAGIS eXpress is launched. However, a model in *dbf* is NOT automatically saved in the *zip* upon exiting MAGIS eXpress.

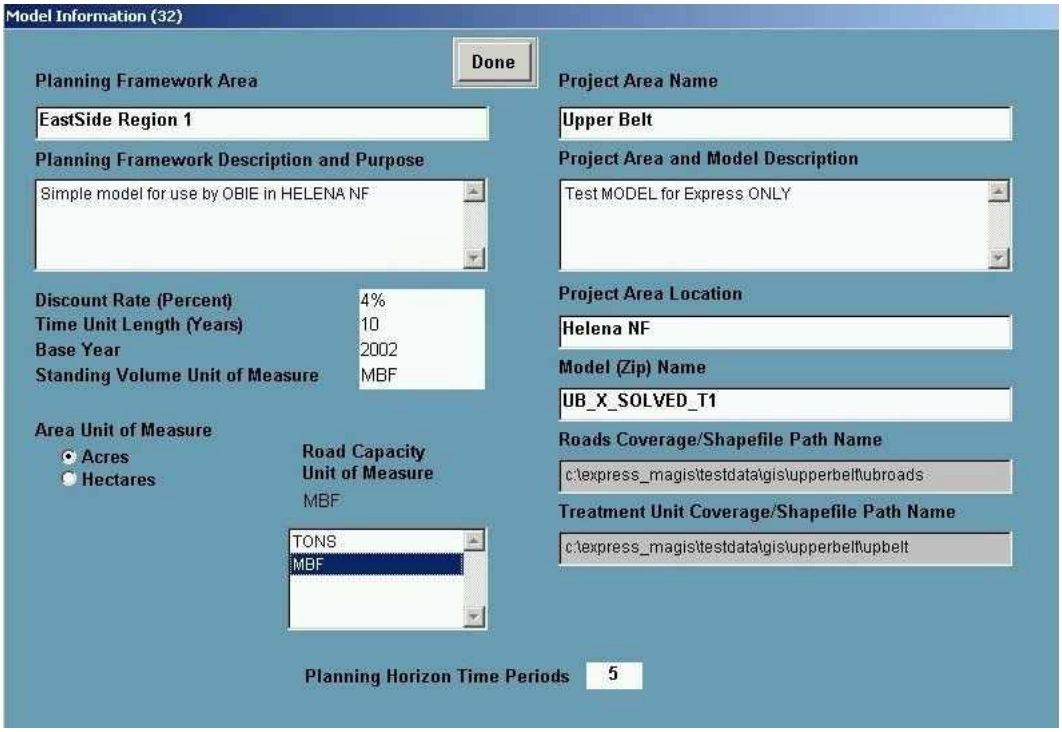
Model Specifications

All data are entered using the Model Specifications Menu. The Model Information form allows the user to enter basic definitions and keep track of the modeling effort. The other data entry work can be broadly separated into four main task areas. Background information, definitions, defaults, and basic relationships are entered as the Planning Framework. Management Regimes are defined as schedules of activities, and have rules by which they can be assigned as options to treatment units. The Planning Framework and Management Regimes data can potentially be used for other modeling projects in the same general geographic region (using the same vegetative pathways, activity costs and so on). The Project Area consists of the GIS data that are imported into MAGIS eXpress, plus the assignment of management options (for both treatment units and roads). Effects Functions are the mathematical relationships that compute quantities, revenues, and costs in the model, and can be partitioned by geographic 'zone' (for example, one Effects Function could be defined as the total harvest volume in management compartment 1 in period 1). Effects functions are used to constrain solutions.

Model Information

The Model Information form is displayed in Exhibit 2. This form is used to specify general information about the planning model, and is useful for defining the model context and geographic boundaries. It includes basic parameters for calculating economic effects, methods for determining growth and yield, and the source of the data sets used to populate the Project Area.

Exhibit 2. Model Information form.



Done - Click to exit the form; changes are saved automatically.

Planning Framework Area - Record the name for the general geographic area; this is usually the largest area for which the Planning Framework data are applicable (this field is required).

Planning Framework Description and Purpose - Description of general framework and purpose (this field is optional).

Discount Rate - Enter a value representing the percent (i.e., enter "4" for a 4% discount rate) with a maximum of two digits. This rate is applied to all costs and prices for the planning periods defined in the Effects Functions (cost and revenue Effects Functions can include one or more periods.) For discounting, activities are assumed to occur in the mid-year of the period.

Generally, Forest Service project planning and economic analysis should use a 4% discount rate. This field is required. Enter 0 if discount rate is not to be used.

Time Unit Length (years) -– Enter the number of years per time period. There are up to five planning periods in the planning horizon. (This field is required.)

Base Year - Enter the four-digit year used as the basis for discounting (usually the current year.) This also serves as the starting year for the planning horizon (i.e., "2004"). So, if the base year is 2004 and the time periods are 10 years long, the first time period is equivalent to the years 2004 to 2013 inclusive, the second period runs from 2014 to 2023 and so on. For discounting, activities are assumed to occur in the mid-year of the periods. (This field is required and is defaulted to the current year.)

Standing Volume Unit of Measure – Enter a short codename (maximum 8 characters) for the unit of measure that describes the standing (timber) volume. This unit of measure forms the basis for conversion factors for other timber products that use a different unit of measure. For example,

you could define standing volume in hundred-cubic-feet (CCF) and have a product called 'pulp' that is measured in tons. When you define the pulp product, you will need to enter a conversion factor that will allow MAGIS eXpress to calculate yield in tons from a starting volume in CCF.

Area Unit of Measure - Click the radio button for the desired area unit of measure (Acres/Hectares). This defines the common measurement unit for the entire planning model and is displayed in the reports.

Road Capacity Unit of Measure - Timber products that are loaded onto the road network become units of 'traffic' for the purpose of accounting haul (traffic) costs. Traffic units are defined in relationship to timber product units of measure. Various choices (based on already defined timber products) for this unit are displayed in the drop down list, from which one can be selected. If you don't see an appropriate name, go to the timber products screen and enter a new timber product with the appropriate unit of measure. See also the discussion above for Standing Volume unit of measure.

Planning Horizon Time Periods – Select the number of Time Periods (1 to 5) to define the modeling time frame.

Project Area Name – This is the immediate project area name.

Project Area and Model Description - The area description for the model (optional)

Project Area Location – Project Area location (for example, a ranger district or national forest name) (optional)

Model (Zip) Name – Displays the name assigned to the last zip file saved to the *zip* (not editable). This field is updated when Save or Save As is selected from the File menu and the model is saved as a zip file.

Roads Coverage/Shapefile Path Name – Displays the GIS road coverage name (not editable). It is blank for a new model, and is filled in after a successful import of the GIS data (Project Area menu).

Treatment Unit Coverage/Shapefile Path Name – Display of GIS treatment unit coverage or shapefile name (not editable). It is blank for a new model and is filled in after a successful import of the GIS data (Project Area menu).

Planning Framework Menu

The Planning Framework menu is for entering background information for the model. Once the Planning Framework data are complete, the project area data can be imported and edited. Planning Framework data can be used for more than one project area (GIS data set) if desired. The Planning Framework menu includes Attribute Names, Resource Information, and Network Information. The Resource Information submenu includes Activity Costs, Import Pathways, Define/Edit States, Growth Rates, Timber Products, and Harvest Specifications and Mortality. The Network Information submenu includes Road Option definitions and Traffic definitions. Definitions and relationships specified for the Planning Framework determine what GIS data are needed. If, for example, an Activity Cost uses a table lookup, the attributes needed for the table lookup are entered

in the Attribute Names screen first, then used to define the Activity Cost, and finally, when the GIS data are imported, that particular attribute will be required in the GIS data.

Attribute Names

Non-spatial GIS attributes are categorized as Attributes and Zones in MAGIS eXpress. Attributes are any type of non-spatial information used to determine costs or values such as standing volume. Attributes come in two flavors: discrete categories and numeric (continuous) values. For example, the attribute ASPECT might have the discrete classes: N, NE, E, SE, S, SW, W, NW (or, simply WET, DRY, and MESIC.) Discrete classes can also be numerals, but they will be treated as characters rather than numbers, and the data type for the corresponding field associated with a GIS map layer should also be character (string). Some attributes are continuous values (like slope or elevation). If such an attribute is to be used in a table lookup for costs, the values must be subdivided into classes. A continuous numeric attribute such as SLOPE could be divided into several classes (for example, 0-15, 16-25, 26-40, and >40.) In this case, the GIS data type can be numeric, and the value of the attribute for a particular treatment unit can be ANY number; MAGIS eXpress will automatically treat that treatment unit as a member of the appropriate attribute class.

Zones are non-spatial information that are used to assign treatment options or partition Effects Function values. A Zone can be any geographically delimited area such as watersheds, management compartments, ownership, or they can be a designated priority attribute of the treatment unit (like 'bug problem'). For example, the user may wish to delimit particular treatment units as part of a certain watershed. The user would create the Zone Name 'WATERSHD', then assign discrete classes named for particular watersheds (i.e., ROCKCRK is a discrete class of WATERSHD which can be treated as a zone for any treatment unit polygon, or link in the Project Area.)

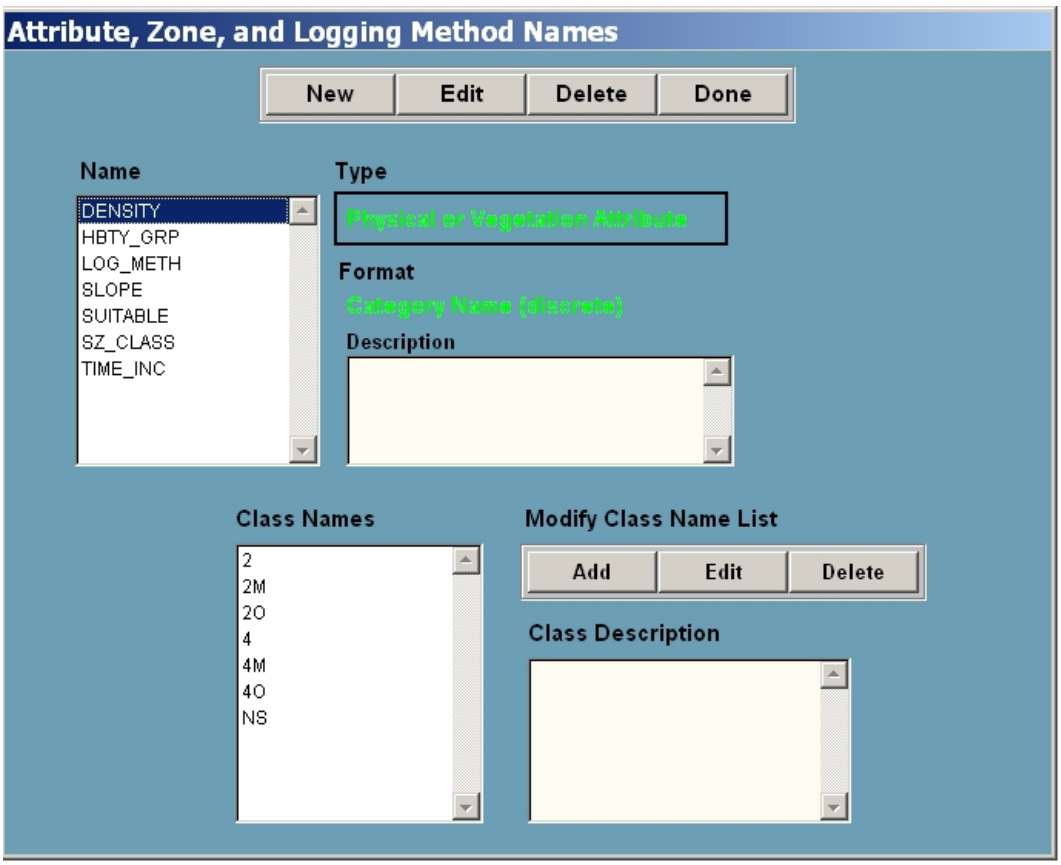
Both attribute and zone names are limited to eight characters. Non-spatial GIS attributes can be added during the GIS import and do not have to be pre-defined. Use the optional description field to clarify or 'decode' your eight-character names.

Logging Methods or Logging Systems or Yarding methods ('LOG_METH' in the names list) are also edited here. MAGIS eXpress comes with a default list of two: 'TRACTOR' and 'HELI' for tractor (any ground-based system) and helicopter (any aerial based system) respectively. Additional logging methods can be added.

Once an attribute or zone has been defined, the user can edit the name and description, and add or remove classes. If the attribute type needs to be changed (i.e. there is an attribute on the list that should be a zone), the existing attribute has to be deleted, and then re-created with the correct information. New zones can be added via the GIS Import Wizard without being created here first (but attributes cannot). However, in that case, only the zone classes that are present in the imported coverage will be added to the class list.

The attribute names form is displayed in Exhibit 3. Enter new attributes, view attribute classes, or edit existing attribute names with this form.

Exhibit 3. Attribute Names form.



New - Click to add new attribute or zone names to the list. A pop-up box appears; enter the new name in the text field and an optional description. Names that are duplicates of existing attributes or zones will be rejected. Select a radio button next to the description that best fits the use this attribute/zone will be put to. Fill in the description field if desired. Click Save. Cancel discards this entry and returns to the main form.

Edit - Select the target attribute name by clicking on it, then click the Edit button to modify the selected attribute name. Only the name and description of an attribute may be edited on this form. Other details may not be edited. Duplicate names will be rejected. Click Save to accept the changes, Cancel discards this entry and returns to the main form.

Delete - Select an attribute on the list by clicking on it, then Click to delete the selected attribute. Several attributes are *system* attributes that cannot be deleted. These include LOG_METH (yarding or logging method) and the following Vegetative Attributes: HBTY_GRP, DOM_SP, SZ_CLASS, DENSITY. CAUTION: be aware that when an attribute is deleted any relationships in which the attribute is used are also deleted. For example, if the attribute has been used for any activity cost definitions, those definitions may be deleted. If it has been used for a management zone or an Effects Function, that part of the management regime specification, or the Effects Function definition, will be deleted (but not the management regime or Effects Function itself). If the deleted attribute was used during the GIS Import process, ALL the imported (internal) tables will be cleared and the GIS Import has to be run again. If the 'Organizing Tables' have been built and the attribute was used for any of those, they will have to be built again.

Done - Click to exit the form; changes are saved automatically.

Name - Display of defined attribute names. Click on an item to select it and display its details.

Type - Display of 'Physical or Vegetation Attribute', 'Management Zone', or 'Logging Method'.

Format - Display of 'Discrete Category' or 'Continuous Values' indicating which format has been adopted for the selected attribute/zone name.

Description of Attribute - Editable display of the description of the Attribute or Zone (optional). Click in the field to make changes. These changes are saved automatically.

Class Names - This box displays the list of classes associated with the currently selected Attribute name. Each attribute must have at least one class. Discrete category class names are character strings of up to 8 letters. For example, if the attribute is 'WATRSHED' the class names might include 'BigCreek', 'LowCreek', and 'SlvrCrek'. For a continuous attribute, the classes are formed by entering the upper limit value of the class. For example, if the Attribute is 'Slope'', classes might be 5, 10, 25, 50 and 999. "5" is a class of all slope values from 0 to 5. "10" is the class of all slope values above 5 but less than or equal to 10 and so on. The upper limit '999' includes everything OVER the next highest number (50 in our example).

Modify Class Name List - Previously entered attribute class names can be added, edited, and deleted using the buttons described below:

Add – Click to add a new class to the list for the selected attribute. Duplicates within an attribute will not be accepted, but different attributes can use the same class names (for example, both SLOPE and ASPECT could have a class upper limit of 10, and both WATRSHED and MGTZONE could use "BigCreek" as a class name.)

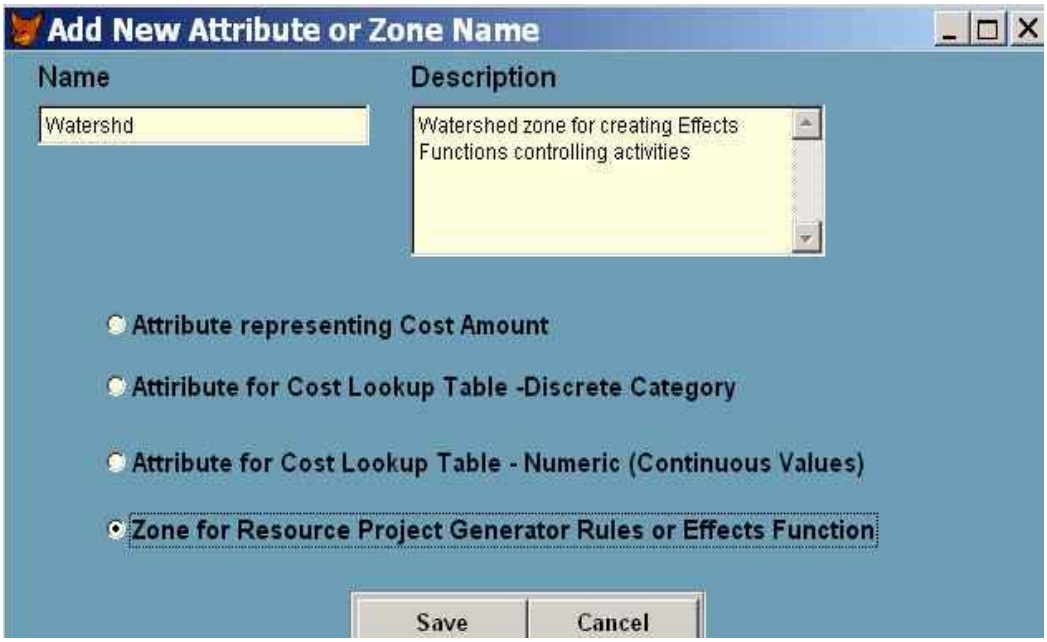
Edit - click to edit the class name. Duplicate names within an attribute will not be accepted, but different attributes can have overlapping class names (for example, both SLOPE and ASPECT could have a class upper limit of 10.)

Delete – Click to delete the currently selected class name. The same rules for cascading the deletion of the entire attribute apply. If this class is used in other definitions those items will be deleted or the class will be deleted from them-there are potentially many cascading effects when an item is deleted.

Class Description – Click in this field to enter or edit the class description (optional).

The "Add New Attribute" form is displayed in Exhibit 4. This form pops-up when the user clicks the New button on the Attribute Names form. Enter a name in the appropriate cell, and carefully select the radio buttons indicating the use for this attribute, then click the Save button.

Exhibit 4. Add New Attribute form



Name - Enter the name of the new attribute. There is a limit of 8 characters. Special characters and spaces are not permitted (i.e. &^%$#@!) except for the underscore.

Description - Optional description field for attribute. This is displayed on the main attributes form, but is not used otherwise.

Attribute Type selection buttons - Select the radio button next to the item that most closely describes the intended use for this attribute or zone:

Attribute representing Cost Amount: For this attribute, each treatment unit has a cost amount assigned as the attribute value. For example, if the activity cost name is 'Site Prep' and the selected attribute name used for this cost is 'site prep', the GIS treatment unit coverage must include the attribute site prep, which contains the total cost (not the per-acre cost) of applying the Site Prep activity to each treatment unit.

Attribute for Cost Lookup Table - Discrete Category: Select this option for attributes that will be used to create cost-category rows in a lookup table and are category names (like aspect: WET or aspect: DRY) rather than numbers.

Attribute for Cost Lookup Table - Numeric (Continuous Values): Select this option for attributes used to create cost-category rows in a lookup table but which are numbers. The user will need to create CLASS divisions for this attribute before it can be used in a cost lookup table. For example, if the Attribute is ‘Slope’’, classes might be 5, 10, 25, 50 and 999. “5” is a class of all slope values from 0 to 5. “10” is the class of all slope values above 5 but less than or equal to 10 and so on. The upper limit ‘999’ includes everything OVER the next highest number. Use the same buttons to add New classes, Edit classes, or Delete classes from the list.

Zone for Resource Project Generator Rules, OR Effects Functions partition: Select this option for ‘Management Zone’ attributes for use by the Resource Project Generator (assignment of management regime options to appropriate treatment units), or for partitioning Effects Function calculations.

Resource Information Menu

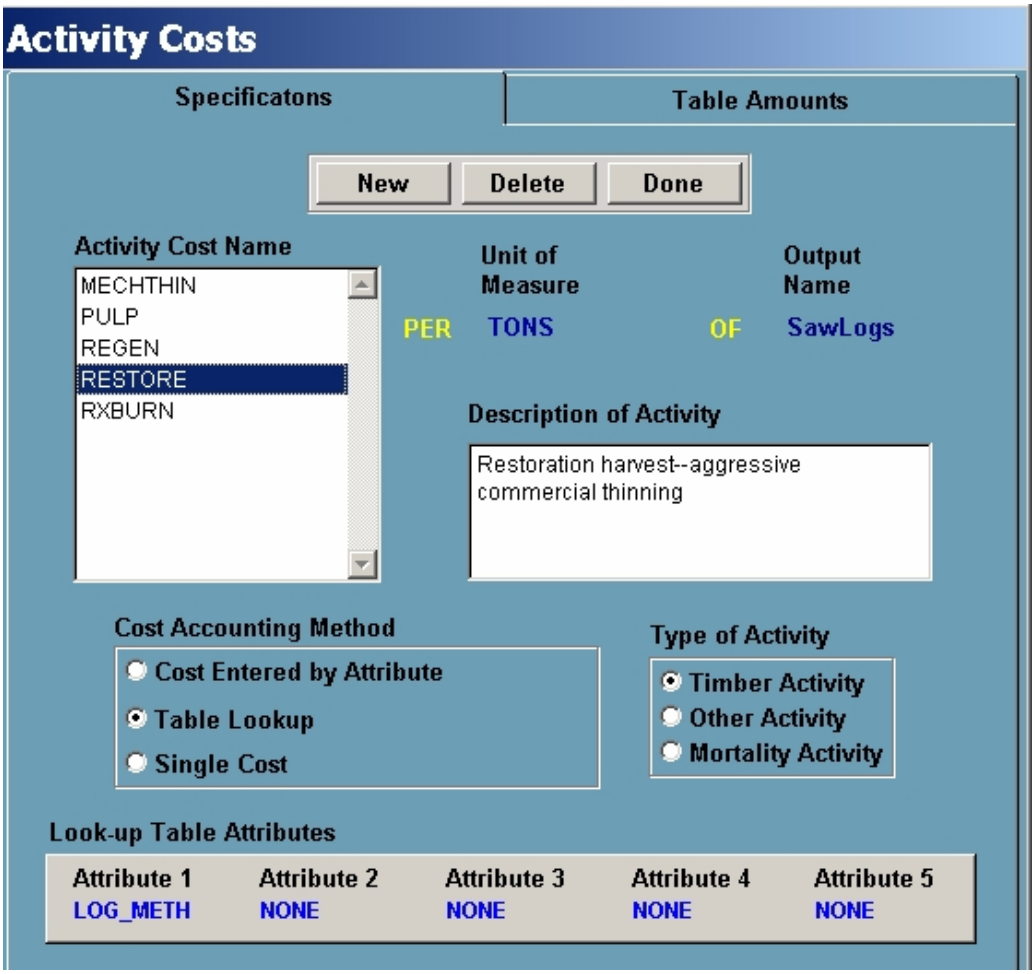
This menu includes the background information for land management activities. These are Activity Costs, Import States, Define/Edit States, Growth Rates, Timber Products, and Harvest Specifications and Mortality.

Activity Costs Form

In this form, displayed as Exhibit 5, the user defines the names of resource activity costs that apply to the treatment units in the planning model. These include on-the-ground activities like prescribed fire, and administrative costs like sale administration. Road costs are entered separately in the 'Network Information' menu. Activity Costs are individual events that can be combined in sequence to form a management regime (see management regime form for more details.) In other words, a management regime is a schedule of activity costs.

The Activity Costs Form has two tabs: Specifications and Table Amounts. The Specifications tab (Exhibit 5) includes a list of defined Activity Costs, and an associated unit of measure (cost per *unit*) and product name (if any): costs can be accounted per area unit of activity ($ per acre) or per product unit ($ per ccf of sawlogs). The method of cost entry (Cost Accounting Method) is displayed in the lower left of the form, and the Activity type (whether the activity affects tree mortality or produces a timber product) is on the lower right. Attributes for cost lookup tables are displayed at the bottom of the form when appropriate. The Table Amount tab is used for entering the cost amount for Table Lookup costs.

Exhibit 5. Activity Cost form – Specifications tab



Activity Cost Name – Click on a name in this list to display and edit information. All information displayed is associated with the highlighted name. Typing a letter speeds searches for occurrences.

Unit of Measure-Output Name - Click on an item in the list to select the appropriate unit of measure for the Activity cost. If Cost per Output unit of measure is selected, the cost amount will be calculated for a resource project based on the output amount of that output produced by that resource project.

Type of Activity – Select the most appropriate type category for the activity cost: Timber Activity, Other Activity, or Mortality Activity. Select Timber Activity for when an activity produces a timber harvest. Timber Activity and ONLY Timber Activity results in a timber harvest. Timber harvest activities do not have to be accounted as a cost per unit of harvested product: they can be cost per acre. Select Mortality Activity when an activity results in tree mortality but there is no associated timber harvest, such as might be the case with prescribed burning. Select Other Activity when the activity does not result in tree mortality or a timber harvest. Note: be careful not to select Timber Activity for two or more timber-harvest related activities that will be included in the same management regime, as this will double count the harvest volume. For example, if it is desirable from an accounting standpoint to separate site prep cost for commercial thinning from the actual harvesting cost for commercial thinning, specify Other Activity for the site prep activity and cost ('SP_comthin' is type Other Activity) and Timber Activity for the actual harvest activity (COM_THIN is aTimber Activity).

Cost Accounting Method – Activity Cost amounts are entered by one of three ways: Cost Entered as Attribute, Table Lookup, and Single Cost. For Cost Entered as Attribute, the cost of

applying an activity to a particular treatment unit is stored as an attribute in the GIS treatment unit coverage. For example, the user might have GIS data showing that a prescription burn on treatment unit 1 is $20,000 and the same type of prescription burn on treatment unit 2 costs $14,500 (these differences may be due to terrain, size of unit or vegetation type, but the actual cost is the only relevant information needed.)

For the Cost Lookup Table method, the cost of an activity in MAGIS eXpress is determined by some combinations of the physical or vegetative attributes of each treatment unit. The specific classes of these attributes for a given treatment unit are used to look up the cost-per-acre amount from the activity cost table. The attribute values come from the GIS treatment unit coverage as well as from standard attributes computed internally in MAGIS eXpress. The table attributes are specified using the buttons Attribute 1 through Attribute 5 on the bottom of the form. Clicking on one of these buttons brings up a pick list of attributes. Attributes are selected from the list by either double-clicking, hitting the escape key, pressing the right mouse button or <enter>. If an attribute is chosen by mistake, click the button again and select the correct one-it will replace the current value. To remove an attribute, click the button and select None. Specify from one to five attributes for a cost table, always starting with Attribute 1, then Attribute 2, and so on. The selected attributes are used to define a lookup table into which cost amounts are entered using the Table Amounts tab. For example, a cost may vary by two attributes, slope and unit size. For a Single Cost, enter the cost in the box. This constant amount is always applied for the activity.

New – Click to add a new Activity Cost Name to the list. The New button brings up the popup window shown in Exhibit 6. Enter a name in the Activity Cost Name field, optional description, and select the Cost Entry Method and the Type of Activity, then click Done. Use Cancel to exit the form without adding a new activity cost.

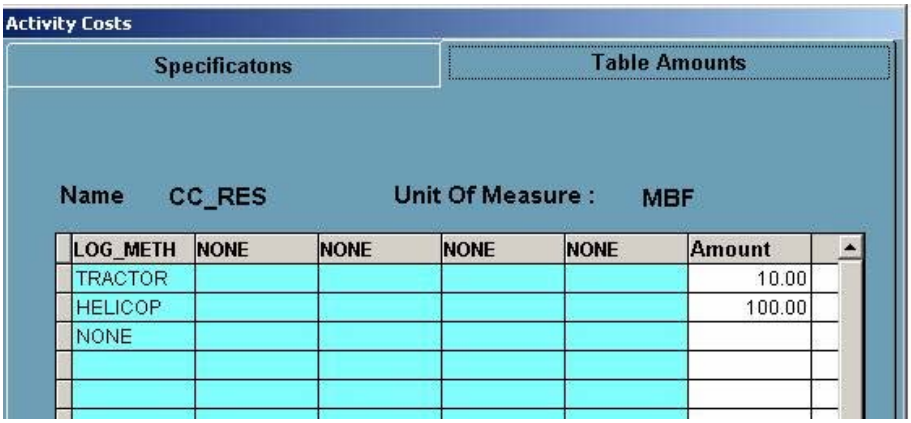
Delete – Click to delete the currently selected activity cost. Use this option with care as it creates a 'cascading' delete of any items using this activity cost, including deleting it out of management regimes and, if built, the organizing tables and deleting the model (matrix).

Done – Click to close the form; changes are saved automatically.

Exhibit 6. Add New Activity Cost form

Table Amounts Tab – The unit costs for the Table Look-up method are assigned in this tab (Exhibit 7). All possible combinations of the attribute classes are displayed for the attributes chosen for the current Activity Cost. The user needs to enter the unit costs for the relevant combinations (not all combinations need to be completed, but all combinations that might occur in the model should be filled in with a cost). If an item is NOT filled in, but is the combination does occur, the calculated value is 0. When the model is built, this table is used to assign cost amounts for the activity cost when it occurs on a treatment unit. MAGIS eXpress looks up the attributes for the treatment unit, then locates the appropriate row in this table, and the cost per acre is assigned to the treatment unit for the appropriate period. When all values have been entered, press Done; cost amounts are saved automatically.

Exhibit 7. Activity Costs – Table Tab



Import States form

Successional change in the vegetation is accomplished with a 'pathway' and 'state' model. Each treatment unit represents a stand of vegetation in a particular 'state'. The state is defined by the combination of Dominant Species, Size Class, and Density. A stand changes from one state to another through time, via a pathway which is either natural succession or some treatment. Pathways are influenced (or stratified) by Habitat-Type Group. The habitat-type group determines how many time steps (Time Increments) the stand remains in the same state (how fast it grows or develops). In turn, which Time Increment in a state may influence the resulting state after treatment. MAGIS eXpress allows the user to build these states and pathways directly or import a single file containing all possible states and pathways. If the desired system is fairly simple (say, less than 40 states) then it may be easier to just enter these states and pathways directly.

Use this form to import a single file that is used to build the states and pathways. If the attributes needed for the state parameters (habitat-type group (hbty_grp), dominant species (dom_sp), size class (sz_class), and density have not been filled in using the Attribute Names form, this import process will check and enter any as needed. However, names in the import file are limited to 8 characters. If the pathway file contains items with names longer than allowed in MAGIS eXpress, a crosswalk file needs to be used. See the appendix for a detailed discussion of the import states file requirements.

The Import States form for selecting the file(s) to be imported is displayed in Exhibit 8. The items to be filled in are:

Select Pathway/State Import File – Click on the button and navigate to the file to be used. This file will be checked for duplicates, name irregularities (8 character limit etc.) and inconsistencies (every state has to have a succession record, for example). Once the file is selected, click 'OK'. The file name should appear in the box.

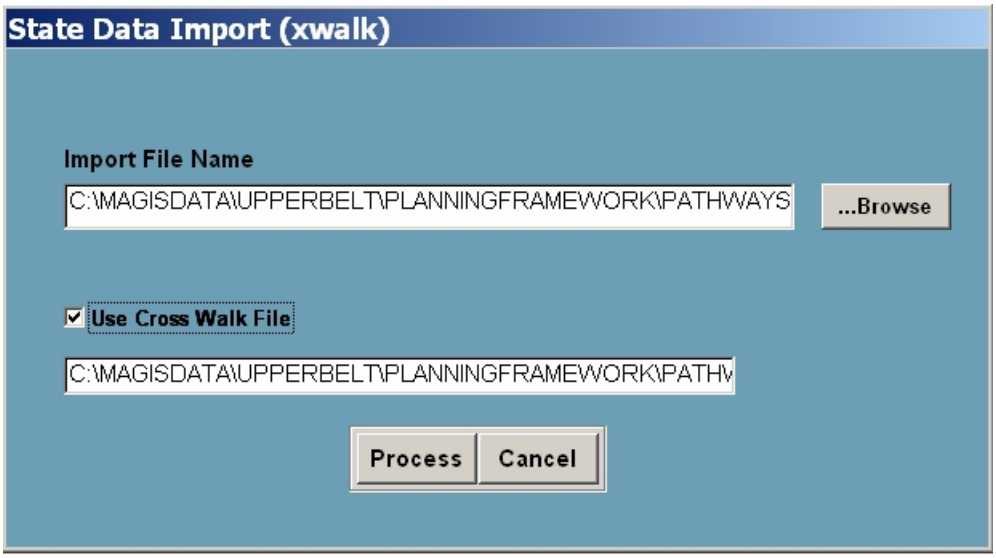
Use Cross Walk File – check this box if a crosswalk file is to be used. The crosswalk file needs to comply with the defined format, and should contain values for every unique name in the import file, including all habitat-type group names, dominant species names, size classes and density (even if they are the same in both the import file and the MAGIS eXpress list of variables.) When the box is checked a browse window pops up, in the same folder the import file was located in. Navigate to the file and click 'OK'.

Process – once the file selections have been made, click the process button to check and import the file(s). The form should close when the process is complete. A warning message appears, reminding the user that the import process has cascading effects on other items in the data. If a pathway system already exists in the model, entries for the management regime state groups, harvest state groups and the GIS data will be deleted. If errors in the file are detected, a view/print form of the error file will be presented.

Cancel – Click to quit the form.

Error Messages - Errors occur in the import process when the import file has names that are too long, or if the crosswalk file does not cover all the names in the import file, or if there are resulting states that do not have records for succession.

Exhibit 8. Import States form



An example of the import file is shown in Exhibit 9. This file can either be a table or a spreadsheet, but it needs to follow the given format. The beginning state fills the first five columns, which are, in order, Habitat-type group (hbty_grp), dominant species (dom_sp), Size or Structure Class (sz_class), Density (usually as canopy cover), Time step in state (using the same length of

time for a period in MAGIS eXpress, i.e. if time periods are 10 years long, the time steps are 10 years long. The path from one state to the next is dependent on the habitat-type group and the time step, that is, how long it has been in the state. The next field is 'Activity'. This list should include activity cost names as defined in the Activity Cost form. The next four fields are the resulting state.

Exhibit 9. Sample Table for States

Hbty_grp	Dom_sp	Sz_class	Density	Time_inc	Activity	R_dom_sp	R_sz_class	R_density	R_time_inc
a	DRY_DF	SAW	4O	1	REGEN	LPODF	SEEDSAP	NS	1
a	DRY_DF	SAW	4O	1	RESTORE	DRY_DF	SAW	2O	1
a	LP	POLE	2	1	SUCESION	LP	POLE	2M	1
a	LP	POLE	2M	1	SUCESION	LP	SAW	2	1
a	LP	POLE	4	1	SUCESION	LP	POLE	4M	1
a	LP	POLE	4M	1	SUCESION	LP	SAW	4	1
a	LP	SAW	2	1	SUCESION	LP	SAW	2M	1
a	LP	SAW	2	1	REGEN	LPODF	SEEDSAP	NS	1
a	LP	SAW	2	1	RESTORE	LP	SAW	2M	1
a	LP	SAW	2M	1	SUCESION	LP	SAW	2O	1
a	LP	SAW	2M	1	REGEN	LPODF	SEEDSAP	NS	1
a	LP	SAW	2M	1	RESTORE	LP	SAW	2O	1
a	LP	SAW	2O	1	SUCESION	LP	SAW	2O	1
a	LP	SAW	2O	1	REGEN	LPODF	SEEDSAP	NS	1
a	LP	SAW	2O	1	RESTORE	LP	SAW	2O	1
a	LP	SAW	4	1	SUCESION	LP	SAW	4M	1
a	LP	SAW	4	1	REGEN	LPODF	SEEDSAP	NS	1
a	LP	SAW	4	1	RESTORE	LP	SAW	2M	1
a	LP	SAW	4M	1	SUCESION	LP	SAW	4O	1
a	LP	SAW	4M	1	REGEN	LPODF	SEEDSAP	NS	1
a	LP	SAW	4M	1	RESTORE	LP	SAW	2O	1
a	LP	SAW	4O	1	SUCESION	LP	SAW	4O	1
a	LP	SAW	4O	1	REGEN	LPODF	SEEDSAP	NS	1
a	LP	SAW	4O	1	RESTORE	LP	SAW	2O	1
a	LP	SEEDSAP	2	3	SUCESION	LP	SEEDSAP	2	3
a	LPODF	POLE	2	1	SUCESION	LP	POLE	2M	1
a	LPODF	POLE	2M	1	SUCESION	LPODF	POLE	2M	1

Define and Edit Pathways forms

The following three forms allow the user to view and edit the pathways for vegetation projection. If the Import States procedure has been used, the imported states and pathways can be viewed with this set of forms. The user may elect to use these forms to enter all pathway and state definitions without importing a file. This is practical for a small pathway set, but is not recommended for an extensive set of states and pathways.

A State is defined as the combination of habitat-type group, dominant species, size or structure class, and density. The pathway is the combination of a state, an activity or succession, and the resulting state. The amount of time (called here the 'time step') a stand (polygon) remains in a given state depends on the habitat-type group it belongs in. Time steps are NOT the same as the time periods or time units in the model (i.e. time step 1 for a given state could occur in model time period 3, because the unit was in a different state in the previous time period and succeeded or experience a treatment that moved it into a new state and starting time step). The time step that a treatment unit is in often determines the successional pathway it will experience, and the habitat-type group determines the number of time-increments needed to reach the next state. For example, a medium, density 3 lodgepole stand may take 3 time steps to reach large, density 3 if it is in a (relatively) warm-moist habitat-type group, but may take 6 time steps to get to the same state if it is in a cold-dry habitat-type group.

Define/Edit State form

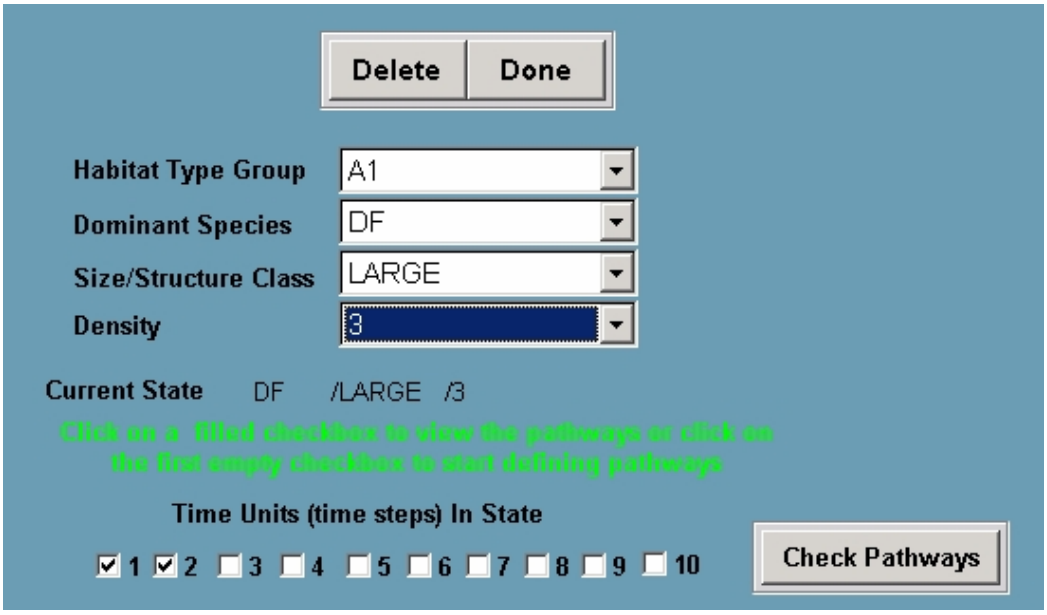
This form (shown in Exhibit 10) displays the four properties defining a selected state and indicates which time units have pathways defined for it. Each time step that has been defined for the

state has to have at least a successional pathway. To use the form, select a state by choosing a combination of properties from the drop-down lists. If the state has at least one (successional) pathway defined, the checkbox next to Time Unit 1 will be filled in. Each additional Time Unit checkbox for which there is a pathway defined for this state will be filled in. Click on the relevant time unit checkbox to view and edit the pathway(s) for that state and time unit.

Treatment pathways for a given state will not be saved unless there is also a successional pathway (equivalent to no management action) for that state. It is extremely important to coordinate the rules for assigning treatment options to polygons, and the treatment pathways. For example, if you set up a rule that assigns the commercial thinning option to polygons that are medium size-class and larger, but fail to set up a treatment pathway for all states that match (e.g. PP/medium/density 3), the model building step will generate an error for each treatment unit that has the option but no treatment pathway for the activity.

To end a successional route, (so you don't have to define successional pathways infinitely into the future), enter a successional pathway for a state that returns it to either the same state (for example, PP/V-Large/density 4/time unit 5 goes to PP/V-Large/4/time unit 5). This works best when the planning horizon is shorter than the successional dead-end that you define.

Exhibit 10. Define/Edit State form



Done - Click to close the window; changes will be saved automatically.

Delete - Click to delete all pathway records for the currently selected state. Any checkboxes (indicating data entered for that time step) will be cleared.

Habitat-type Group - Use the drop-down list to select the habitat-type group. All items on these lists were either brought in with an imported file or entered by the user. The list can be modified in the 'Attribute Names' form.

Dominant Species – Use the drop-down list to select the Dominant species (code). See note above

Size Class – Use the drop-down list to select the size class (code). See note above

Density – Use the drop-down list to select the density (code). See note above.

Current State - As selections are made the current state is displayed

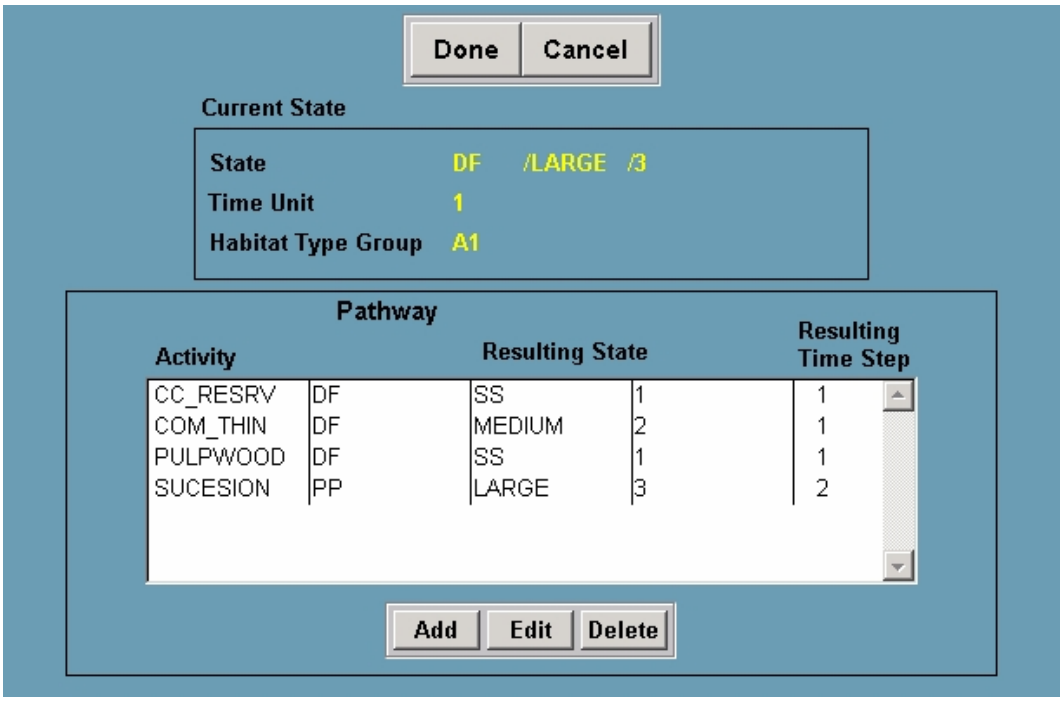
Time Units (Decades) Within State – These check boxes indicate which time steps pathways are defined for. A check indicates that at least succession has been defined. If a given combination of state parameters has NO checks in any of the boxes, then that combination does NOT have a successional pathway and is therefore NOT a defined state. Click in the box to bring up the form labeled Edit Pathways for State (see below).

Check Pathways – Click on this button to determine if all successional pathways have been created and there are no errors.

Edit Pathways form

The Edit Pathways form is displayed in Exhibit 11. This form is used to add or edit the pathways for a state selected in the Define/Edit State form. The currently selected state is displayed, along with a list of any pathways that have been defined for it. To add a pathway click the Add button and select an activity and time unit, then the resulting state from the 'Add Pathways' Form. Similarly, select a pathway and click Edit to change the resulting state from the current definition. Select a pathway and click Delete to remove it from the list. Each time step that has been defined for the state has to have at least a successional pathway.

Exhibit 11. Edit Pathways form



Done - Click to close the window; changes will be saved automatically.

Cancel - Click to undo the last changes

Current State - Label of current state properties

Pathway - Each pathway consists of the activity/resulting state and resulting time step. The entire 'pathway' can be thought of as current state/ current time step plus the activity (or succession) then the resulting state. Every existing state has to have a successional pathway. In order to create a finite set of pathways, the final 'pathway' for a given set of states has to either 'cycle' back to itself, or to some other state that has a successional path. For example, you can set up a 'final' state by creating a pathway like the following:

Douglas-fir/Very Large/Density3/Time step 5 - > Succession - > Douglas-fir/Very Large/Density3/Time step 5.

This pathway effectively ends the cycle, and is fine for any model where the number of time periods is 5 or less, and the GIS data only have states with time steps that start at 1 (this frequently is the case because data are not refined enough to assign time steps for states, so we assume time step 1)

Add - Click to add a new pathway to the current list. This brings up the 'Add New Pathways' form; see description following. Select an activity (not already listed) and the resulting state and time step for that activity acting on the current state.

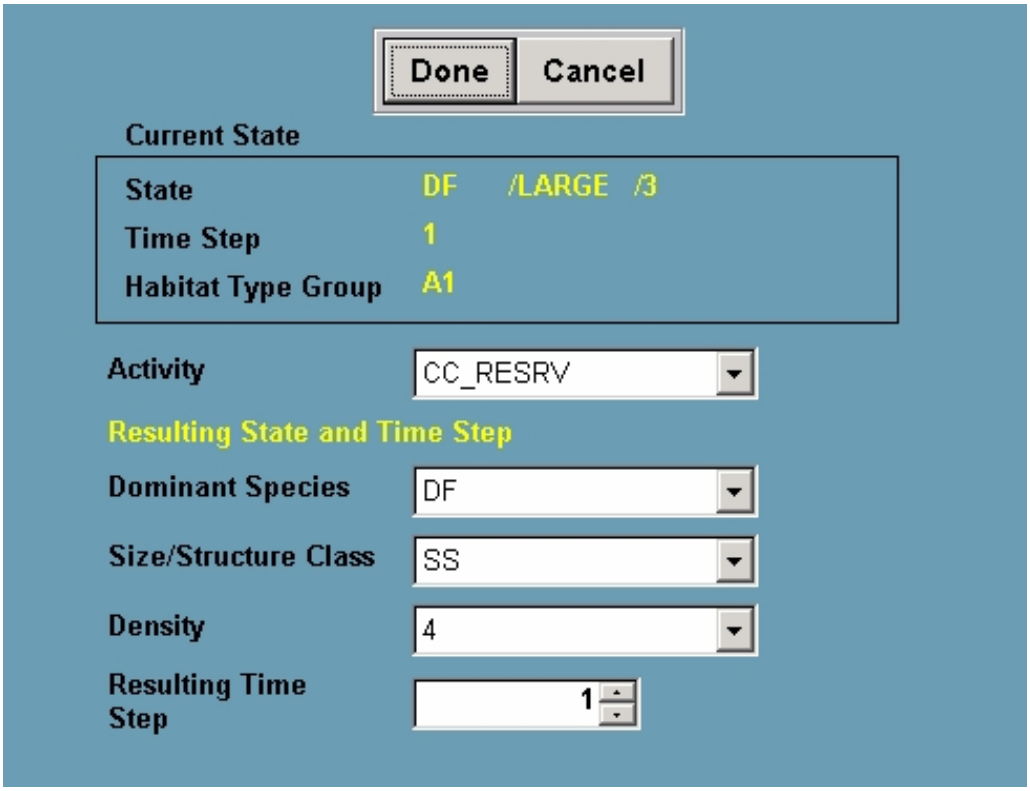
Edit - see form below. Allows the user to change the resulting state and time step for a given current state and activity.

Delete - Click on a pathway in the list, then click the Delete button to remove the selected pathway. Removing pathways will cascade delete information in other tables, and require that the user (re)import the GIS data, (re) build the resource projects, and (re)build the organizing tables for the model.

Add New Pathway form

The 'Add New Pathway' form displayed in Exhibit 12, allows the user to add or edit a pathway for the current state. Select an Activity, then the resulting state and time step using the drop-down lists. Any New states/time step combinations will need to have successional records added for them. NOTE: Use the 'Check Pathways' utility to make sure all successional pathways have been created.

Exhibit 12. Add New Pathway form



Done - Click to close the window; changes will be saved automatically.

Cancel - Click to release changes made on this form and return to the previous form. No new state will be added

Current State - Display of the current state for which this pathway will be created. To switch to a different state, click Cancel and choose the desired state by making selections from the drop-down lists.

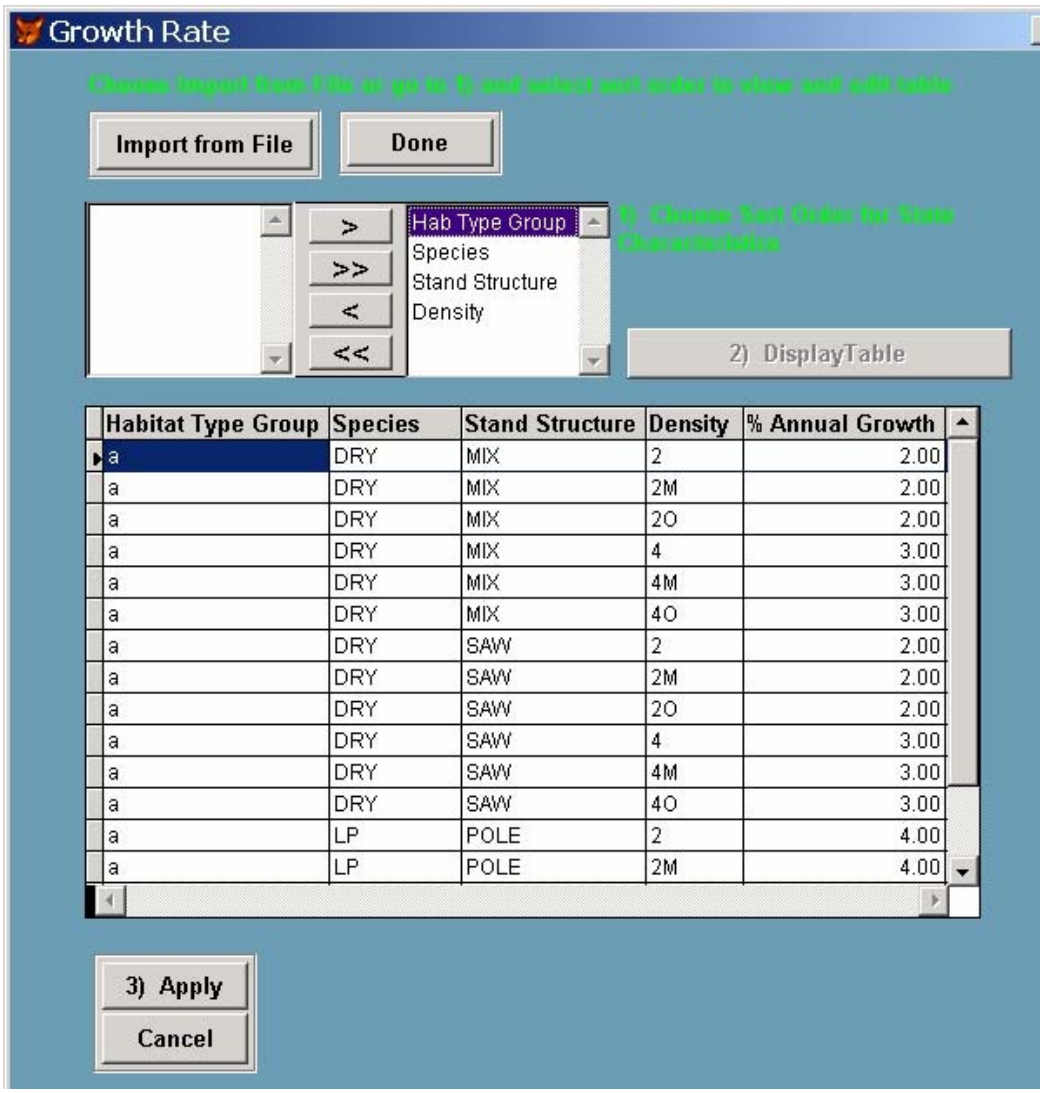
Activity, Dominant Species, Size Class, Density, and Resulting Time Step - Click on the down-arrow to display all activities. Select an activity from the list of all possible activities by selecting the desired item from the drop-down list (or spinner control).

Growth Rates form

In MAGIS eXpress, treatment unit polygons have been assigned a standing volume (starting volume) in the GIS, which is imported into the model with the other GIS attributes. If the user desires to model an increase in standing volume due to growth, growth increment rates (as a percent) are entered here. Each growth rate is specific to a given state. Differences in growth response due to treatment or succession are not modeled. Growth rates are a function of the state they are applied to, regardless of how the stand arrived in that state. In this form (displayed as Exhibit 13), the user enters the annual growth rate (as a percent) in the right-hand cell. For any state in which the annual growth rate is left as 0, the standing volume will only be modified by any harvest or mortality activities applied to the treatment unit. If a growth rate is entered, the rate will be applied to the amount of standing volume on a treatment unit at the beginning of a planning period. If any treatments (either harvest or mortality) are applied, the residual volume after the treatment is the volume reported for the period.

To make viewing and editing the states easier, the user can sort the table by any or all of the relevant state properties. If the state/pathway system is very large, we recommend building a table or spreadsheet for these properties and importing it into MAGIS eXpress.

Exhibit 13. Growth Rates form



Habitat Type Group	Species	Stand Structure	Density	% Annual Growth
a	DRY	MIX	2	2.00
a	DRY	MIX	2M	2.00
a	DRY	MIX	2O	2.00
a	DRY	MIX	4	3.00
a	DRY	MIX	4M	3.00
a	DRY	MIX	4O	3.00
a	DRY	SAW	2	2.00
a	DRY	SAW	2M	2.00
a	DRY	SAW	2O	2.00
a	DRY	SAW	4	3.00
a	DRY	SAW	4M	3.00
a	DRY	SAW	4O	3.00
a	LP	POLE	2	4.00
a	LP	POLE	2M	4.00

Done - Click to close the form.

Import from File - Click to import a dbf or Excel™(extension .xls) file containing the growth rates (the popup dialog box is displayed in Exhibit 14.)

The table (or spreadsheet) must have the following characteristics: Table fields or spreadsheet header title: hbty_grp,dom_sp,sz_class,density,out1. Each field's values have to match the existing categories of each property defining a state. For more details on table preparation see the appendix.

Select Sort Order for State Characteristics – Use the right and left arrows to arrange the order of the desired state characteristics (habitat-type group, species, stand structure, density) from top to bottom, which forms the order in which the set of state records are sorted into the grid.

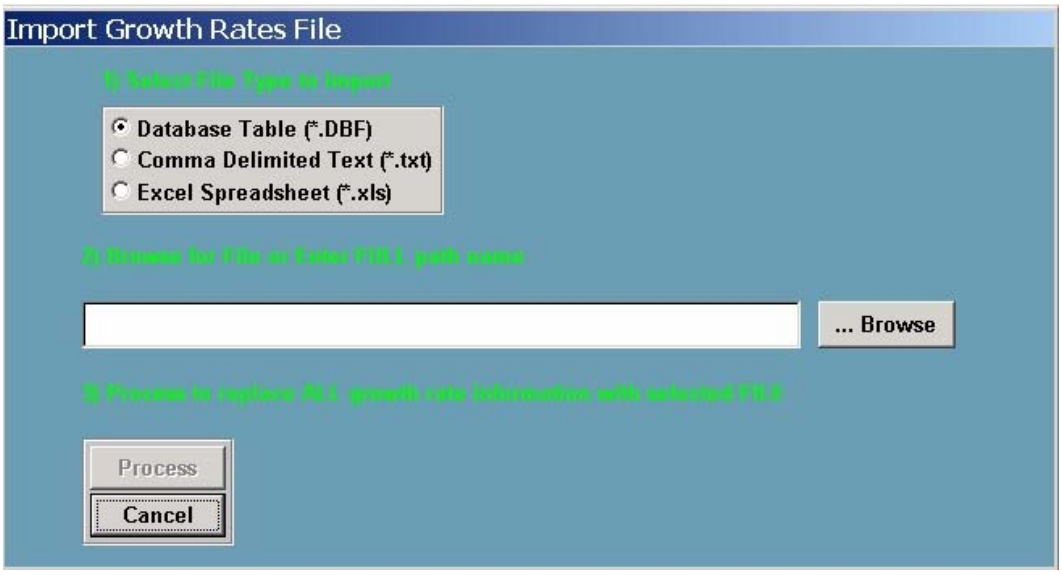
Display Table – Once you have selected one or more fields in the desired order from top to bottom, click the button to display the table sorted in the selected order. Only the % annual growth column is editable.

Grid - % Annual Growth – Click in a cell to enter or edit the percent values (0 to 100) for the annual growth for the state.

Apply – Click to accept the growth percentages entered on the form. If you do not click 'Apply' any changes will NOT be saved! (Any existing records are unchanged, however).

Cancel – Click to reject any current changes made to the table. Previous values will be retained.

Exhibit 14. Import Growth Rates File form



To import a file containing growth rates the user must first select the type of file to be imported. This can be a dbf, txt or xls file. Click the appropriate radio button next to the file type. Next the user must browse or type the full path name where the file to be imported is located. Finally the Process button is clicked to fetch the selected file or the Cancel button is clicked to exit this form and return to the Growth Rate form.

Timber Products form

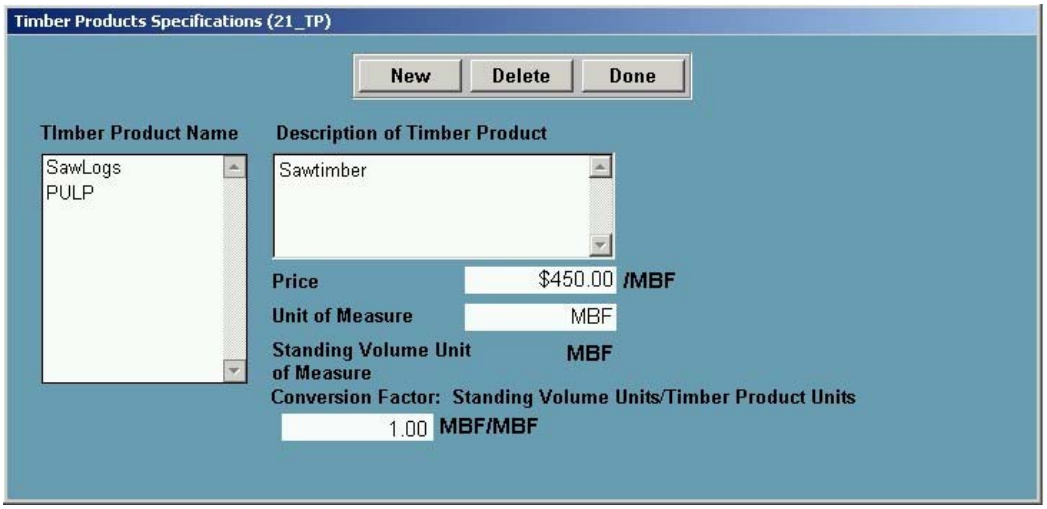
The Timber Products form (displayed in Exhibit 15) is used to define the outputs from timber harvesting activities. Each product is defined by its own unit of measure and the relationship of this unit of measure to the standing volume unit of measure (they could be the same), in order to track and report standing volumes and harvest volumes. Standing volume is affected by growth-rates, harvest percent, and loss (percent) due to mortality (optional).

Timber products are associated with specific management activities, and are removed as a percentage of the standing volume. The percentages are defined using the Harvest Specification form. Standing volume is incremented at the beginning of each planning period, volume is decreased by mortality (optional) and products are removed as a percentage. The volume remaining at the end of growth-mortality-harvest (multiple products) is reported as the standing volume for the

period. The remaining volume is not incremented until the next period. Each product needs to be related to the standing volume unit of measure (selected in the Model Information form) with a conversion factor. The default factor is 1 (same units of measure).

Harvest percentage can be stratified by vegetative state as a 'state group'. For example, the user could define state groups so that a commercial thin applied to LP/Large/4 removes 30% of the volume as sawtimber and 10% as pulpwood, but when applied to PP/Large/2 removes 20% of the standing volume as sawlogs but no pulpwood. It is up to the user to define the state groups for this purpose, and the groups can be as broad or as specific as needed for modeling the problem. At least one state group needs to be defined to apply timber harvest. NOTE: It is useful to keep this in mind when defining timber products, since the conversion factors (relative to the standing volume unit of measure) determine how easily the user can define harvest amounts for each product.

Exhibit 15. Timber Products form



Done - Click to close the form; changes will be saved automatically.

New - Click to add a new timber product. A popup window will be displayed, allowing the entry of the name and description. Click Save to accept the new entry. Edit the remaining information on the main form.

Delete - Click to remove timber product from this list. All references to this product will also be removed from other tables, including harvest specifications, Effects Functions, and resource project amounts tables

Timber Product Name - Display of defined products. Select an item to display and edit specific information.

Description of Timber Product - Optional (may be edited in the form) display of text description of the selected product.

Price - Click in the box to activate, then enter the value (price) of the output per unit (unit of measure selected for the output).

Unit of Measure - Enter or edit the unit of measure.

Standing Volume Unit of Measure – Display of standing volume unit of measure defined in the Model Information form.

Conversion Factor – enter the ratio of the amount of this product relative to one unit of the standing volume. For example, if the product is pulp, measured in tons, and the standing volume unit of measure is hundred-cubic-feet (ccf), enter 3.7 (for 3.7 tons of pulp per ccf). This is an important number for determining harvest volumes; all timber products are measured relative to the standing volume units.

Harvest Specifications and Mortality form

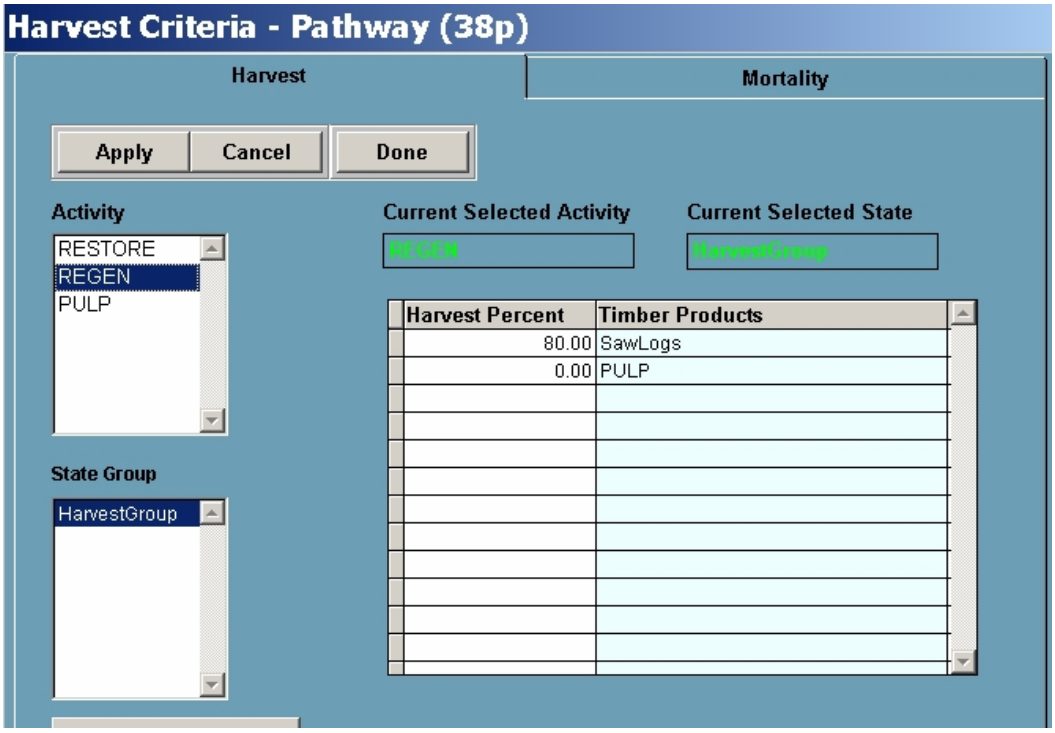
This double-paged form is used to enter the residual volume percentage for each type of harvest activity (tab 1), or the residual standing volume after an activity that results in mortality (tab 2). The work on either page is similar. The user creates state groups, which are groups of vegetative state characteristics to which the particular activity percentage will apply; the percentage of the volume to be removed due to mortality for that activity-state group combination is entered in the grid.

Harvest Specifications Tab

For Harvest Specifications, the harvest volume percentage implies the residual volume--if 20 percent is harvested, 80 percent is left to grow as the residual volume. This percentage is calculated from the standing volume. MAGIS eXpress calculates the standing volume based on the initial volume and the growth rate for the current vegetative state. For example, the amount of timber harvested may be dependent on size class groupings. The user then defines state groups using size class as the main criteria (V_LARGE, LARGE, MEDIUM, POLE) and assigns a different harvested volume as a percent for each group. That is, when harvesting V_LARGE with a commercial thin, 40% of the standing volume is removed, but if POLE is harvested with the same treatment, 60% of the standing volume is to be removed. Treatment units that have a harvest activity applied to them will use the appropriate time-sensitive state group to determine the amount of harvest. If a treatment unit does not fall into a defined state group category, harvest amount will be zero.

On this form (isplayed in Exhibit 16), select an activity. If more than one state group is defined for harvest specifications, select a state group as well. The selected activity and state group will be displayed with records for each product. If this activity and state group combination has previously had product percentages defined, they are also displayed. To enter or edit product percentages, click in the cell under harvest percent and enter a values. Click the Apply button to accept your changes or Cancel to revert to the previous values. Not all products need to be harvested by a given activity-state group (i.e. have a percent harvested value entered)even though all defined products are listed. As in other forms, cells or columns colored blue are not editable.

Exhibit 16. Harvest Specifications tab



Apply – Click to apply additions, edits or deletes for the selected activity. If the activity name is changed or the done button clicked before clicking 'Apply' any edits will be lost.

Cancel – Click to discard edits
Done - Click to close the form

Current Selected Activity – Non-editable cell display only of currently selected activity

Current Selected State - Non-editable cell display of the selected state group.

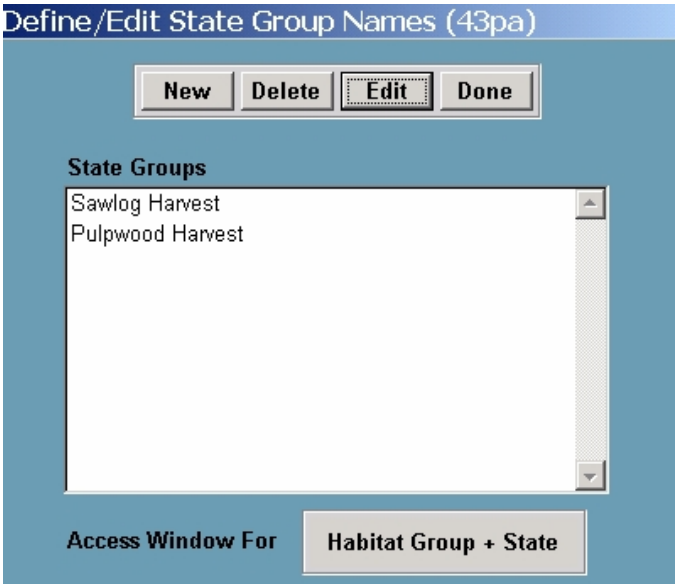
Activities – Select an activity name to edit harvest specifications for this activity. The table of state group names and percentages will refresh, as will the display of 'current selected activity'.

State Group - Select a state group. If only one is defined for harvest, it will be displayed as the default.

Table: Residual Percent – Click in the cell to edit its content. Enter values as percent (i.e. 80% is entered as 80.0) Residual Percent is the relative amount of volume that will REMAIN on the site after harvest, so if 80% is entered for a commercial thin, the harvest volume will be 20 percent of the standing volume.

New/Edit /State Group - Click to view and edit the state groups used for harvest. A popup window will be displayed: "Define/Edit State Group Names" displayed in Exhibit 17. This form lists all the defined state groups for harvest. To add a new state group, select 'NEW', to edit the NAME of the state group select EDIT, to delete a state group from the list, select DELETE, and 'DONE' exits the screen.

Exhibit 17. State Group Names



Done - Click to close the form.

New - Click to add a new State Group name. Enter the name in the popup window and click OK to accept it and return to the original form.

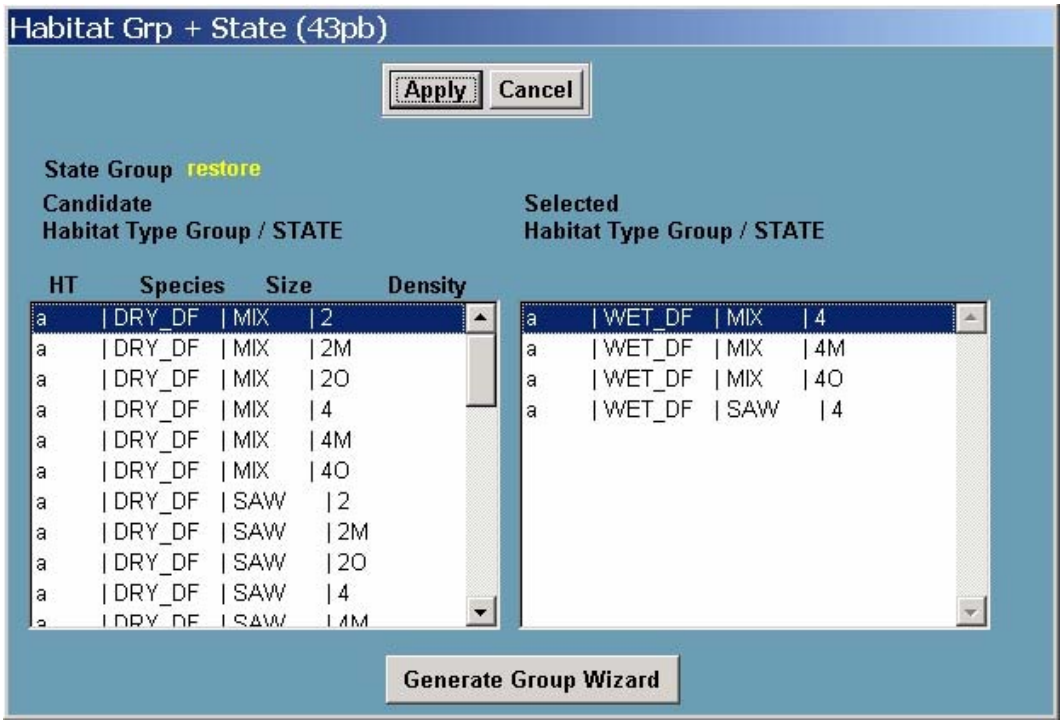
Delete - Select a State Group name, then click Delete. All information about this group will be deleted.

Edit - Select a State Group name, then click Edit. Edit the name and description in the popup window, and then click OK to accept the change and return to the original form.

State Groups – List of defined state groups

Access Window For: Habitat Group + State – Click to display the form used to enter or edit state group information (displayed in Exhibit 18). Selected states appear on the right-hand list, all remaining state-habitat-type group combinations are displayed in the left-hand list. States can be moved right or left by right-clicking or double-clicking on individual items, or by selecting an item and using the move-right or move-left arrows. Multiple items may be selected by holding down the Shift or Ctrl keys.

Exhibit 18. State Group members



Apply - Click to accept selections and close the form.

Cancel - Click to revert to previous selections and close the form.

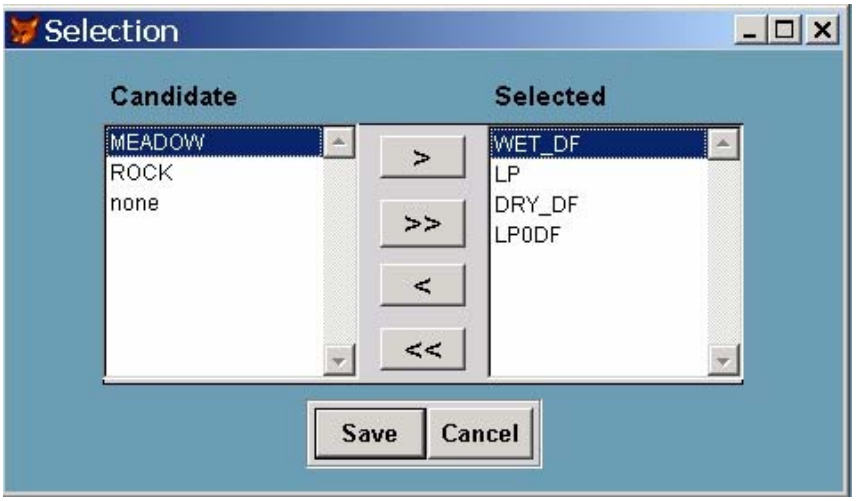
State Group - Display of current group name being edited.

Candidate Habitat-type Group / STATE - List of all possible combinations of habitat-type-group, dominant species, size class, and density categories from the pathway definitions file. Items already 'selected' are moved from this list to the right-hand list.

Selected Habitat-type Group / STATE - List of selected items, and therefore the states making up the state group, that have already been selected.

Generate Group Wizard – Click to start the group wizard: this wizard allows the user to select state combinations by rules (i.e. get all the forested, Douglas-fir, large, density 3 or 4 states). It occurs as a series of forms (an example of which is shown in Exhibit 19), one for each state parameter. Select the values by double-clicking or right-clicking on the desired items on the left side and moving them to the right-hand list. Multiple items may be selected by holding down the Shift key. Click the Save button when the desired items are in the selected list. Click Cancel to exit the wizard at any point. When the wizard is completed, click the Apply button to accept this new state group and exit the main form. If you click Cancel during or after running the wizard, the state group list will revert to the previous setting.

Exhibit 19. State Group Wizard habitat-type group form example



Candidate - This list is populated based on the selections made in the preceding form. The first list (habitat-type group) is not filtered, however. Dominant species candidates are selected from the pathways where those dominant species categories are included in the selected habitat-type groups. Size class categories are only listed for those that occur for the selected habitat-type group and dominant species classes, and so on. Double-click, right-click, or use the arrows to move items to the 'selected' list. Once the desired selections are made, click the Save button or click Cancel to exit the wizard.

Selected - List of items selected by the user. Double-click, right-click, or use the arrow buttons to add or remove items from the list.

Save - Once the desired selections have been made, click the Save button to save the selection and move to the next form in the wizard.

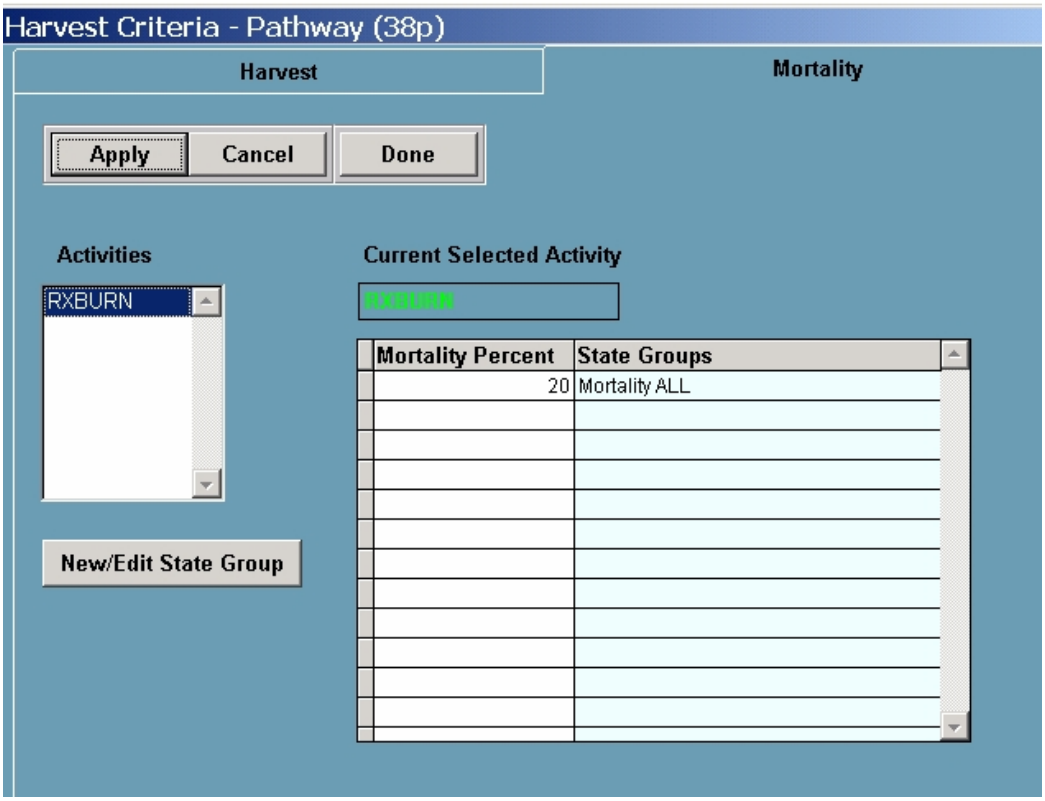
Cancel – Click to exit the wizard (may be done in any of the forms). The state group list will revert to the previous setting.

Mortality Tab

This page (displayed in Exhibit 20) is used to enter the percent mortality associated with a given activity. This percentage is modeled as a reduction in the standing volume due to this activity, a reduction that does NOT create any volume output as timber products. A mortality type activity can be coupled with a harvest activity to to modify the residual volume (the standing volume), or occur alone to remove trees from a unit without producing a timber product. To associate mortality with harvesting, create two activities (a harvest activity and a mortality activity) and put them in the same management regime in the same time unit, making sure that the mortality activity FOLLOWS the harvest activity.

If the mortality activity occurs BEffects FunctionORE (higher on the management regime schedule than) the harvest activity (the standing volume is reduced by the mortality percentage first, then the harvest volume is taken off of what remains). Just remember they are both entered as percentage reductions of the current value, so a 10 percent mortality followed by a 70 percent harvest gets you 63% of the original standing volume.

Exhibit 20. Mortality tab



Apply – Click to save changes.

Cancel - Click to revert to previous settings

Done – Click to close the form. Only changes that were “Applied” will be saved.

Activities - List of activities that were identified as ‘mortality’ activities. Mortality can be applied to a harvest management regime by including the mortality activity in the management regime. To insure that the harvest volume is volume remaining AFTER loss due to mortality, the mortality activity should precede the harvest activity in the management regime definition (either temporally or just be higher on the list if they occur in the same time unit).

Current Selected Activity - Display of the selected activity for reference

New/Edit State Group - Click to add or edit state groups for mortality. There has to be at least one group in order to assign mortality percentages to activities.

Mortality Percent - Click in the cell next to the state group and enter the percent mortality for this activity-state group combination. A value of 10, for example, indicates that 10 percent of the standing volume is lost to mortality due to this activity when it is applied to stands belonging to this state group.

State Groups - Lists the state groups that have been defined for mortality activity. A 0 or a blank field next to a state group name (in the mortality percent column) indicate no mortality for that state-group/activity combination.

Network Information Menu

This part of the menu system encompasses all the background information for the road network. The road network definitions include 'Road Options', which are the generalized road standards that either represent the existing road condition, new road construction, or a change in the road standard for reconstruction of an existing road. Road options are sets of road types that are equivalent (in the management sense) for any given road segment (link). A road segment can be assigned more than one road option; during the solution process, either the user will select which road option will be selected for a given segment or MAGIS eXpress will select a road option based on the user-defined scenario. Road options are assigned either "Reconstruction" costs or "Construction" costs. Road segments are either existing (status "E") or proposed for construction (status "C"). Therefore the user may wish to define a road option referring to existing roads, enter "reconstruction" costs, and then define another road option consisting of the same road types which is intended for proposed roads. Costs will therefore be entered as "construction" costs. Definitions made in these screens will be applied to the actual GIS data; GIS data attributes have to match attributes used in these definitions, and the Project Builder user specifies the table categories to get the default value.

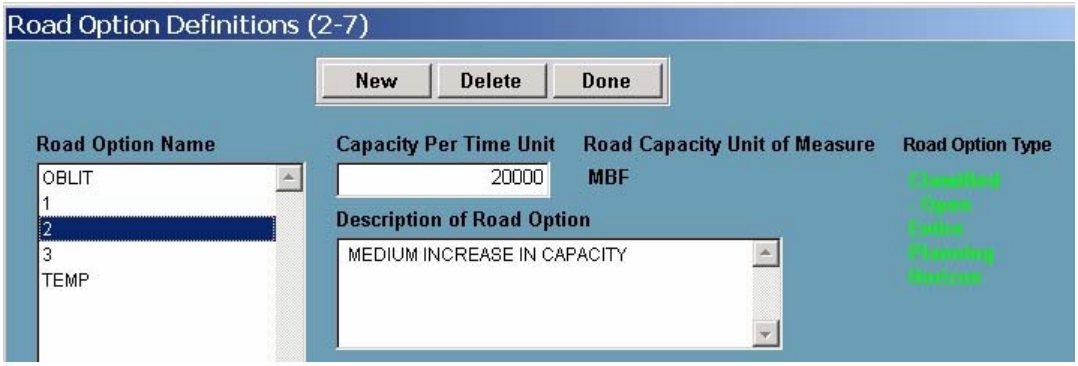
Road Options Definitions form

In this form (displayed in Exhibit 21), road options are defined. Assignment of road options to links as road project choices needs to reflect the initial status of the link, and the road option type. There are THREE main types of options. "Classified", "Temporary" and "Decommission". Classified options are 'permanent' roads, which are open from the period of implementation (or period 1 in the case of existing roads) through the end of the planning horizon. "Temporary" roads are only options for PROPOSED links, and are open ONLY during the period they are constructed (and not thereafter). "Decommission" options are options to remove from use or obliterate a link. This type of road option may only be assigned to EXISTING links. When developing Road Option definitions, the user should consider the TYPE of road option as well as the status (existing or proposed) that it might be assigned to. It is entirely up to the user how detailed these road options are.

When the GIS data are imported, they need to match the road option definitions here. Existing roads need to be defined (rd_option should be an attribute of the network coverage or shapefile) with a road option that is the same as one of the "Classified" options on this list. Proposed links do not need a rd_option attribute value. Fixed Costs will be assigned by link and road option during the GIS data processing phase of model building.

Care must be exercised when changing, deleting or adding road definition - if GIS data have already been imported, model data will be deleted and the GIS data will have to be imported again.

Exhibit 21. Road Options Definitions form



Done – Click to close the form; changes will be saved automatically.

New – Click to add a new road option to the list. Type the name of the road option (up to eight characters) and right-click or <enter> to accept the new name.

Delete – Select a Road Option Name and click Delete to remove it from the list. All definitions downstream will also be cleared, as will any imported GIS data

Road Option Name - Click to highlight a road option name in the list; the defined characteristics of this road option will be displayed and are editable.

Capacity Per Time Unit - Enter the maximum volume of product (in the road capacity unit of measure) that can be moved across a link of this road option (type) in one time unit.

Road Capacity Unit of Measure (no edit) Display of capacity unit of measure (defined in the Model Information form). It should be the same as one of the timber product units of measure or the standing volume unit of measure.

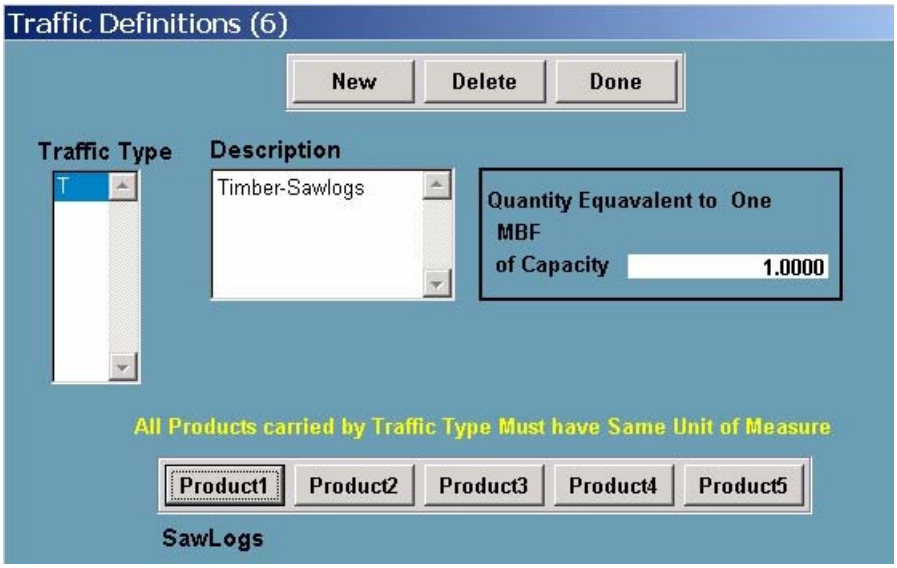
Description of Road Option - (Optional) Enter a description of the Road option

Road Option Type (no edit) - Display of the defined type for the selected road option. This should be selected when a new road option is created.

Traffic Definitions

Traffic (or more specifically, Timber Products Hauled on the Network) is defined in this form (shown in Exhibit 22). Each ‘traffic type’ represents a product or group of products with the same unit of measure.

Exhibit 22. Traffic Definitions



New – Click to define a new traffic type. Enter the name of the new traffic type in the pop-up box, and click OK to accept the new name and return to Traffic Definitions form.

Delete – Select the Traffic Type to be deleted, then click Delete to remove it from the list. All associated records will be deleted.

Traffic Type - Click a traffic type name to highlight it. The settings and values for that name will be displayed in the various boxes.

Description - Optional text description of the traffic type.

Quantity equivalent to one (capacity unit) of Capacity - Click in the box to enter the amount of the current traffic type that is equivalent to a truck carrying 1 unit of the Road Capacity unit of measure (which is displayed). NOTE: That unit of measure is selected from the product units of measure in the Model Information form.

For example, if the Road Capacity unit of measure is CCF, and the traffic being defined is measured in tons, a conversion factor for equivalent units is entered here. If 1 ton of this product is equivalent to 2 CCF, the conversion factor that should be entered is 0.5.

Note: The user determines the maximum capacity of a Road Option in the road options definition form. During the solution process, if the capacity for a road option is exceeded, the solver either selects another road option for the segment (if it is available) with a higher capacity, or it does not select the resource project producing the traffic.

Select Product Comprising This Traffic Type: Product 1 - “Traffic” is the MAGIS eXpress terminology for timber products once they are loaded onto the road network and become ‘traffic variables’ (which may incur a cost). Select ONE product for this defined type. ALL products define in the Timber Product form have to be defined as traffic, or they will not be hauled on the network and will not incur haul costs.

Management Regimes

MAGIS eXpress computes a solution to a planning problem by selecting resource projects from the set of all defined resource projects. A resource project is a unique combination of

treatment unit, management regime, loading node, logging method, and period of implementation. A management regime is a schedule of activities. In a MAGIS eXpress planning problem, treatment units are assigned management regimes as options by the resource project generator.

The resource project generator uses rules to distribute management regime options to treatment units. These rules are based on the vegetative condition of the treatment unit and the geographic (or management) location of the unit. State groups are developed to determine which treatment units are eligible for which management regimes. Additionally, some spatial considerations can be used to determine eligibility. These are geographic 'zones', defined in the GIS layer. The user selects a zone name, then the zone classes that are eligible for the selected management regime. For example, there might be an area that is off limits to even-aged management for wildlife reasons. The user would select this zone, and select the zone classes that represent areas in which it is permissible to clearcut, but leave the zone classes where no cutting is allowed on the 'candidate' list. More than one zone can be used for this process, but only one state group can be used for a given management regime.

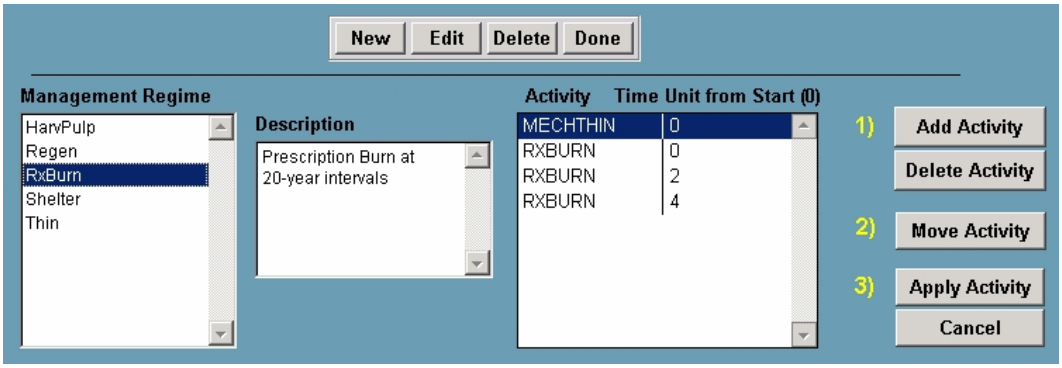
Management Regime Definition

The Management Regime Definition form (shown in Exhibit 23) is used to create the definition for the management regime as a schedule of activities, and to set up the rules to be used by the resource project generator.

The resource project generator uses rules to distribute management regime options to treatment units. These rules are based on the vegetative condition of the treatment unit and the geographic (or management) location of the unit. State groups are developed to determine which treatment units are eligible for which management regimes. Additionally, some spatial considerations can be used to determine eligibility. These are geographic 'zones', defined in the GIS layer. The user selects a zone name, then the zone classes that are eligible for the selected management regime. For example, there might be an area that is off limits to even-aged management for wildlife reasons. The user would select this zone, and select the zone classes that represent areas in which it is permissible to clearcut, but leave the zone classes where no cutting is allowed on the 'candidate' list. More than one zone can be used for this process, but only one state group can be used for a given management regime.

To define a management regime, select New and enter a new management regime name and description. Next, select activities that comprise this management regime using the Add Activity button. NOTE: Activity order within a time unit can be important in determining the resulting state from a management regime, or in determining the residual volume and harvest volume from various activities. Use the Move activity button to adjust the order by dragging activities up or down. The Apply Activity button needs to be clicked to save the management regime definition. Once the management regime is defined, the resource project generator rules can be developed for this management regime (See description below, accompanying Exhibit 25.)

Exhibit 23. Management Regimes definitions



New - Click to add a new management regime. This activates a pop-up window prompting the user for a name. Click OK in the popup window to accept the new name.

Edit - Click to activate a popup window in which the name of the management regime can be edited. Click OK to accept changes.

Delete - Click to delete the selected management regime; this will delete the schedule and rules for the RPG as well.

Done - Click to exit the form.

Management Regime – List of defined management regimes. Click on a name to select it and view the information about the item.

Description – Description of management regime. Click in the box to edit the text. Changes will be saved automatically

Activity Name // Time Unit From Start - Display of activities constituting the selected management regime, and their timing. The indicated time units are relative units from the implementation period. A relative time unit of 0 means 0 time units from the time unit of implementation--in other words, IN the same period. It is acceptable to have more than one activity in the same time unit, but the same activity can NOT occur in the same time unit more than once (that is, rxburn 0 mechthin 0 is OK, and rxburn 0 rxburn 1 is OK, but rxburn 0 rxburn 0 is NOT OK)

Add Activity – Click to add activities to the management regime. A drop-down list of available activities will appear in a new window. Select an activity from the list by scrolling down and clicking on it.

Delete Activity - Click to remove the selected activity from the management regime.

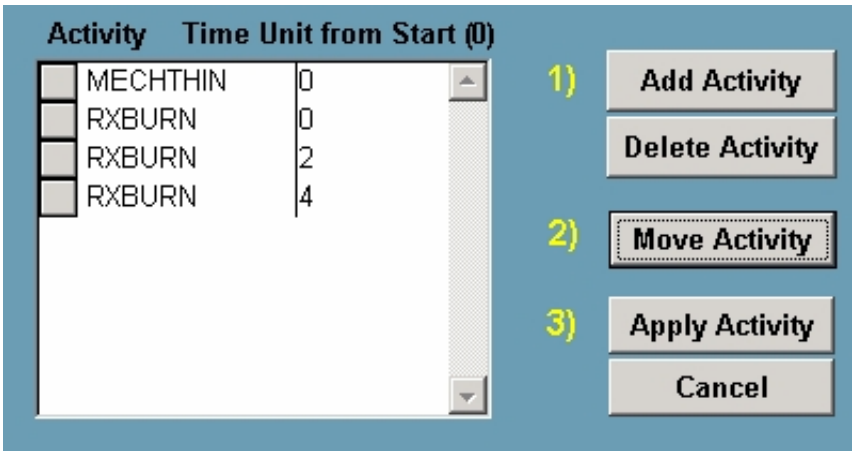
Move Activity – Click to rearrange the order of activities constituting a management regime. The Activity list will refresh with ‘mover’ buttons for each activity (displayed in Exhibit 24). Click and drag the mover button to move activities up and down in the list. The order of activities on this list will be the order in which they will be implemented when activities occur in the same time unit. This is only important for activities that have an effect on the vegetative state. For example, both prescribed fire and precommercial thinning have an effect on the vegetative state. When the prescribed fire and precommercial thin are applied in the same time unit, and the prescribed fire is on top, the state resulting from the prescribed fire will be the state that the

precommercial thin is applied to (with future consequences for harvest volume and revenue.) and the final resulting state will be determined by the action of the precommercial thin on the post-prescribed-fire state. If the activities were in the reverse order (i.e. precommercial thin ABOVE prescribed fire) then the final state will be the result of prescribed fire applied to the post-precommercial-thin state.

Apply Activity – Click to apply any changes made to the activity schedule in a management regime.

Cancel – Click to cancel changes made to the activity schedule.

Exhibit 24. Management Regimes mover tabs to sort activities



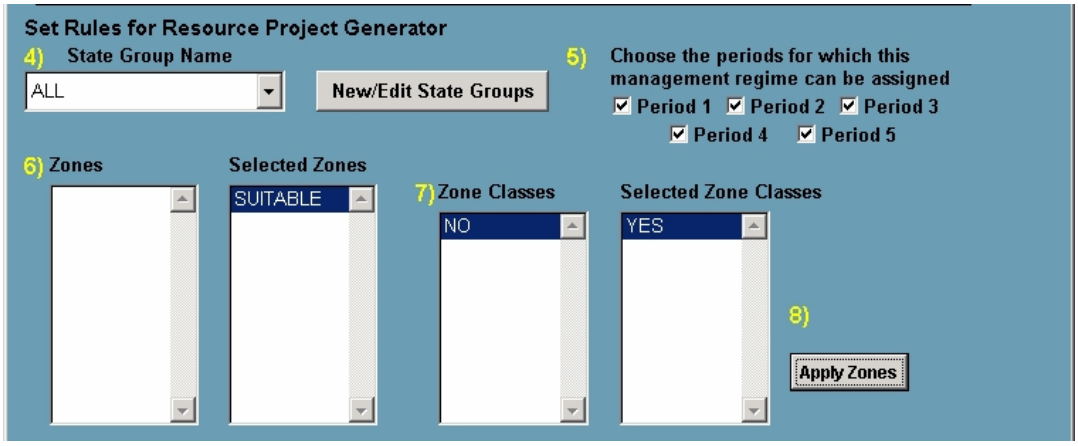
Resource Project Generator Rules

The Resource Project Generator (RPG) is a function of MAGIS eXpress that creates resource project options for treatment units based on a set of rules. These options form the basis for selection in a MAGIS eXpress solution. The RPG is applied AFTER the GIS data have been imported; to start it up, go to the Model Specifications menu, then Project Area, Treatment Unit Specifications and finally, "Build Resource Projects". A MAGIS eXpress solution consists of selecting the resource projects (and the road 'projects' required by the particular solution) from the set of options created here. If a management regime is not an option for a particular treatment, it CANNOT be selected into the solution.

The user can assign options manually by building a 'management' table that lists the options for each treatment unit. The easier method is to use the RPG to create the options from which MAGIS eXpress makes selections during the solution process. The rules by which the RPG makes this assignment are entered here, with the management regime definitions (Exhibit 25). There are three parts to the rule: a) the 'State Group', b) the time units allowed, and c) management zones (actually zone classes). A treatment unit will receive the management regime as an option if, in an allowable time unit, and an allowable combination of zone classes, it is (or will be) in a vegetative state that falls within the State Group (based on successional pathway).

For example, it might be the case that a harvesting regime could be assigned as an option to any treatment unit where the vegetation is forested and medium size-class or larger, and that is within the FS 'Suitable' zone, but not in the 'Grizzly Bear Management Zone'.

Exhibit 25. Resource Project Generator Rules – Management Regime form



State Group Name – Click the drop-down list arrow to select the state group for this management regime. Only ONE state group is used for a given management regime. This is a required step: if no state group is selected, the management regime will not be assigned to any treatment units.

New/Edit State Groups -Click to get a popup window to add or edit state groups to the list. These state groups are unique to the resource project generator (and are not used for harvest specifications or mortality specifications).

Period 1 …Period 5 Click the checkboxes next to the period to select the time periods in which the management regime option could start. At least one box needs to be checked for the option to be assigned.

Zones….Selected Zones – Select one or more zones for this management regime. EACH selected zone needs to have one or more zone classes selected in order for ANY management regimes to be assigned by the RPG. Work with one zone at a time. Double-click the candidate Zone to place it into the selected Zone list. SINGLE-Click on this selected Zone name to display the zone classes in the candidate list of classes (double-clicking a Zone Name removes it from the selected list.) DOUBLE-click candidate classes to place in the selected Zone Classes list. Then click the Apply Zones button to save this configuration. Now repeat for any additional zone names desired. A treatment unit has to belong to one of the selected zone classes FOR EACH zone defined (this is an 'AND' relationship) in order to receive the option.

Zone Name – Double-click on a zone name from the candidate list to add it to the selected list. More than one zone can be selected-this allows the user to use a combination of characteristics to assign options. A treatment unit might need to be in one of a set of management compartments AND have a slope of less than 30 percent.

Selected Zone - SINGLE click a Zone name to refresh the zone classes list for that zone. Double-click a Zone Name to move it back to the "candidate" list.

Zone Classes … Selected Zone Classes – Select the acceptable zone classes for each selected zone name. A treatment unit can belong to ANY of the selected zone classes to receive the option.

Zone Classes – SINGLE-click on a ZONE NAME in the selected list to highlight it. When this is done, the candidate list of zone classes for that zone name will be generated. Double-click or

right-click on the desired zone classes to move them to the selected list. Select the APPLY button before returning to a different Zone Name.

Apply Zones – Click to save the information for a given zone name. If a different zone name is selected before this is clicked, information may be lost.

As an example from the UBX Tutorial, a program of spring-burning at 20-year intervals for the purposes of reducing undergrowth and shade tolerant species (it might be used to restore open ponderosa pine forest) can be summarized as a management regime that uses two activities: ecosystem broadcast burning (RxBurn) with a required mechanical thinning treatment (MechThin) before the initial prescription burn. Each of the activities appears as a line in the Management Regime definition, with the mechanical thinning occurring once (in relative year 0) and the RxBurn in relative years 0, 2, and 4 time units from implementation.

Project Area Menu

The Project Area portion of MAGIS eXpress involves the spatial data for the planning model. This includes the GIS data that are to be imported, and specifications for treatment and road activity options. The GIS data consist of a treatment unit polygon layer and a network (arcs and nodes) layer. The network layer is required, but if no network analysis is desired, the user can employ a 'dummy' coverage (see appendix on how to construct this).

Project Area for treatment units is the polygon coverage used to build resource project options and later obtain a solution. Treatment units are used to calculate or sort out solutions by geographic zones. The zones needed for the model are to be determined by the user and need to be attributed to the treatment units in the GIS coverage. Treatment units are associated (make connections to) with the network by the node to which timber products are loaded onto the network (loading nodes). Vegetative state characteristics, any required physical attributes (i.e., slope, aspect) and geographic zones are assigned to treatment units. If the user has created treatment unit polygons by combining stand polygons, it is recommended that the preponderance method for assigning vegetation attributes be used (that is, assign the vegetative state represented by the most acres within a treatment unit polygon).

Project Area for roads is the transportation network to be used in the model. This network includes any proposed roads; MAGIS eXpress cannot lay out new roads! The geospatial database is imported into MAGIS eXpress (copies are made that are stored in the *dbf* and in the zip file. Once the network is imported, the user must locate the proposed roads and assign 'options' for MAGIS eXpress to use in solution. Proposed roads must have at least one option assigned, or they cannot enter in the solution and carry timber products. Options for proposed roads may be TEMPORARY (the road will be open ONLY during the period selected) or CLASSIFIED (the road will be open from the period selected through the end of the planning horizon). Existing roads do not need to have additional options, but may have reconstruction or decommission options.

Using the Project Area menu, the user can check the data requirements for the Geospatial database (i.e. the attributes and zones determined to be required by the cost and management regime definitions). Once the necessary GIS data are assembled, they are imported into MAGIS eXpress. This process checks for the required attributes, has the user assign 'exit' (also sometimes called 'final demand') nodes for moving timber out of the transportation network. The road network 'connectivity' is tested in relation to these exit nodes. Each node on the network has to connect to at least one 'exit' node. After the GIS import is complete, additional processing includes assigning options for road activities, assigning fixed and variable costs for roads, and building the set of options for resource projects (the 'resource project generator'). Once this is complete, the user can set up and solve the desired plannning scenarios.

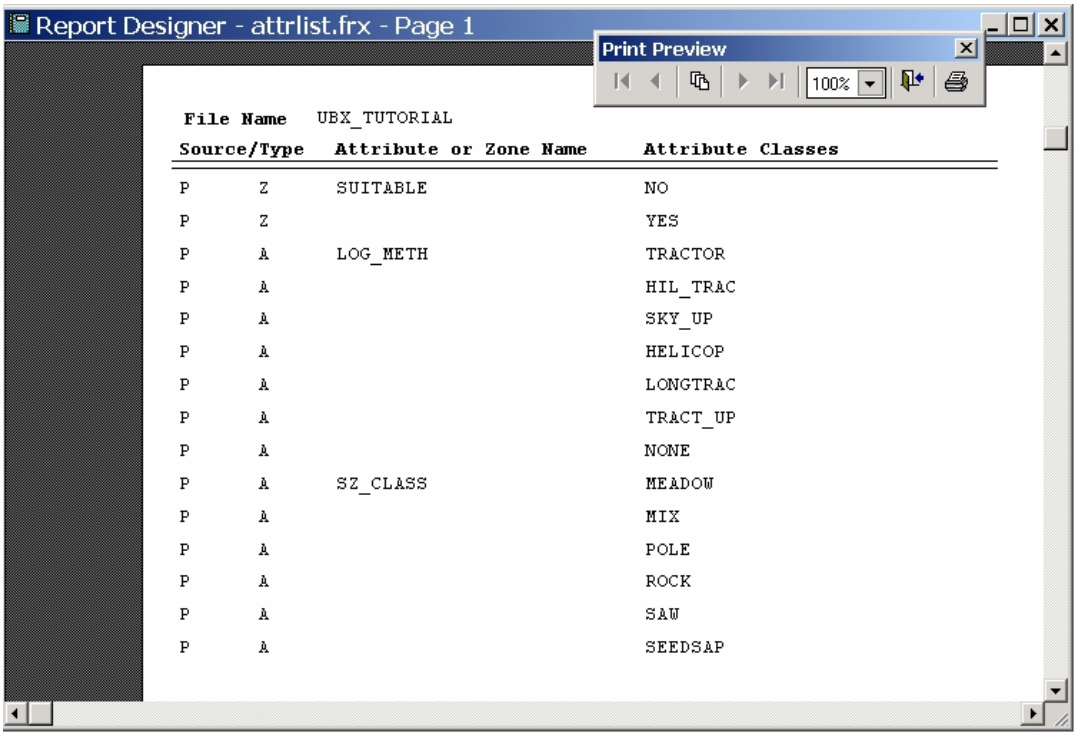
Required Attributes

This menu item allows the user to check on the definitions already made for the planning model, to determine what non-spatial attributes will be needed with the Geospatial database when they are to be imported. Exhibit 26 displays the Combined Required Attributes report. This report lists all the attributes and zones that have been used for costs or for management regime zones. It will also list the 'startvol' attribute used to calculate standing volumes. Attributes that are always required (for example, the vegetation attributes of HBTY_GRP, DOM_SP, SZ_CLASS,DENSITY are not listed unless they are used for a cost evaluation table).

The report columns are:

Source: ‘P’ for polygon
Type : ‘Z’ for zone, ‘A’ for Attribute
Attribute or Zone Name
Attribute Classes: all defined classes are listed.

Exhibit 26. Combined attribute list report



GIS Import Wizard

This procedure runs the MAGIS eXpress GIS import wizard. It requires ArcGIS 8.1 or later installed on the same computer. Geospatial databases used by MAGIS eXpress can be in the form of coverages or shapefiles. A treatment units (polygon) coverage and a road network (arc) coverage (or ‘dummy’ road coverage’) are required. This wizard is used to check and enter attribute values into internal MAGIS eXpress tables. There are two kinds of required attributes: the physical attributes that are always required by MAGIS eXpress and the user-defined attributes that form the definition of cost lookup tables. For each type of feature (arc or polygon) the ‘always-required’ attributes are checked automatically. See the appendix on the ‘always-required’ attributes for each theme.

The user may have to adjust attribute values in the MAGIS eXpress definition tables (form ‘attributes’) or adjust the GIS attribute table field names or values to match the attributes that are expected. There may be some iteration in this process, to repeat one or more steps of the import process, if any errors occur.

The network layer can be set up as a ‘dummy’. See the appendix on Dummy Network databases if a model without a network is desired.

The wizard is comprised of four forms, each of which has to be completed successfully before continuing to the next form. Forms 1 – 3 each include Help, Next, and Cancel buttons. Forms 2 - 3 also include Back buttons; the user may revisit forms as needed, proceeding back or forward in sequence. If a critical check fails at any point in the processing of forms 1 – 3 of the wizard, the import process is canceled. Form 4 allows the user to add zones that have not already been defined, and attributes that are defined but not already used (and therefore required); it allows the user to make sure that all desired attributes are added to the current planning model. Form 4 includes Help,

Back, Cancel, and a Finish button. The Finish button is only enabled when all checks have completed successfully.

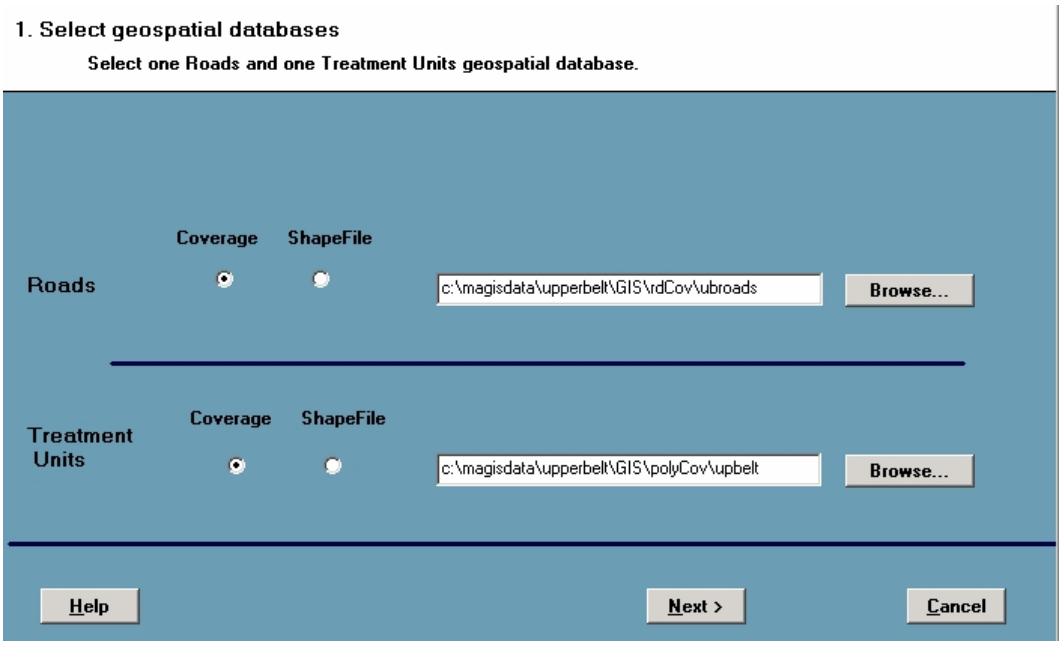
Select GeoSpatial Databases (Form 1)

This form (displayed in Exhibit 27) is used to identify the geospatial databases to be used and to perform internal checks for data integrity before proceeding. It is recommended that the user document a copy of the data to be used in MAGIS eXpress, so that it can be referred to and retrieved if needed. There may be several changes that need to be made to the MAGIS eXpress data before completing the model. For this reason, it is useful to retain and document a separate copy of the data for MAGIS eXpress use.

It is required that the arcs and nodes of the road data, and the polygons of the treatment unit data have unique identifiers in a field different than any of the standard ESRI identification fields. These identifiers are used for the from-node/to-node identifiers for links and as the polygon identifiers for treatment units. When a geospatial database is modified, the identifier values change and much work may be lost (particularly if the user has built a loading node table linking polygons and nodes) Both geospatial databases need to be projected (with the same projection).

The network geospatial database has to meet certain requirements: both arcs and nodes need to have proper topology, there needs to be one node at each intersection, links with only one endpoint are not acceptable, nor are duplicate links (two different links with the same two from-node/to-node ID), and all links need to be connected (snapped) to make the network functional. An additional note is that any link that is to carry timber products must make a connection to one or more exit nodes. Geospatial databases need to be projected, and the polygon and arc data need to be in the SAME projection. Both geospatial databases need to have proper topology (created with the BUILD function in ArcInfo) which creates the feature attributes tables for each feature class.

Exhibit 27. Select GeoSpatial Databases form.



Full Path Name of data layer. Enter the full path names or use the browse function to identify the location of your treatment units and roads geospatial databases. If you have used the wizard before for the current model, the full path names for the previously selected databases will

be visible in the text boxes. Either an ESRI coverage or shapefile may be used for either spatial data set. NOTE: ESRI GeoDatabase formats are not suitable for MAGIS eXpress.

Roads Coverage/Shapefile Click the radio button to the right of "Roads" corresponding to the ESRI format of your geospatial data that will be used for the network layer. This theme is required-but it could be a 'dummy'. See appendix on how to make a dummy road layer.

Treatment Units Coverage/Shapefile Click the radio button to the right of "Treatment Units" corresponding to the ESRI format of your geospatial database that will be used for treatment units. This theme is always required. Either an ESRI coverage or shapefile may be used for either spatial data set. ESRI GeoDatabase formats are not suitable for MAGIS eXpress.

Next - Click after both selections have been made. This starts the import process. MAGIS eXpress analysis of the data include testing for completeness of files for each database and whether both databases are projected and in the same projection. If these tests are passes, the next form is displayed. If an error message appears, cancel the wizard, correct the problem, and try again.

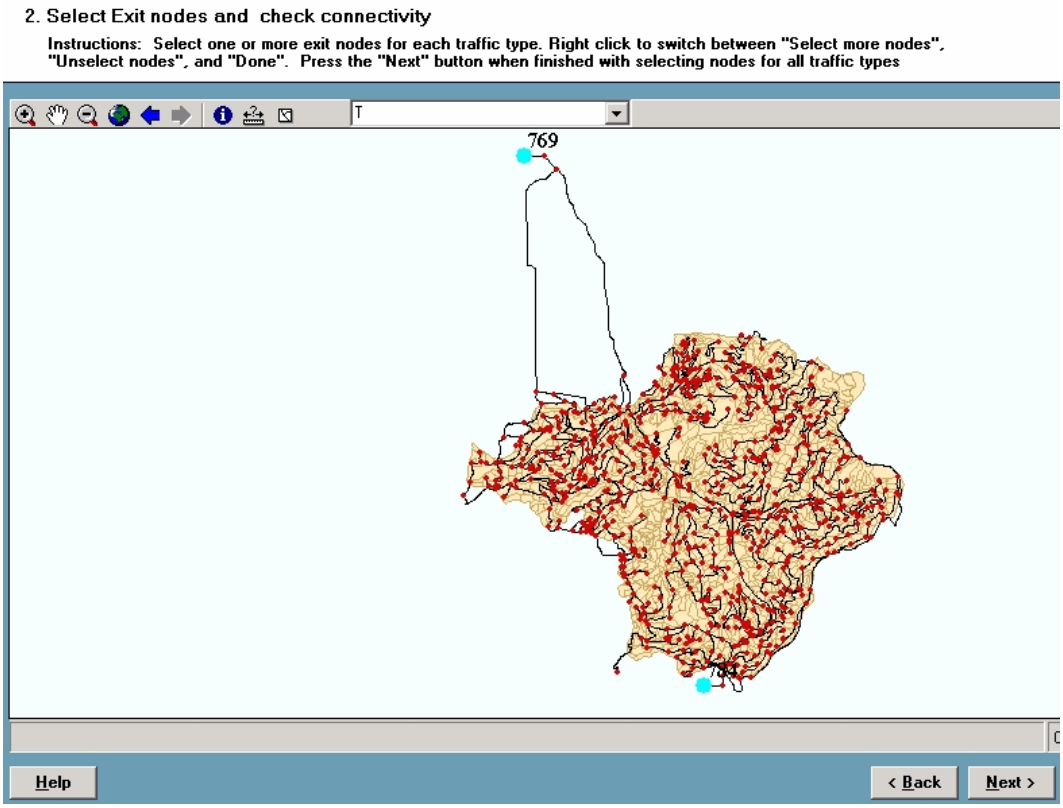
Cancel - Click at any time during the process to abort it.

Help - Activates the online help with GIS information. This is the same information given in the appendix on making Geospatial database/shapefiles.

Select Exit Nodes and Check Connectivity (Form 2)

This form (displayed in Exhibit 28) has two functions: 1) the user selects exit nodes for each traffic type defined in the model, and 2) based on that selection, the network's connectivity is checked. Exit nodes are the locations on the network where traffic leaves the model area: they are either 'final demand' nodes representing the actual mill site, or a node that represents the last road node within the planning area that traffic moves through or to before leaving the planning area. EVERY node on the network has to connect to one or more exit nodes. If variable (traffic) cost is to be computed, and exit nodes are not final demand nodes, there needs to be a 'dummy' link on the network representing the distance to the mill. See appendix for details on dummy road geospatial databases and dummy links.

Exhibit 28. Select Exit Nodes form



Map Toolbar Description

Use the map navigation and identification and measuring tools on the toolbar as needed. The following standard tools and buttons are included:

Zoom In - Select this tool, then click and drag a rectangle or click in the center of the area desired for zoom in.

Pan hand - Select the tool, then click and drag to move the map display in the pane.

Zoom Out – Select this tool then click and drag a zoom rectangle, or click in the center of the area desired to zoom out.

Zoom to full extent - Click to reset the map display to the fullest extent of the largest layer

Back extent (left arrow) - Click to change map display to previous view

Forward extent (right arrow) - Click to change map display to a previous view. Views are saved in order; if more than two views are in the 'stack' the left arrow moves to earlier views and the right arrow moves to more recent views.

Identify - Select this tool, then point and click on a node feature. An attribute table will pop up displaying field values for that feature. The popup window must be closed before other actions can occur.

Distance - Click and drag to form two endpoints. Distance is displayed in the same units as that of the geospatial database projection (usually meters) in a message line at the bottom of the screen.

Clear Selected Features - Click to clear all selected features from the current selection set. .

After using a tool, right click and select a menu item to continue with node selection or save selected nodes.

Traffic Type - Select the traffic type (timber product) from the dropdown list located in the toolbar over the map display. At least one Traffic Type must have been defined prior to using this interface.

Node Selection - Select one or more 'Exit' nodes for the selected traffic type by pointing and clicking with the left mouse button. A label displays the internal ID value for that node. This value (ID) must match the ESRI internal ID value for that node in the network geospatial database or shapefile. Right-click and select Done to save the selected nodes for the currently selected traffic type.

Next - Click to check connectivity and continue to the next form in the wizard after selecting and saving exit nodes for ALL traffic types.

Connectivity Check Completed - The connectivity check will fail if there is a disconnected link (a link that doesn't connect to one of the exit nodes), two links with the same 'from node' – 'to node' value pair, a link with only one endpoint (a circular link), or an intersection (three or more links) without a node. If an error message appears, cancel the wizard, edit your network coverage or shapefile to remove errors and then run the import process again. If the connectivity check completes without error, respond OK to the message to move to the next form.

Rebuild Road Options? - This message appears if the user has worked on the road options form for this same geospatial database and then run the import process again. If this import represents a new modeling effort, then road options should be rebuilt. If this is a 're-import' of the same information, and the network has not changed, road options can be retained.

Map display - The map displays treatment units and existing and proposed roads. Only node features are selectable in this particular map. Clicking with the right mouse button displays a context menu specific to the purpose of this interface.

Status bar - Coordinates are displayed in map units.

Right click pop-up menu action modes:

Add – (re) Set tool for selecting additional nodes to be chosen for the currently selected traffic type. This is necessary after using a tool or button on the toolbar.

Subtract – Set tool for removing nodes from those already selected for the currently selected traffic type.

Done - Select to save the chosen exit nodes for the currently selected traffic type.

Other:

Help - Click located at the bottom of the screen to display information about how to select exit nodes.

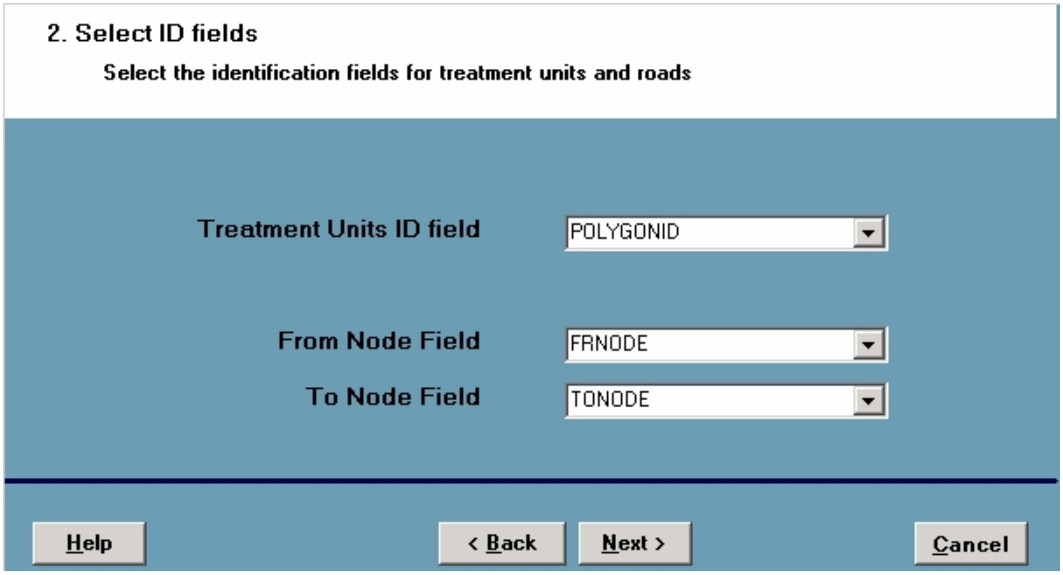
Back - Click to navigate back to the first form in the wizard to select a different geospatial database if needed.

Cancel - Click at any time to abort the import process

Select ID fields (Form 3)

This form (displayed in Exhibit 29) is used to identify the unique ID fields for each of treatment units and road networks databases. It is highly recommended, particularly for the network data, that the user create a separate ID field for each theme for the feature (treatment polygon or road segment). It is sometimes necessary to change or update the GIS data after attempting to import it because of errors in the data. The network layer is particularly vulnerable to this-the connectivity check often reveals data errors that were not originally obvious. When the layers are constructed, the user needs to identify the network nodes where polygon outputs are loaded onto the network. This might be a very extensive task. If the network undergoes modification AFTER this task is completed and is rebuilt, the node IDs will no longer match. If this happens, the user will have to rebuild the loading node file (see appendix on loading nodes). If the user has created a separate ID field for the nodes, they will not lose any work as a result of changes to the network layer. ID fields must have a unique entry for every treatment unit or road network link.

Exhibit 29. Select ID Fields form



Treatment Unit ID – Use this dropdown list of all of the user-defined attribute fields from the treatment units geospatial database to select the user-defined, unique identifier (ID) field. The values in the selected ID field CANNOT be longer than five characters (they can be numerals.)

From Node and To Node Fields – Use these dropdown lists of all the user-defined, numeric attribute fields from the road network geospatial database to select the user-defined unique identifier (ID) fields for the from- and to-nodes for the links. The values in either field MAY NOT be longer than five characters.

Help - Click to display context sensitive help

Back - Click to navigate back to previous forms in the wizard. One may edit the exit nodes or return to the first form to select a different geospatial database.

Next - Click to process the selections and proceed to the last form in the wizard. These ID fields will be used in all data tables and maps to label the respective features.

Cancel - Click to abort the import process.

CheckFields (Form 4)

This form (displayed in Exhibit 30) checks the attributes and attribute classes for roads and treatment units, and converts the attribute tables into records in MAGIS eXpress tables. The first process checks for required road attributes in the GIS, and compares their values with the defined values in MAGIS eXpress (road options). Any user-defined and user-required zone names will be listed in the right-hand (selected) list in the lower portion of the form. All GIS attributes are checked against the master list (see "Attribute Names" form.) for proper definition, and to verify that class names in the GIS match defined class names in MAGIS eXpress. The user may add zones for Effects Functions definitions at import (they don't have to be pre-defined in "Attribute Names"), but the class values in the GIS have to meet internal requirements: attribute names and class names are limited to 8 characters, may have NO internal spaces, and no illegal characters (*&@ and so on are illegal; only the underscore is allowed.)

After completing the two steps for road data, click the treatment units tab to perform a similar analysis for treatment unit attributes. Either may be repeated by clicking on the associated page tab. Required attributes for treatment units are the vegetation characteristics for pathway-states, and management information. User-required attributes include direct costs or attributes for cost table lookups, and user-required zones that have been usedfor the Resource Project Generator rules.

Additional zones may be added at this point. These zones may be used, for example, for defining Effects Functions or augmenting management regime rules.

After each processing step, a message is displayed indicating successful completion or that errors are present in the data. If the message includes an OK button, click that button to continue; if not, click anywhere or press any key to continue.

Road Data tab

Verification of required 'system' attributes (FROM_NODE, TO_NODE, CUR_STATUS) begins automatically (see Exhibit 30.), and while this processing is progressing, the items on the lower half of the roads page are disabled. If an error is indicated, click on the Display or Print command buttons to view or print a list of problem fields-cancel the wizard, make corrections, and retry. If the 'Required Link Attributes Have been added to MAGIS' message (Exhibit 31) is displayed, click OK and continue to the lower portion of the page for the user-required attributes.

Exhibit 30. Check Attributes and Zones for roads

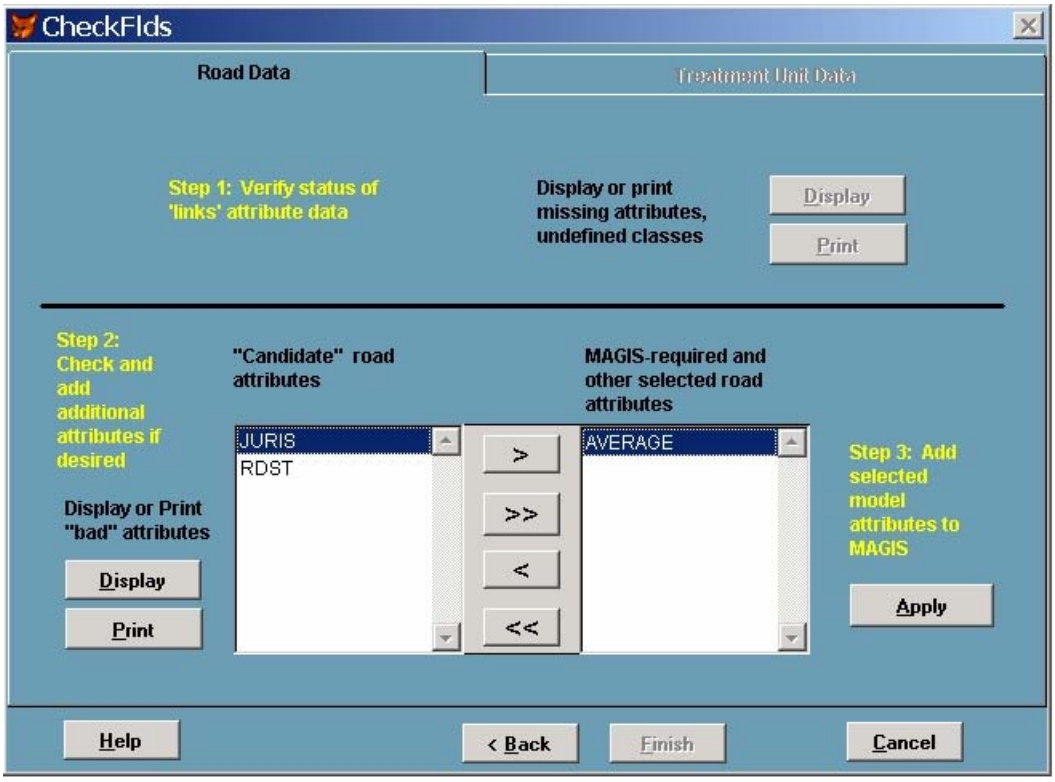
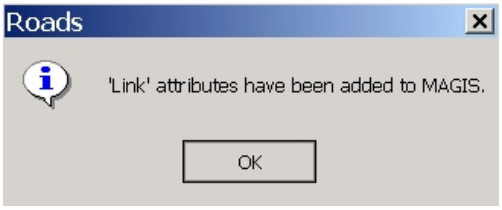


Exhibit 31. Completed processing message



Display - Click to view attributes that do NOT meet the requirements for MAGIS eXpress. Errors include discrepancies between the Pathway definitions for states and the GIS attributes of the same name.

Print - Click to send the error report to the default printer.

Candidate Road Attributes - For MAGIS eXpress, only the road attribute “AVERAGE” is required. Any other attributes passing the verification process appear in the Candidate/Selected lists. These may be used for Effects Functions zone information. Select “AVERAGE” and any zone attributes desired for Effects Functions, by double-clicking or right-clicking to move them to the Selected list. Click the Display or Print button (located beneath the Step 2 instructions on the form) for a list of candidate attributes which have not passed the test (for example the field name might be too long.) If any attributes not passing the verification process at this step are to be included in the model, cancel the wizard, correct field errors and retry the import wizard.

MAGIS eXpress required and other road attributes - This is the list of attributes ready for final checking and importing into internal tables. If an attribute appears on this list, and has not been moved there by the user, it should have '_R' appended to the name. If it does NOT have '_R', there is something wrong with it, and will need to be fixed (the import will fail in this case). NOTE: Attributes moved from the candidate to the selected list will not have '_R' appended and will not need it to import correctly.

Apply - Click to process the selected attributes.

Display - If enabled, Click for a display of attributes that are not ready for the next import step. A brief description of what is wrong with each attribute is included; the types of errors checked are different at each step. All attributes in the roads geospatial database are checked but not all are necessarily required or used in the model. At Step 2, attributes that were expected to be in the candidate list, but are not, should be listed here.

Print - Click to print the same information shown by the Display command button.

Help - Click for context-sensitive help.

Back - Click to return to previously visited forms.

Finish - Click to complete the import process. - This button is enabled only if all checks for both roads and treatment units have completed successfully.

Cancel - Click to abort the import process, when error messages indicate that verification checks for road network attributes have failed.

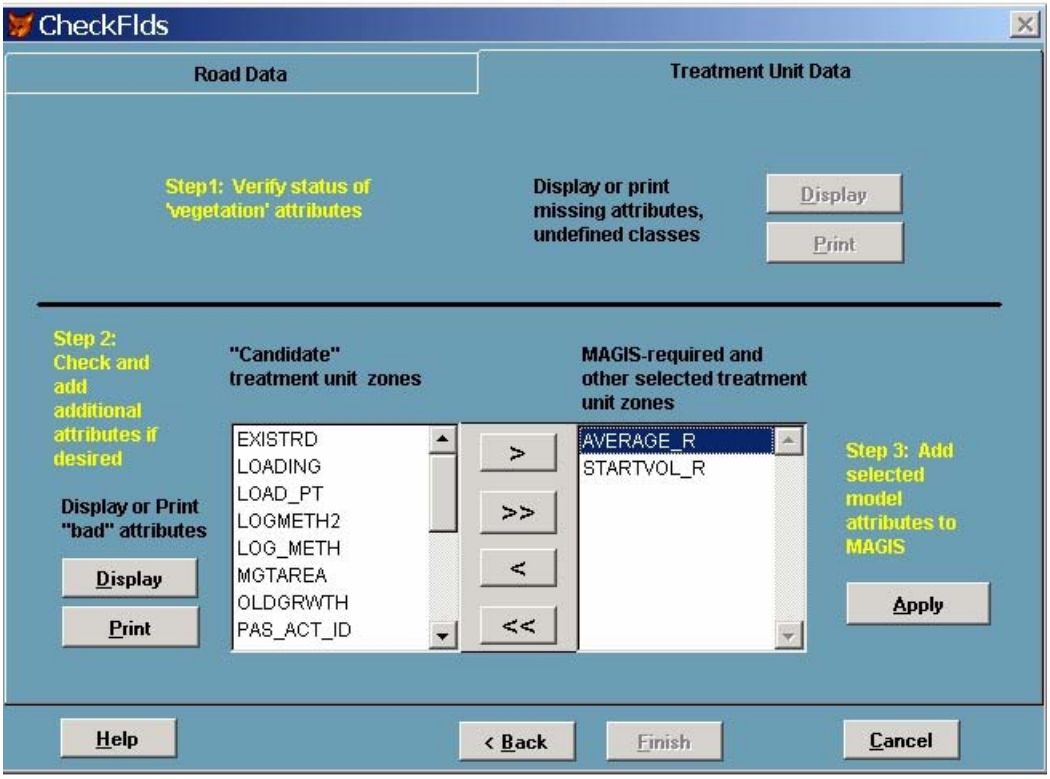
Treatment Unit Data tab

Verification of the required 'system' GIS attributes begins automatically when the tab is clicked. Required attributes for treatment units include the treatment unit ID (selected in form 3 of this wizard), pathway vegetation attributes (HBTY_GRP, DOM_SP, SZ_CLASS, DENSITY, TIME_INC), standing volume (STND_VOL), past activities (PAS_ACT_ID), and years since the past activity (YR_SIN_ACT). The user must have these fields with these names in their geospatial databases. The values for the attributes must match the values used in MAGIS eXpress to define the pathways and states. For example, if, in MAGIS eXpress, the user's pathway includes "V-LARGE", the geospatial database value for SZ_CLASS must be "V-LARGE" and not "VERY_LARGE" or anything else.

User-defined attributes include those that are used for cost look-ups, direct costs, zones for management regime definitions (resource project generator rules), and zones for Effects Functions.

This form page (see Exhibit 32) has two sections, similar to the road data tab. The upper portion is concerned with the required GIS attributes and the lower portion with attributes the user has specified as required by having made cost, management regime, or Effects Function definitions that use them. The GIS required data are processed first. When that is complete, a message window will be displayed indicating the success or failure of the first step. A failure message (click OK to respond) will be explained by viewing table of 'errors' with the Display button. The message indicating success (click OK), means that the user can move on to the the lower half of the form.

Exhibit 32. Check Attributes and Zones for Treatment Units



Display - If enabled at Step 1 or Step 2, Click for a display of missing attributes that are not ready to be processed. A brief description of what is wrong with the attribute is listed as well; the types of errors checked are different at each step. All attributes in the roads geospatial database are checked but not all are necessarily required or used in the model. At Step 2, attributes that were expected to be in the candidate list, but are not, should be listed here.

Print - Click to print the information shown via the Display button.

Candidate Treatment Unit Zones - This is a list of all potential model attribute names that have passed checks through Step 2. Double-click, right-click or click-and-drag an item from the candidate list to the selected list for processing. NOTE: If a required attribute name is listed on the right with a '_R' appended to the end, do not move it back to the candidate list. Do not create duplicated names on the selected list (candidates might appear on the left AND on the right with a '_R').

Selected Treatment Zones - This is the list of attributes to be imported. If an attribute appears on this list, and has not been moved there by the user, it should have an '_R' appended to the name. If it does NOT have '_R', there is something wrong with it, and will need to be fixed (the import will fail in this case). NOTE: Attributes moved from the candidate to the selected list will not have '_R' appended to them and will not need it to import correctly.

Apply – Click to process the selected attributes. Error messages will let the user know if anything is incorrect. A 'continue' window will be displayed when processing is completed without errors. Click anywhere or press any key to continue.

Help – Click this button to display context-sensitive help.

Back – Click to return to form 3, form 2, or form 1 of the wizard.

Finish – Click to complete the import process. This button is enabled only if all checks for both roads and treatment units have completed successfully.

Cancel – Click to abort the import wizard in case error checks for treatment units have failed.

Network Specifications Menu

In this section of planning model building, the specifications for network-specific activities are entered. Once the GIS data are imported, the user needs to assign options for road activities, the cost-per-mile for each option and assign variable costs for moving timber products through the network. Variable costs should include any maintenance costs for the local link.

Build/Edit Road Projects form

This map interface is used to enter fixed road costs for any road 'management' activities such as new (classified) construction, temporary road construction, road re-construction/upgrades and road decommissioning. For each proposed link, the user is to assign one or more road options and its associated fixed cost. The fixed cost for a particular road option can vary from link to link, but might be the same on several links; the map interface allows selection of multiple links at a time for batch processing. These 'options' form the basis for any road management that MAGIS eXpress can apply during the solution process: if an option isn't created here, it cannot be selected for the solution. If costs are not assigned here, they can't be accounted for in the solution. Proposed links MUST have at least one option before they can be used in a planning scenario (otherwise 'NOACTION' for that link is the only option). For existing links, the existing condition represents 'No Action'. The GIS data for existing links needs to indicate the current status and condition (or road standard) for these links. The GIS data also need to include (digitized) the proposed links, and their 'status' but does not require that they have a proposed option created in the GIS--that will be done in this form.

The master list of road options is created using the Road Options Definitions Form. The user needs to define all options that may be used.

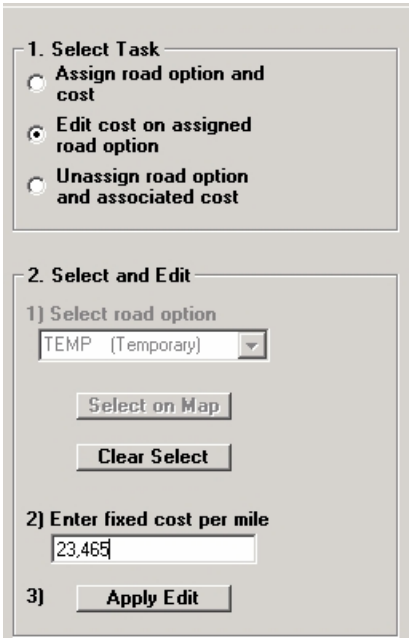
Certain rules apply for assigning options to links. 'Classified' options are permanent road surfaces, and remain open from the period of implementation through the end of the planning horizon. Existing links that have a road standard in this category are considered open unless a decommission option is applied to them. Classified options may be the existing 'option' for an existing link, may be a construction option for a proposed link, or may be a re-construction option for an existing link. 'Temporary' road options are what they indicate: they are temporary road surfaces, meant to be used only during the harvesting project and to be removed thereafter. They are open only during the period of implementation. Temporary options may ONLY be assigned to proposed links. 'Decommission' options represent PERMANENT CLOSURE of a link, and therefore can only be applied (assigned) to an existing link. The link is CLOSED from the period of implementation onward.

This form is used to perform any of three main tasks: Assign road options to links, Edit road option fixed costs, and Delete road options. Some control and tool behavior varies by chosen task. There are three main 'panes' or areas in which the user can work. On the left hand side of this form there are a tabbed 'task pane' and 'table of contents'. The map pane takes up most of the remaining form area and has its own set of tools and conventions. The tasks, in order of operation, are

described first, followed by a more detailed description of the table of contents and the various tools.

Task pane - The task pane (shown in Exhibit 33) is displayed as a tabbed page together with the map Table of Contents. Several steps are required to complete a road project assignment task using this interface: Select a task, select features, then enter cost, and finally apply edit. NOTE: The map display changes whenever a different road option is selected and when the Add New/Apply Edit/Delete button is clicked. The Task Pane exhibit below shows the Apply Edit button because task 2 was selected.

Exhibit 33. Road Projects Task Pane



Select one of the three tasks to start the editing process. Road Options have to be assigned to at least some links before one can edit or delete (the second and third tasks) them.

Assign Road Option and Cost - Use this task to assign construction options to proposed links or re-construction or decommission options to existing links. The logical first task is to assign options to proposed links. Select this button to start assigning new options.

Select Road Option - Choose a road option from the dropdown list. Road option category names, ‘classified’, ‘temporary’, and ‘decommission’ are indicated for convenience. The map display is then updated to indicate which links already have this road option assigned.

Select On Map - Click to update the map display with links which are available to have the selected road option assigned to them. At this point, only these links can actually be selected using the selection tool. Click and drag the tool to select one or more links. Links can be added to the selected set by repeating the click-and-drag operation on different links. To remove a link from the selected set, right-click with the tool in an inactive space and select ‘subtract’ from the popup menu. The tool stays in the subtract mode until the menu is activated again (with another right-click) and ‘add’ is selected. ‘Add’ is the default mode.

Enter Fixed Costs Per Mile - Once all the desired links are selected, enter a cost in this textbox.

Apply Edit – Click theis button to complete the task. To move to another task, or repeat the task with a different road option, either click one of the other task buttons, or click the 'Clear Select' button.

Edit Cost on Assigned Road Option – Select this button to start this task.

Select Road Option – Select a road option from the drop-down list of road options; select an option that you know has been assigned to at least one link. NOTE: If an option is selected that has NOT been assigned to any links, an error message will be displayed.

Select on Map – Click this button to display a table containing all links and current fixed cost matching the road option selected. Select one or more links using the select tool, or by clicking the square area on the extreme left of the table itself (this selects the entire table record and is shown highlighted).

Enter Fixed Cost per Mile – Enter a new value in the "Enter Fixed Cost per Mile" box, and click

Apply Edit - Click to complete the edit action. Alternatively individual table values can be edited by clicking in the Fixed Cost cell and entering the desired cost there. Than click the Apply Edit button to update the table with the new cost (changes are also saved simply by clicking on a different row in the table.)

Unassign road option and associated cost

Use this task to remove an option previously assigned to a link. This makes the option unavailable for the solution process, so several rules about what can be deleted apply here.

Select on Map - Click this button to display a table containing only those links and assigned fixed costs that match the currently selected road option. NOTE: The displayed table is not editable, but can be used to select individual records or groups of records. Select one or more links using the methods described above.

Delete - Click to remove the selected road options from the table. Click a different task button or click the Clear Select button to move to a different task.

After each action, view the map layers to decide on your next action. This can be for the same task/road option, for the same task but different road option, or for a different task and a different road option.

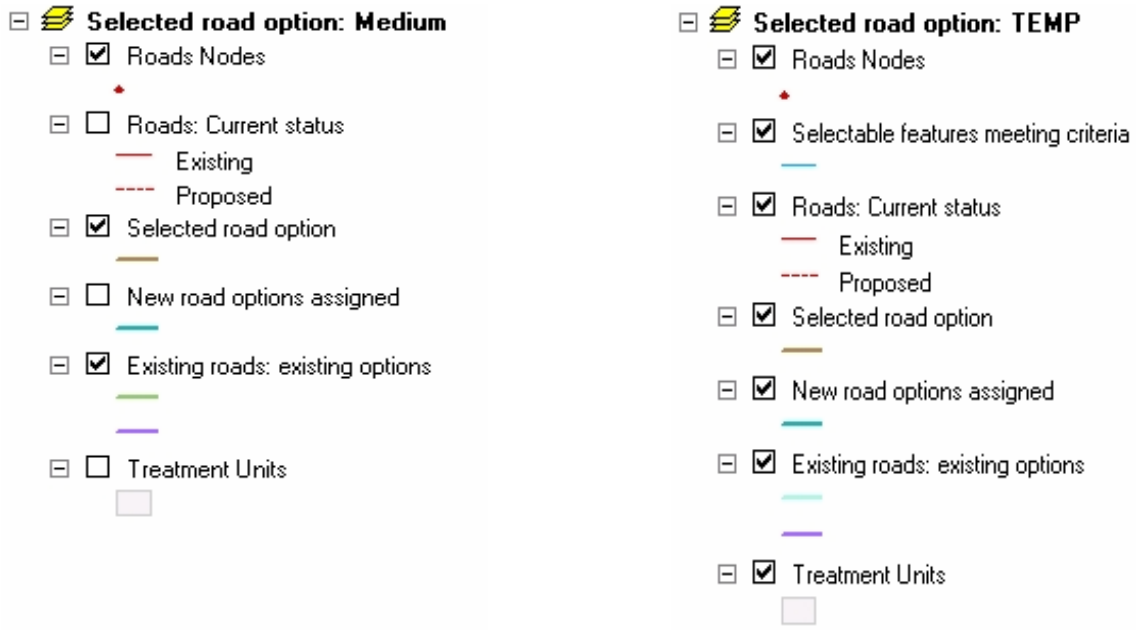
Table of Contents (TOC)

The map display (shown in Exhibit 35) and TOC layers provide feedback about road options for each of the three tasks. The Table of Contents for Road Options (shown in Exhibit 34) includes

layers that are used for reference as well as layers that are needed for the task. The user can modify the table of contents legends and symbol colors as needed to aid in completion of the task.

Three layers are displayed for the Assign task and four layers are displayed for the Edit and Delete tasks. In the left side of Exhibit 34, the TOC is displayed as it appears after the road option is selected, but BEffects FunctionORE 'Select on Map' is clicked. The layer 'Selected Road Option' indicates which links are already assigned the selected road option (NOT which links are in a selected set). Displayed on the right side of Exhibit 34 is the TOC as it appears AFTER the 'Select on map' button is clicked. A new layer, 'Selectable features meeting criteria' appears. This layer indicates the links which meet the criteria, and which can be selected. NOTE: NO links are selected until the user selects features.

Exhibit 34. Table of Contents for Road Options form



Description of Map Layers:

Road Nodes. – This layer is the same for each of the three tasks. It displays the nodes or endpoints of each link, to aid in orientation and selection of links.

Road status – This layer is the same for each of the three tasks. The line symbols are drawn over the other layers to indicate whether a link is existing or proposed.

Selectable features meeting criteria –. This layer is present for each task after the Select on Map button has been clicked. While on the Assign task, it displays links that are available to have the option newly assigned, but while performing the Edit task, it displays links that have already been assigned the selected option (so they may be edited).

Selected road option – This map layer indicates which links have had the currently selected road option assigned. The display for this layer is updated when a different road option is selected from the road option combo-box list and when the Delete button is pressed.

New road options assigned – This layer is present for each task. It shows all links which have had one or more road options (different than the existing option in the case of existing roads) assigned. The display for this layer is updated each time an Assign or Delete action has taken place.

Existing roads Existing options – This layer is present for each task. It shows only existing links, colored by the existing 'option' (this is not really an option, but the current condition of that link. It could be thought of as the 'no action option' for that link.)

Treatment units – This layer is present for each task, as a display of the background treatment units to assist in orienting the user to the road layer.

TOC Usage Notes

The currently selected road option name is printed at the top of the TOC for reference.

The legend for each layer in the TOC may be toggled (expanded) between visible and not visible.

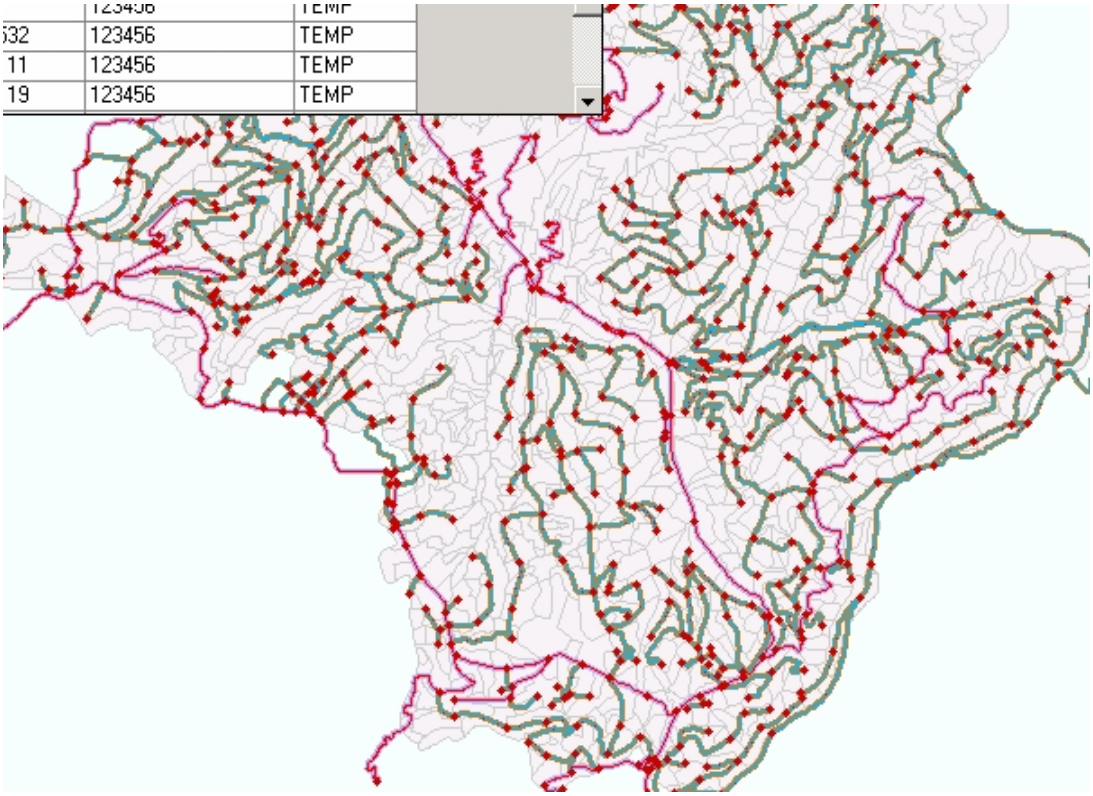
Drag layers up or down to rearrange the order of display if needed.

To change individual legend item symbols, left click directly on a symbol. A color palette dialog box will appear; make your selection and click OK to close the dialog (use <ESC> key to close the dialog box without making changes).

To change all symbols for a layer legend in one operation, right click on the layer name. The layer has to be visible (checkbox checked) before this legend editor is active. A symbology tab dialog box for the particular type of legend for that layer will appear. First reselect the highlighted attribute table field from the field list, and then make your edits to the legend.

Map display - The map display (shown in Exhibit 35) includes a standard map navigation toolbar and a display table (which is active when the Select on Map option is clicked). Use the map to locate and select links for the indicated action. Use the display table for editing individual records, or selecting groups of records for road project cost editing.

Exhibit 35. Road Projects Map Display and Toolbar



Right click pop-up menu action modes:

Add - Click to enable cursor add features or individual table records to the current selection set, especially after using a tool on the toolbar.

Subtract - Click to enable the cursor to unselect features or individual table records from the current selection set.

Map Toolbar Description

Standard map navigation tools and an Identify tool are included on the toolbar (displayed in Exhibit 35). These tools include:

Stop Map Tool – After using one of the OTHER map tools, Click this tool to revert to the pointer (default cursor). Right-click and select a mode to reset the tool for selection.

Zoom In - Select this tool, then click and drag a zoom rectangle, or click in the center of the area desired for zoom in.

Pan hand – Select this tool, then click and drag to move the map display in the pane.

Zoom Out – Select the tool, then click and drag a zoom rectangle, or click in the center of the area desired to zoom out.

Zoom to full extent - Click to reset the map display to the fullest extent of the largest layer

Back extent (left arrow) - Click to change the map display to a previous view.

Forward extent (right arrow) - Click to change the map display to a previous view. Views are saved in order; if more than two views are in the ‘stack’ the left arrow moves to earlier views and the right arrow moves to more recent views.

Identify - Select the tool, then point and click on a feature. Attributes for that feature will be displayed in a popup window. This window must be closed before other actions can continue.

Distance - Select the tool, then click and drag and to display the distance. Click again to end a session (the tool is still active and a new location may be selected to start a measurement.) Distance is displayed in the same units the data is projected in (usually meters) on the tool itself.

Cost table operations

The table (shown in Exhibit 35) listing fixed cost records is displayed during the Edit and Delete tasks. Records in the table correspond to features in the layer 'Selectable features meeting criteria'. Thus, only records representing features that MAY be selected are listed. Selecting features on the map highlights records in the table and vice versa. Click on the gray rectangle at the left edge of the record to select a record. (There is an arrow pointing to the current record in the table.) Use the map navigation tools to view areas which might initially be displayed beneath the table. The table is not resizable or movable. Click the Promote button on the toolbar to move selected (highlighted) records to the top of the table for easier viewing.

Records can be sorted in ascending or descending order of any field by double-clicking the field header.

Records may be selected/unselected and the "Fixed_cost" field (Edit task only) can be edited. To select one or more records, click to the left of each record in sequence. One way to edit the fixed cost field is to enter a value in the text box in the task pane and click the Apply Edit button. The entered cost will appear in all records which were selected. To edit the Fixed cost field directly in one record, click once (do not double-click), type in the desired value, and click once anywhere in another record or click the Apply Edit button. Selected records can be deleted only by pressing the Delete button (Delete task only).

Status bar

During the selection of links, the number of miles of road currently selected is displayed in the message panel at the bottom left. When an Assign task action or Delete task action occurs, the number of affected links is displayed in the panel at the left. The message panel at the right always displays coordinates in map units.

Traffic Costs form

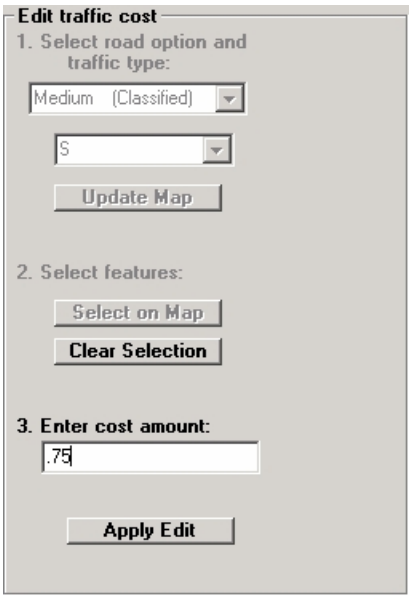
This form is used to assign traffic (variable) costs to links. Each cost amount represents the cost of hauling one unit of timber product one mile on the particular road standard (in MAGIS eXpress called a road 'option'.) For example, the cost to haul timber on a gravel road is higher than on a paved road (since the truck has to go slower), but may be lower than on a 'temporary' surface or dirt road. The cost for a particular road option can vary from link to link due to other factors (grade, curves, and required maintenance.) The form is designed to allow the user to work as efficiently as possible; one method might be to assign the same cost to all or most links having the same road option, then refine that cost for individual links that vary from the average cost. There are three main windows or panes on the form: the Task Pane, the Table of Contents (TOC), and the Map display. Use the Task Pane to select the traffic type to which costs will be assigned; use the TOC to modify the information displayed, and use the map display to locate and edit costs for selected links.

Task Pane

The task pane (shown in Exhibit 36) is a tabbed page with the map Table of Contents, and is displayed on startup of the form. There are four steps to perform: 1) select criteria (road option and

traffic type), 2) select one or more links, 3) enter the cost per unit of product per mile, and 4) click the Apply Edit.button to finalize the process. The map display updates whenever a different road option is selected and when the Apply Edit button is clicked.

Exhibit 36. Task Pane for Traffic Costs



1. Select road option and Traffic Type - Select a road option from the drop-down list. The selected road option forms the basis for identifying links whose traffic costs are to be edited.. The 'Selected features meeting criteria' and the 'Selected road option' layers are updated each time a road option is selected from the list. 'Decommission' options are not appropriate for setting traffic costs and are not included in the road option list.

Traffic type - Select one traffic (timber product) type from this second drop-down list or select 'All'. For each selected road option, each traffic type should be selected in turn to ensure that traffic costs are entered for each road option – traffic type combination for each link.

Update map - Click to update the map features based on the selected criteria. The layer 'Selected features meeting criteria' then becomes available.

Note that the value "All" is included in both combo-box lists. This is useful for viewing all road option – traffic type record values or all traffic type traffic costs for one road option for selected links.

2. Select features

Select on Map - Click to create a set of editable links. This button must be clicked before selecting links on the map and/or in the table. Links that have the chosen road option become available for selection. There are records in the attribute table (traffic cost table) for each link for each road option and traffic type. If the user fails to enter a variable cost for one of these, the link is not closed to hauling, hauling is 'free'!. The display table lists the records of the selectable links.

To select features, either click on individual links or drag a rectangle through one or more links. This action may be repeated as many times as needed.

To unselect links on the map or link records in the table, use the right click menu to set the action mode to Subtract (from the selection). Then select links or records to be removed from the current selection. This action may be repeated as many times as necessary. After unselecting features, again use the right click menu to return to Add (to the selection) mode.

Clear Select - Click to clear any map/table selections and allow restarting a map/table selection for the currently selected road option – traffic type combination or restarting with a different road option – traffic type combination.

3. Enter variable cost - Enter the cost per unit of timber product per mile that is to be applied to all selected links (records) for the currently selected road option and traffic type.

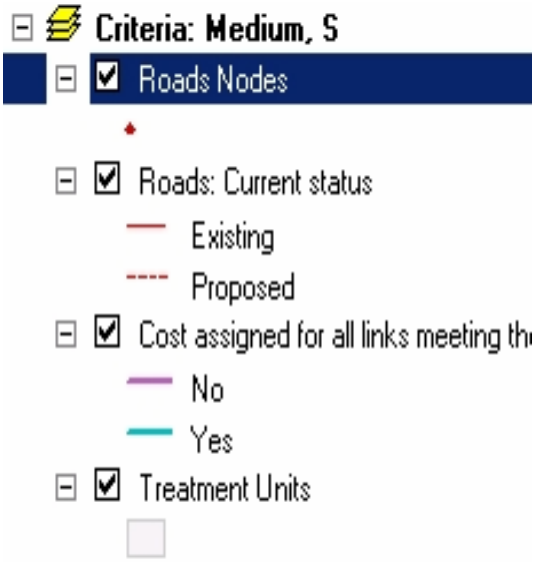
Apply Edit - Click to apply the variable cost to all selected links/records for the currently selected road option – traffic type combination. A cost must be typed into the text box before pressing this button.

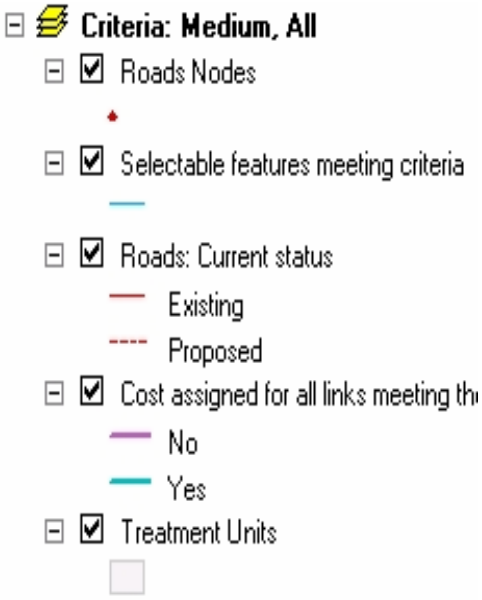
The currently selected task and road option – traffic type combination remain in effect. The user may repeat the sequence of selecting links features or records, typing in a cost value and clicking the Apply Edit button as many times as needed before selecting a different road option – traffic type combination.

Table of Contents (TOC)

The map display pane (shown in Exhibit 37) and TOC layers (show in Exhibit 36) provide feedback about road options and traffic costs for each of the three tasks. Three layers are displayed on the map. Clicking the right mouse button on the map displays a context menu for the map selection tool.

Exhibit 36. Table of Contents for Traffic Costs





Description of Map Layers:

Road nodes. – This layer is the same for each of the three tasks. Nodes at beginning and end of each link assist in orienting the user to link values.

Road status. – This layer is the same for each of the three tasks. The line symbols are drawn over the other layers to indicate existing or proposed links.

Selectable features meeting criteria. – This layer indicates links that have a cost assigned for the currently selected road option-traffic type combination (Exhibit 36 on the right). This layer is only drawn when the Select on Map button is activated.

Cost assigned for all links meeting the criteria. – This layer (see left panel in Exhibit 36) displays the status of links meeting the criteria: if the link does NOT have a variable cost assigned for this criteria, it is symbolized “NO”, and if it has been assigned a cost, it is symbolized “YES”. This layer is updated each time that an Apply Edit action has taken place or when a different criteria is selected.

TOC Usage Notes

The currently selected road option-traffic type combination is printed at the top of the TOC for reference. The legend for each layer in the TOC may be toggled (expanded) between visible and not visible.

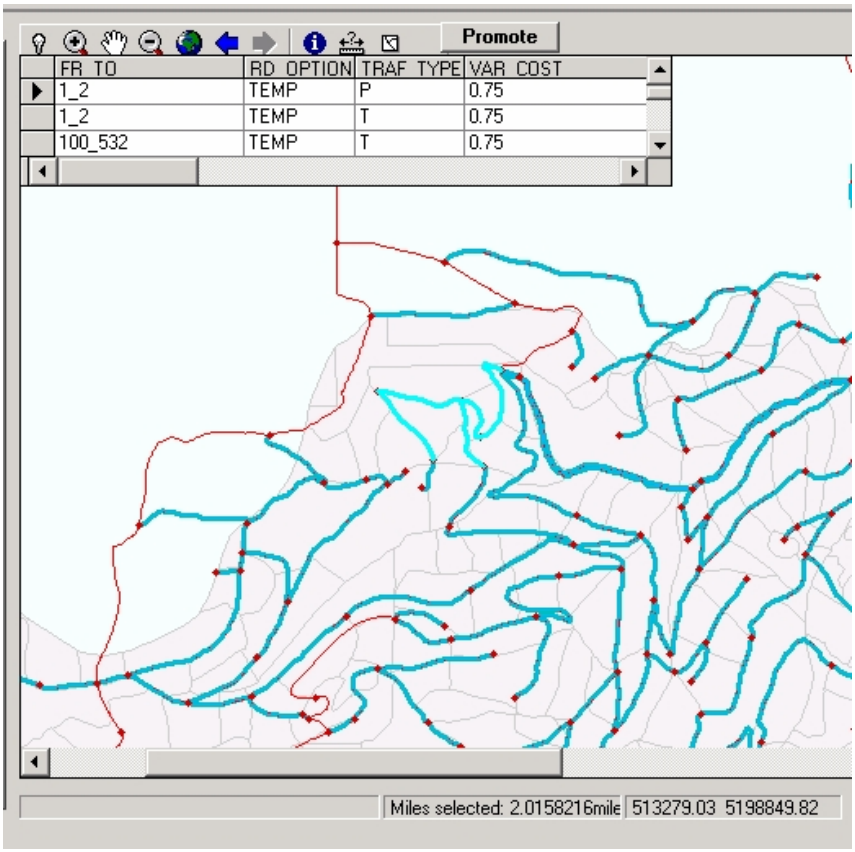
Drag layers up or down to rearrange the order of display if needed.

To change individual legend item symbols, left click directly on a symbol. A color palette dialog box will appear; make your selection and click OK to close the dialog (use <ESC> key to close the dialog box without making changes).

To change all symbols for a layer legend in one operation, right click on the layer name. The layer has to be visible (checkbox checked) before this legend editor is active. A symbology tab dialog box for the particular type of legend for that layer will appear. First reselect the highlighted attribute table field from the field list, and then make your edits to the legend.

Map display – The map display creates a graphical interface for selecting specific links to edit. The map toolbar contains standard map navigation tools for changing the map extent and view. The select tool includes a right-click menu to change the selection mode from add features to subtract features. This display also includes the 'Display Table' when the 'Select on Map' button has been clicked.

Exhibit 37. Map Display, Toolbar, and Display Table for Traffic costs



Map Toolbar Description

Standard map navigation tools and an Identify tool are included on the toolbar. These tools include:

Stop Map Tool – After using one of the OTHER map tools, Click to revert to the pointer (default cursor). Right-click and select a mode to reset the tool for selection.

Zoom In –Click this tool and drag or click in the center of the area desired for zoom in.

Pan hand – Click this tool and drag to move the map display in the pane.

Zoom Out – Click and drag a zoom rectangle, or click in the center of the area desired to zoom out.

Zoom to full extent – Click to reset the map display to the fullest extent of the largest layer

Back extent (left arrow) – Click to change the map display to a previous view.

Forward extent (right arrow) – Click to change the map display to a previous view. Views are saved in order; if more than two views are in the 'stack' the left arrow moves to earlier views and the right arrow moves to more recent views.

Identify – Click this tool to select the tool, then point and click on a feature. Attributes for that feature will be displayed in a popup window. This window must be closed before other actions can continue.

Distance – Click this tool and drag to form two endpoints. Distance is displayed in the same units the data is projected in (usually meters) at the bottom of the map pane.

Promote (only when table is active) - Click to move selected records to the top of the display table (see Display table).

Right click pop-up menu action modes:

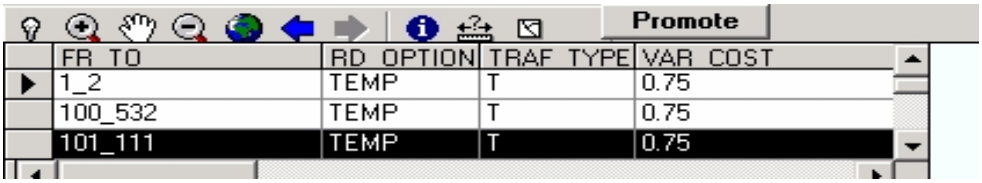
Add – Click to enable cursor add features or individual table records to the current selection set, especially after using a tool on the toolbar.

Subtract – Click to enable the cursor to unselect features or individual table records from the current selection set.

Display table operations:

The table (shown in Exhibit 38) appears when the Select on Map button is clicked. Records listed in the table correspond to features in the layer 'Selectable features meeting criteria'. Selecting features on the map highlight records in the table and vice versa. Use the map navigation tools to view areas which might be initially displayed beneath the table. The table is not resizable or movable. Click the Promote button on the toolbar to move highlighted records to the top of the table for easier viewing.

Exhibit 38. Display Table for Traffic Costs



The records in this table of traffic costs can be sorted in ascending or descending order of any field by double-clicking the field header.

The user may select/unselect records and edit the variable cost field. To select one or more records, click on the record marker (the gray square) to the left of each record in sequence. One way to edit the Variable cost field is to enter a value in the text box in the task pane and click the Apply Edit button. The entered cost will appear in all records which were selected. To edit the variable cost field directly in one record, click once (do not double-click), type in the desired value, and click once anywhere in another record. Use the Promote button to move selected records to the top of the table for convenience.

Status bar

During the selection of links, the number of miles of road currently selected is displayed in the message panel located at the bottom left. When an Apply Edit action takes place, the number of links affected by this action is displayed in this message panel at the left. The message panel at the right always displays coordinates in map units.

Treatment Unit Specifications Menu

Once the GIS data are processed (imported) into MAGIS eXpress, treatment units need to have information developed about loading nodes (points where timber products enter the road network as 'traffic'), and then management (treatment) options are to be assigned to each treatment unit. These options form the basis for a MAGIS eXpress solution-they are the 'decision variables' from which the solver chooses a schedule of treatments to satisfy the Effects Function chosen as the objective function, within all defined constraints. The options can be generated by running the 'resource project generator' which assigns options based on the user-defined rules (see Resource Project Generator Rules), or the user may elect to create the options manually (or a combination of the two.)

The processing steps to process in this menu include running the Loading Node application to assign defaults for loading nodes (required), running the resource project generator (required, but if no rules are set in the management regimes definitions form, only NO ACTION options will be created), and checking and editing (if necessary) the treatment options generated.

Loading Nodes

This menu selection results in a dialog box allowing either a tabular edit or a map display of the treatment units and road network together. Its purpose is to develop a set of default loading nodes that are to be used later by the Resource Project Generator. Loading nodes are specific to logging system (yarding method). So, for each logging method that might be applicable to a given treatment unit there should be a default loading node assignment. These defaults are then used by the 'Resource Project Generator' resource projects are created. A resource project is a MAGIS eXpress management option which consists of a treatment unit, management regime, logging method (yarding system), loading node, and period of implementation. If there is more than one default logging method–loading node for a treatment unit, a separate resource project will be created for each logging method.

In this interface the specific tasks are to select a default logging method to work with, then select one or more nodes, select one or more treatment units that will load to those nodes, then click the Save button. A table will appear in which the user fills in the percentage of the timber output that loads to each of the selected nodes from the designated treatment units.

Map Display and Toolbar

The map display shows a treatment unit layer, a link (arc) layer and a node layer. The toolbar includes map tools and 'task' tools. The menu system contains mostly the same tools as in the toolbar, plus a few more as follows:

File:

Exit - Click to exit the map interface and return to MAGIS eXpress. You will need to restore the MAGIS eXpress window which has been minimized to the task bar. Respond to the text message 'Press OK if Done with the GUI' by clicking the 'OK' button.

View

Contour Lines - Available only when a contour.e00 file has been created in ArcView or ArcInfo and saved in the DBF folder. Optional. Click this item to activate the contour line map.

Overlay - Click this item to display a full extent view of the treatment unit layer in a popup window, with the screen extent outlined in red. This is useful for orienting the work area when zoomed in (not much help when zoomed out!)

Legend – Click this item to show a popup legend box giving colors for nodes and areas. This legend is not editable. CLN in all cases stands for Current Loading Nodes and indicates the set of all currently selected nodes.

Legend color descriptions:
Black node = available to add to selection (only when in "Node Mode")
Cyan node = selected node
Gray polygon = not assigned to any node
Red polygon = not available, assigned to a different node(s) for this type
Green polygon = assigned to current loading node set
Purple polygon = selected but not yet assigned or assigned to this current loading node set plus other, non selected node
Yellow polygon = assigned to a different node(s) for this logging method. Available for selection
Tool bar - Click to toggle the toolbar visible or not visible. When the toolbar is not visible, tools may still be used from the menu
Control bar - Click to toggle the control bar (task tools) visible or not visible. When the control bar is not visible, selections may not be made. The last know selection will be used.
Status bar - Elevation is reported for cursor position, but only if grid.e00 is present in dbf folder (see appendix X for details on grid and contour functions.)
Restore - Reset view to default view of entire map.
Refresh - Update map view. Does not change view extent.

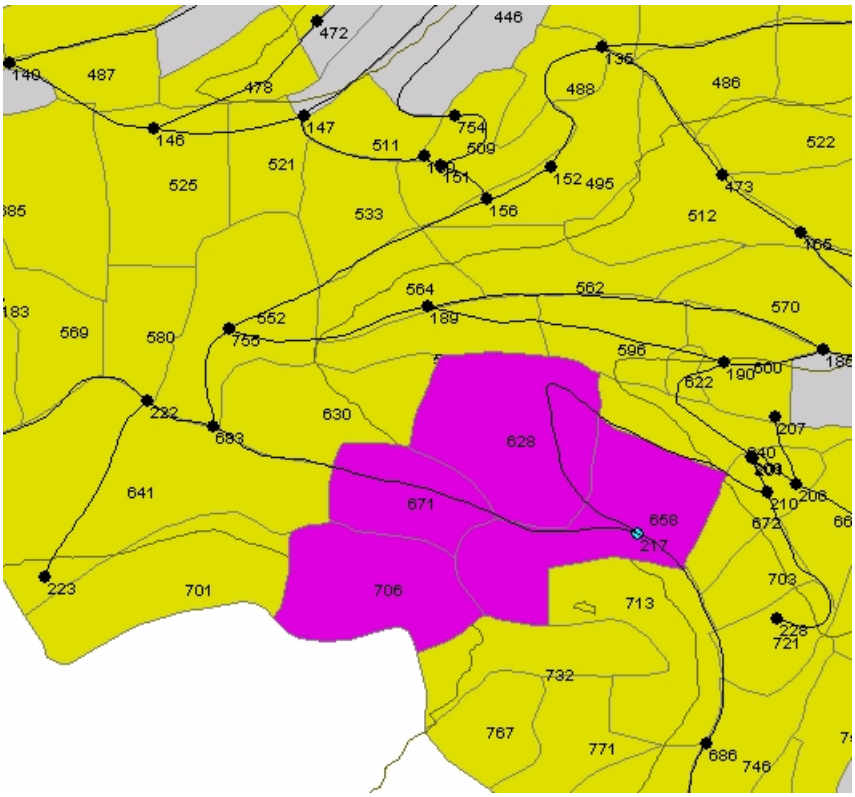
Tools:

Zoom Factor - Use arrow to expand menu to the right. Select the map zoom factor (default is 2.0). This factor applies to both zoom in and zoom out.
Zoom In - Click to activate the Zoom In tool. The tool is active if the cursor appears as a magnifying lens with a " + " in the middle. Click in the center of the area to be zoomed to. (Click and drag does NOT draw a zoom-in rectangle.)
Zoom Out - Click to activate the Zoom Out tool. The tool is active if the cursor appears as a magnifying lens with a "- " in the middle. Click in the center of the area to zoom out from.
Normal Pointer - Click to revert the cursor back to the normal pointer for node or area selection. The cursor should appear as an arrow. Right-click will also work to revert the cursor back to normal selection.

Mode

Nodes - One or more nodes needs to be selected first. Click this item to start selecting nodes. Select a node by clicking on the node identifier, which should be the number closest to the node.
Areas - Once a node has been selected, the areas will be colored according to the legend. An area loading to the selected node will be colored green. If no polygons are green, no areas have been assigned this node (or combination of nodes). Purple polygons are assigned to this node and some other node in addition to the selected node(s). See Exhibit 39 for example of this situation.

Exhibit 39. Select Node and Area(s)



Map Toolbar

The map toolbar (shown in Exhibit 40) contains the main map functions (which can also be accessed from the menu) plus the task functions (which are NOT accessed from the menu). These functions are: Logging Method, Loading Type, Save, and Clear.

Exhibit 40. Loading Nodes toolbar

 Click this tool to zoom in on the map area currently displayed.

 Click this tool to zoom out on the map area currently displayed.

 Click to return the cursor to selection mode. The cursor will appear as an arrow. A right-click will also return the tool to normal selection mode.

 Click this tool (default setting is ON) to add nodes to the selected set of nodes. Using the select tool (the arrow) click on the number nearest the desired node to select it (IMPORTANT). Treatment units that are already assigned to that node AND LOGGING METHOD will be colored green. Treatment units that have been assigned to a different node for the current logging method will be colored yellow. Treatment Units not assigned with this logging method (or not assigned at all) will be colored gray. This is the same as Mode/Nodes menu selection item.

 - Once all the nodes are selected for the current set, click this tool to permit treatment units to be selected. Click on the treatment unit id number closest to the desired treatment unit

(IMPORTANT). Selected treatment units will be colored purple. This is the same as Mode/Areas menu selection item.

 - Click to obtain a popup window containing a full extent view of the treatment unit layer, with the screen extent outlined in red. This is useful for orienting the work area when zoomed in (not much help when zoomed out!) This is the same as View/Overlay menu selection item

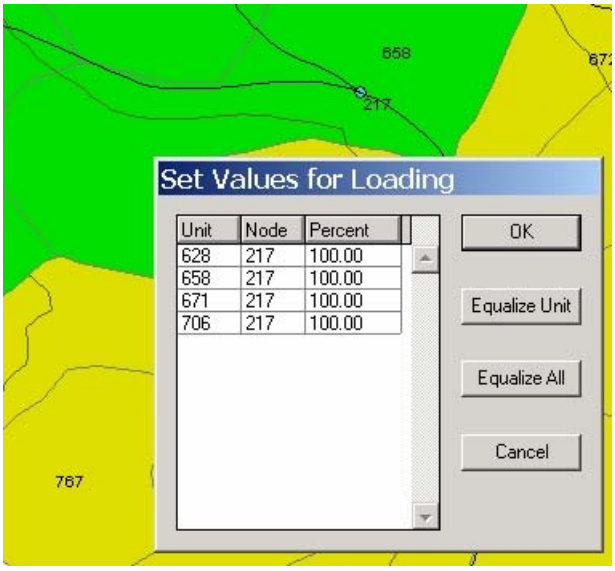
Logging Method - Use this dropdown list to select the logging method (yarding system or logging system) to work with. Every treatment unit that potentially uses a given logging method should have a loading node default assignment for that logging method.

Loading Type - Default to Fixed for MAGIS eXpress. (MAGIS allows variable costing for loading node-logging methods). Do NOT change to 'Variable' in MAGIS eXpress. (It should be grayed out so that this action cannot occur). There will be no references to it in other parts of the model, and any assignments will not be used.

Save - Click to bring up the table editor (shown in Exhibit 41) for completing the loading assignment. All combinations of treatment unit and loading nodes for the current set will be displayed.

Clear - Click to clear the current selections. If there is unsaved work, a message window will appear to allow work to be saved if needed.

Exhibit 41. Loading Nodes Save



OK - Click to save edits and exit the table form. Each unit listed needs to have nodes totaling 100 percent loading. See instructions on Right-click function for removing selections.

Equalize Unit - Click to divide the percent loaded equally among all nodes for the selected unit record. If only one node is selected, percent will be assigned as 100.

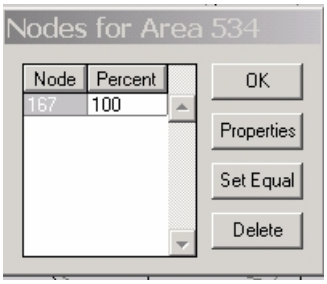
Equalize All - Click to divide the percent loaded equally among all nodes for all units displayed in the table. Each unit will have 100 percent loading divided equally among all selected nodes.

Cancel - Click to nullify edits and exit the form.

Clear - Click to clear the current selections. If there is unsaved work, a message window will appear to allow work to be saved if needed.

Right Click function - Right click on a polygon to bring up a table of the nodes (displayed in Exhibit 42) which this treatment unit is assigned for the current logging method. Loading nodes can be deleted or redistributed here.

Exhibit 42. All Nodes for Treatment Unit table



Node - The node identifier

Percent - Click in the cell to edit the percent. Percentages of timber products loaded from one treatment unit to one or more nodes on the transportation network must add to 100.

OK - Click to accept changes and close the form.

Properties - Click for a popup display of the attributes for the selected treatment unit.

Set Equal - Click to automaticlly apportion the percentage loaded equally among all the nodes present in the displayed table.

Delete - Click after selecting a node record by clicking on it so as to remove this node from the treatment unit assignment.

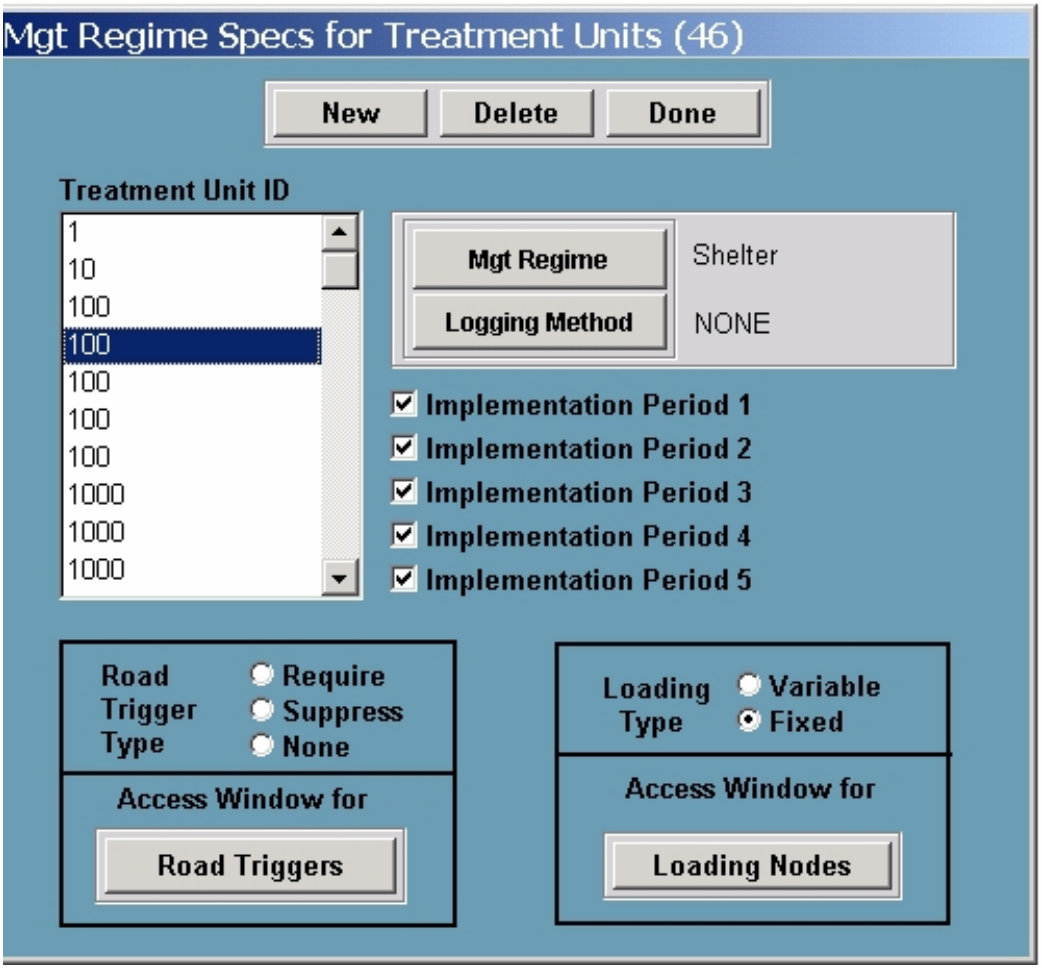
Build Resource Projects

This procedure generates a set of management options for treatment units based on the Resource Project Generator rules set in the Management Regime Definitions form. On execution the user will see a “Please Wait” form. When completed the user will see either a “NO ERRORS” message or an error display routine.

Edit Resource Projects form

Use this form to view and edit resource projects generated by the automated procedure. Options may be added, edited or deleted using this form (displayed in Exhibit 43.) This step is optional, providing the resource project generator ran to completion without errors

Exhibit 43. Edit Resource Projects form



New - Click to create a new resource project for the treatment unit represented by the currently selected project. In the popup window select a management regime for the new project. If the management regime includes harvest activities, MAGIS eXpress will use defaults from the Loading Nodes defaults table to create a new project for each default logging method. If there are no default logging methods for this treatment unit, one project will be created with no logging method or loading node. Select Logging Method to choose a logging method for this project, then select Loading Nodes to assign the loading node.

Delete - Click to delete the currently selected resource project. This removed the project from consideration in the solution. No Action projects may not be deleted.

Done - Click to close the window; changes will be saved automatically.

Treatment Unit ID – This is a listing of all treatment units. Select an ID to view the details of the given resource project. Each resource project generates an ID for the treatment unit (so unit 10 might appear 3 times and unit 1002 might appear only once on the list, indicating that 10 has 2 additional projects for MAGIS eXpress to select from, but 1002 only has a “No Action” resource project).

Mgt Regime - The management regime for the selected project is displayed to the right of the button. Click the button to select a different management regime for the project. Duplicate resource projects will cause problems, so they are removed on exiting the form.

Logging Method - The logging method for the selected project is displayed to the right of the button. Click the button to select a different logging method for this project. Duplicate resource projects will cause problems for the solver, so they are removed on exiting the form

Implementation Period 1 to 5 - Check all periods for which this resource project may occur. No Action resource project occurs ONLY in period 1.

Road Trigger Type - There are three choices: “Require”, “Suppress” and “None”.

Access Window for Road Triggers - Click to define road triggers.

Loading Type - MAGIS eXpress only allows ‘fixed’ loading type. Variable loading (in MAGIS), allows the user to assign a cost for using a loading point rather than a fixed percentage of the product.

Loading Nodes - Click to display the loading node assignment(s) for the currently selected project. Edit by double-clicking on a node from the list and assigning a percentage of the total product from the project. Total percent of timber products loaded onto one or more network nodes from a single treatment unit must add to 100.

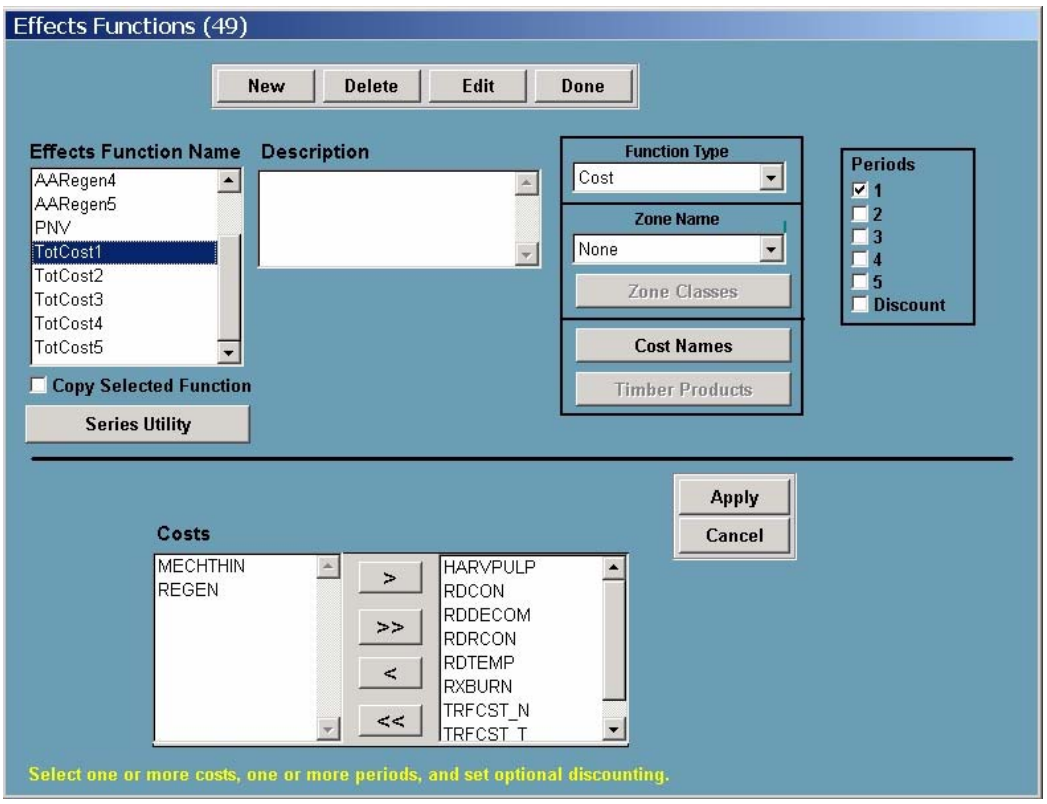
Effects Functions

Effects Functions permit MAGIS eXpress to collect and sort information about activities, management regimes, costs, and outputs. An Effects Function is a limitation or condition placed on some specified aspect of a planning model’s characteristics; for example one can define an Effects Function that keeps track of the acres of prescription burning activities in period 1. This number of acres would be different in a scenario where PNV was maximized from a scenario in which the Fire Risk Index was minimized. Other examples of user-defined Effects Functions include cost of prescription burning in period 1, or volume of sawlog harvest in management compartment A2143 in period 1.

In the Solver Specifications, an Effects Function is selected as the objective function to be maximized or minimized. Once one Effects Function is selected as the objective, any of the other Effects Functions could be used to constrain the planning model. Constraints on Effects Functions could be upper or lower limits, or a set range of allowable values.

This form (shown in Exhibit 44) is used to define Effects Functions to calculate specified values (cost, revenue, output, timber volume, area, or length. The value to be calculated determines the Effects Function type: Timber Product, cost, net revenue, and area control. Timber product functions determine volumes of products. Cost functions sum the designated costs, net revenue is determined by the designated revenues minus the designated costs. Cost and net revenue functions may be discounted (the discount rate is set on the ‘Model Information’ form.) Acreage control functions calculate acres (or hectares) of the designated characteristic. There are may possible acreage-control functions such as acres of a particular vegetation state characteristic, acres of a particular management regime or activity, and acres with standing volume that falls within a defined range of values.

Exhibit 44. Effects Functions Definitions



New – Click to define a new Effects Function. A popup window will appear. Enter a name (8 characters or less, no non-alphabetic characters except '_' allowed. Next enter (optional) a short description of this function and choose a Function Type from the dropdown list. Click the Save button to accept the new function or close the window to quit without defining a new function.

Delete – Select an Effects Function, then click Delete remove it. If the model has been generated, any changes made here will not appear until the next time the model is generated. If the Effects Function was created by defining and generating a series of functions, only the currently selected function will be deleted. Delete an entire series by clicking the Series Utility button and deleting it from there.

Edit – Click the button after selecting an Effects Function name to edit this name. Any other editing may be done directly on the form. If the Effects Function was created by defining and generating a series of functions, only the currently selected function will be edited. Edit an entire series by clicking the Series Utility button and modifying it from there.

Done – Click to close the form. If any new Effects Functions have incomplete definitions (i.e. period not defined) a warning message will be shown.

Effects Functions Names – List of existing Effect Function names. Select one to view details.

Description – An optional description of the highlighted Effect Function.

Function Type – A drop-down list of acceptable Effect Function types namely: Timber Product, cost, net revenue, and area control.

Zone Names dropdown list – Select a zone name from the drop-down list for the currently selected Effects Function. (Optional). If a zone name is not selected (the default condition), the Effects Function will the entire planning area. If a zone name is selected, the Effects Function will apply to the selected zone classes ONLY.

Zone Classes - Click to select one or more zone classes for an Effects Function. The candidate-selected list at the lower half of the form will display all available zone classes. Select one or more zone classes by double-clicking or right-clicking on the desired items. Move items back to the candidate list the same way.

Cost Names – Click to toggle the candidate-selected window which lists costs for net revenue Effects Function types.

Timber Products – Click to toggle the candidate-selected window which lists timber products for net revenue Effects Function types.

Periods - Select one or more time periods by clicking on the desired check box. Time periods not available to the current planning scenario are grayed out. NOTE: Timber products and area control functions may only have ONE period selected. Costs and Revenues may have more than one period selected.

Discount - Click this check box to discount the selected Cost or Net Revenue Effects Functions. Dollar values will be discounted back to the analysis year selected in the 'Miscellaneous' form.

Copy Selected Function – When this box is checked, select 'New' to create a new function based on the selected Effects Function. A different name is needed, but other characteristics will be copied to the new function. If a number of Effects Functions based on similar characteristics is desired, consider the Series Utility to create multiple Effects Functions for different periods, each of a series of zone classes or both.

Series Utility – Click to start the series utility. A new form will be displayed, in which the user may manage Effects Function series. Series can be defined, edited, deleted or generated from the new form. See details on using the utility below.

Candidate – Selected list for zones, costs, and products: After selection of Effects Function type, candidate-selected lists appropriate to the type are activated.

Costs – Select one or more costs for the selected Effects Function by double-clicking or right-clicking items to move them to the selected list. Net revenue is calculated for timber product revenues and/or costs. When costs are being displayed in the candidate lists, click the Timber Products button to switch to timber products.

Zone Classes – Select one or more zone classes by double-clicking or right-clicking items to move to the selected list. If summary by a number of individual zone classes is desired, it may be more efficient to define an Effects Function series (see the Series Utility information for details).

Acreage control Select the area control type from the dropdown list. For each type, specify the characteristics that define the condition or limitation. Changing the acreage control type here will cause MAGIS eXpress to ‘forget’ any attributes previously chosen.

Management Regimes - Select one or more management regimes from the list by double-clicking on the candidate names. MAGIS eXpress calculates the area that has the selected management regime(s) in effect for the selected periods. A management regime is in effect from the period of implementation to the end of the planning horizon. This type of Effects Function could be used to limit the number of acres with the selected management regimes.

Activities- similar to Management regimes. MAGIS eXpress calculates the area (acres or hectares) that have the selected activities applied (in the selected periods)

Vegetation State Characteristics

Volume - Select to calculate the area (acres or hectares) that has standing volumes that fall within a particular range-for example, we might want to know how many acres are very high volume treatment units, so the range would be set for 20 (lower limit) to 999 (upper limit) CCF per acre. Click in the boxes on the popup list to enter the values for the lower and upper limits, and then click the OK button to return to the form.

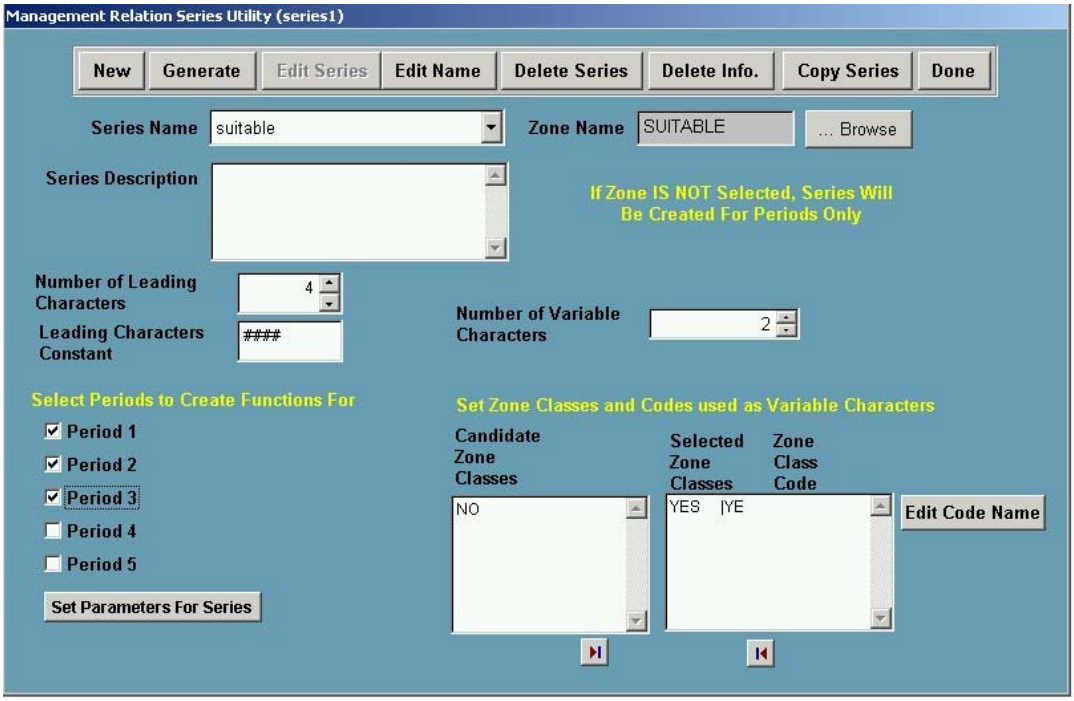
Dominant Species – Select the dominant species of interest. MAGIS eXpress calculates how much area (acres or hectares) is classified with the selected dominant species in the given time period.

Size Class – Select the size classes of interest. MAGIS eXpress calculates the area (acres or hectares) that is classified as the selected size class(es) in the given period

Density – Select the density classes of interest. MAGIS eXpress calculates the area (acres or hectares that is classified as the selected size class(es) in the given period.

Series Utility – This form (displayed in Exhibit 45) is used to define, manage, and generate series of Effects Functions that share a common set of characteristics, but may differ by specific zone classes or period (or both). For example, the user may wish to create a number of Effects Functions, each of which calculates harvest volume for ONE watershed within the planning area. The user sets definitions for the series in a manner similar to defining individual Effects Functions, then ‘generates’ a series. This is useful when there are many Effects Functions to set up (helps avoid repetitive data-entry errors).

Exhibit 45. Effects Functions series definitions



New – Click to create a new Effects Function Series. Enter a series name and description in popup window, and click OK to accept the new name. Edit the rest of the characteristics on this form.

Generate – Click to generate the Effects Function series. Until this button is clicked, the Effects Function series may be defined, but individual functions in the series will not appear in the Effects Function list on the main form. Once the Effects Function series is generated, it may not be edited until the Edit Series button is clicked. Edit series will remove all series Effects Functions from the main list until it is generated again.

Edit Series – Click to edit Effects Function series characteristics. This button is only available when the series has been generated. Until the series has been generated, edits may be made freely without clicking the 'Edit Series' button. When this button is clicked, all functions belonging to the series are removed from the master list (as seen on the main Effects Function form); the series will then need to be generated again.

Edit Name – Click to edit the NAME of the series only. Enter changes in the popup window and click the OK button.

Delete Series – Click to remove the series definition AND the series functions from the master list.

Delete Info – Click to remove the series characteristics and zone information. Effectively re-sets the series information. NOTE: Available only for series that are not 'generated'.

Copy Series – Click to create a new series by copying the current series. Enter a name in the popup window and click the OK button.

Done – Click to close the form and return to the main Effects Functions form. Changes to series definitions are saved automatically, however, in order for the series Effects Functions to appear on the master list, they have to have been generated using the Series Utility form.

Series Name – Dropdown list of all series currently defined. Click on the down-arrow to view the list. Click on an item in the list to select it.

Series Description – Optional description of the series which may be edited at any time.

Zone Name – Optional selection of a zone by which to classify each function in the series. Only one zone name can be selected (from zones for which the GIS data have values). If a zone is not selected for the series, the series will be generated for each selected period.

Number of Leading Characters – Click the up or down arrows on the spinner to increase or decrease the number of leading characters. The "Leading Characters Constant" field will be adjusted according the number of characters selected. Up to 6 spaces may be reserved for the leading character (at least 1 is reserved for the zone code, and 1 is reserved for the period.) A series function is named by combining the leading characters, a zone code, and then the period for which the series is valid. It may be useful to include an underscore to separate parts of the function name.

Leading Characters Constant – Click in the cell to enter the characters that will form the prefix for the Effects Function name for each function in the series. A series function is named by combining the leading characters, a zone code, and then the period for which the series is valid.

Number of Variable Characters – Click the up or down arrows on the spinner to increase or decrease the number of variable characters (they are 'variable' because this part of the name will come from the zone code that the series function uses for its zone class).

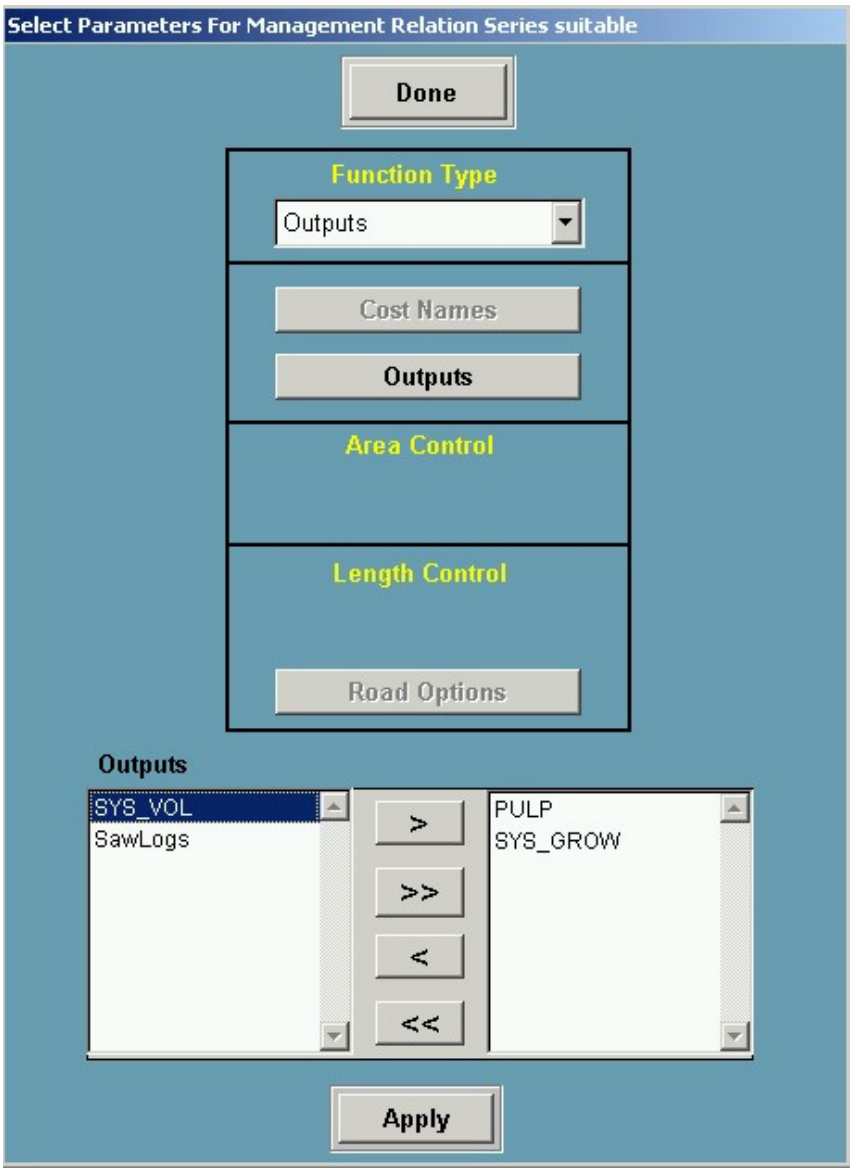
Select Periods – Click in each check box for each period for which a function is to be created. The default setting is all possible planning periods. One series function will be created for each checked period, for each selected zone class. If no zone is selected (or no zone classes selected) only the period definition will be used. No functions in a series will be created for 2 or more periods for the same function.

Set Parameters for Series – Click to display the form (displayed in Exhibit 46) for selecting the function type and the characteristics for that type. All function types are available.

Set Zone Classes and Codes used as Variable Characters – The candidate-selected list shown here truncates the zone class names as they are moved to the selected list, based on the "number of variable characters" set above. Double-click on a class name or use the transer buttons (below the lists) to move all items from the candidate to the selected list (or back again). The 'code' showing to the right of the full name is the suffix that will be used for the series function name. If two codes end up the same, the user should edit one or both codes so they are unique. Use the Edit Code Name button to edit such codes.

Edit Code Name – Click to edit a code name (they should be unique). Enter the desired value in the box and click the Save button. Click the Cancel button to exit the form without changing the code name.

Exhibit 46. Effects Functions series details



Build Model Menu

Generate Organizing Tables form

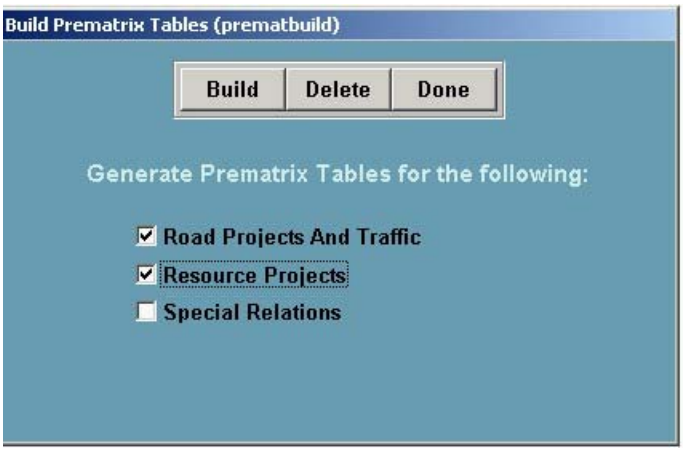
Before running planning scenarios, MAGIS eXpress needs to build a set of master (organizing) tables which precalculate the costs, volumes and revenues, and vegetation pathways for the resource and road projects in the model. This required process makes solving a planning problem more efficient; it also conducts internal data checking and provides a means for the user to check the entered data.

These organizing tables may be generated (see Exhibit 47) for just roads or just resource projects, but both have to be completed before planning scenarios can be defined and solved. Once the table has been built for a particular type, the check box for that project will become unavailable(grayed) the next time this form is opened. When the Process button is clicked for resource projects, a dialog box will be displayed (see Exhibit 48) allowing the user to select the management regimes to be included in the model. This is an opportunity to run a smaller model if

desired, or restrict decision variables to a subset of all defined management regimes. It is necessary to move at LEAST the No Action management regime to the 'Included' list in order to continue.

Prematrix table generation may take from a few seconds or a few minutes to much longer, depending on the model size and number of projects. Various types of data errors are captured and reported (some are more fatal to the process than others). If there are no errors, the process concludes without a message.

Exhibit 47. Build/Delete Organizing Tables form



Build – Click to initiate processing. This is only available if one or both of the project boxes are checked.

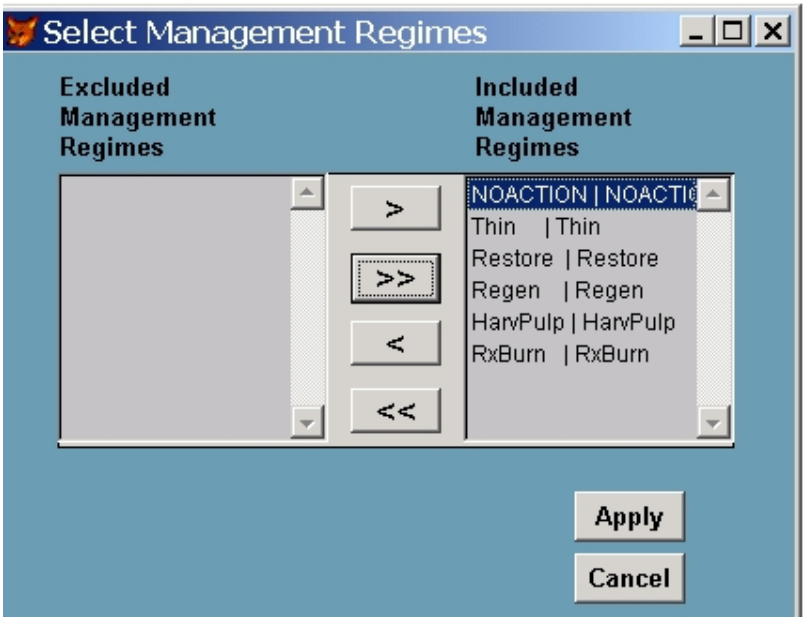
Delete – Click to display the form (Exhibit 49) used to select and delete road or resource project tables. This step needs to be done prior to (re) building the organizing tables.

Done – Click to close the form and return to the main menu.

Road Projects and Traffic – Click this checkbox to select road projects. Select Build to start processing.

Resource Projects – Click this checkbox to select resource projects. Select Build to start processing. A popup window titled "Select Management Regimes" will be displayed (shown in Exhibit 48); select all or some of the management regimes listed to include in the tables. Projects not included will not be available for selection in a planning scenario solution. No Action projects should ALWAYS be included.

Exhibit 48. Selection of Included Management Regimes



Excluded Mgt Regimes - This is a default list of all management regimes forming resource projects in the current model. Right-click, double-click, click-and-drag, or use the mover buttons to transfer some or all of the Management Regime names to the selected list. Any resource projects for management regimes left on the Excluded list will NOT be available for solutions.

Included Mgt Regimes - All resource projects for management regimes included on this list will be processed and available for solutions. If the management regime is not on this list it will not be available. The “No Action” nabagenebt regime should always be moved to this list.

Mover Buttons - Click the single arrow to move a single selected item, click the double-arrow to move the entire list in the direction the arrow is pointing.

Apply – Click to finalize the Included Management Regime list.

Cancel – Click to cancel and exit the form.

Exhibit 49. Delete Selected Tables form

Delete Selected Tables – Click to start the delete process after the appropriate Prematrix Tables checkboxes have been clicked.

Cancel – Click to cancel and exit the form.

Delete Roads and Traffic Prematrix Tables – Click this checkbox to indicate that road projects are to be deleted.

Delete Resource Projects Prematrix Tables – Click this checkbox to indicate that resource projects are to be deleted.

View/edit Prematrix Tables form

A resource project is a unique combination of treatment unit, management regime, logging method (if appropriate), loading node(s), and period of implementation. Resource projects form the basis of a MAGIS eXpress solution; the solver selects the resource projects that best meet the objective and constraints, and includes necessary road projects and the resulting traffic. Road projects are defined by a link (identified by the from-node and to-node), road option, and the period of implementation. Traffic (variable cost of moving timber products through the network) is generated on a link (identified by the from-node and to-node), based on its road option, and the hauled product (traffic type). It is reported as a cost per mile per unit of product (traffic).

All three activities (resource projects, road projects and traffic) affect the planning model's solution. Thus, solving for maximum Present Net Value can include the fixed costs for road projects and the variable costs of the traffic, so selection of resource projects by the solver is adjusted to include those (for example, a treatment unit might have two different resource projects, one which loads by tractor to a node on a nearby link, but using that link to carry traffic might be expensive - requiring new or re-construction, OR there might be a resource project where the products are loading onto the network by a more expensive system (say aerial yarding), but might have lower fixed and variable costs. The solver can resolve these situations very easily.

This form (see Exhibit 50) allows the user to choose which prematrix tables are to be accessed, namely resource projects, road project (fixed) costs, or traffic (variable) costs by clicking the appropriate radio button next to the desired item.

Exhibit 50. Select Tables to view/edit form

Done – Click to exit the form and return to the main menu.

Road Projects – Click this radio button to view/edit road projects (options) and costs.

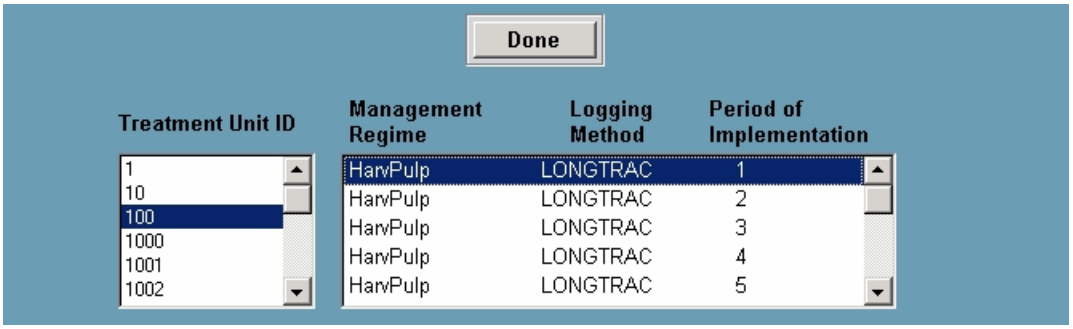
Traffic – Click this radio button to view/edit Traffic (options) and costs.

Resource Project – Click this radio button to view resource project (options), costs, product volumes, product revenues, and vegetation characteristics.

The resource projects tables include resource project costs, resource project outputs (timber volumes) and revenues, and vegetation state. The form is organized into two main sections: the upper portion (shown in Exhibit 51) is used to select the project information to view. It displays treatment unit identifiers and, for each treatment unit, the management regime and period of implementation that form the resource project. The lower section is divided into tabbed pages allow viewing of costs, volumes, and vegetation state as appropriate.

To view information about a particular resource project, first select the Treatment Unit ID from the list on the left, and then select the project (consisting of the management regime, logging method and period of implementation) from the list on the right. If a management regime is not listed, no resource project was created for that unit with that management regime.

Exhibit 51 View/Edit Resource Projects Select Project



Done – Click to exit the form. Any edits made to the table values are automatically saved.

Treatment Unit ID – Unique list of all treatment units in the model. Select one unit by clicking on it. The list of projects (management options) assigned to that unit will be displayed in the adjoining list.

Management Regime – List of all management regimes assigned to the selected treatment unit. Click on one record to display the values for that project on the tabbed pages below. Each

treatment unit will have a No Action record. Assignment of any additional projects (management options) for the treatment unit depends on the management regime rules set by the user, and on the GIS data.

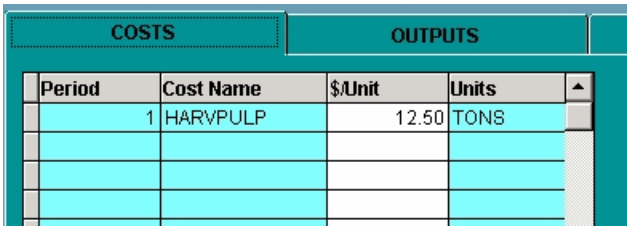
Logging Method – Displays the assigned logging method (yarding) for the resource project

Period of Implementation – Displays the planning period in which this particular resource project is to be initiated. The management regime to be implemented may have activity costs that occur AFTER the period of implementation. The management regime in effect BEFORE the period of implementation is NO ACTION.

Treatment Costs Tab

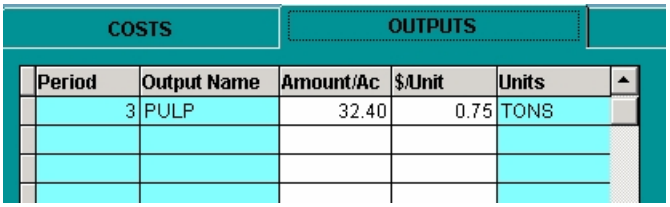
The treatment costs tab (displayed in Exhibit 52) includes information about treatment costs for the selected project only. The table indicates the period in which the cost occurs, the cost name, and the cost per acre or per unit output (in this example, the cost is per ton of pulp product.

Exhibit 52. Treatment costs tab



Output amounts and values tab shown in Exhibit 53 displays the timber product amounts, expected revenue, and units for the selected resource project. Amounts and values may be edited. Amounts are in units per acre (not total for the project).

Exhibit 53. Output Amounts tab



Vegetation Pathways tab displays the state and standing volume for the treatment unit for each period, for the selected resource project. States are reported as the resulting state (at the end of the planning period), and thus represent the states resulting from treatments or succession.

Exhibit 54. Pathways tab

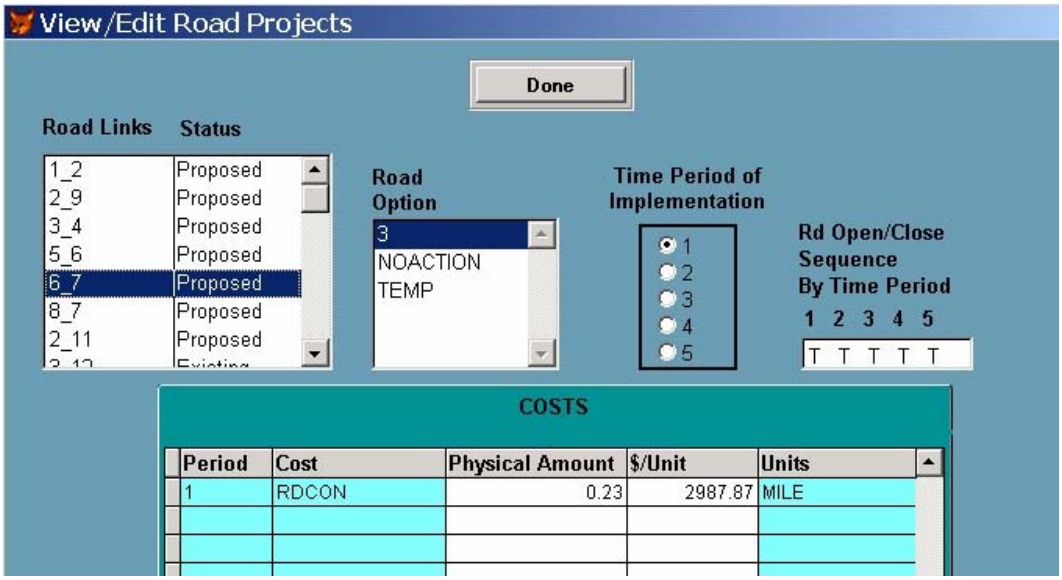
COSTS | OUTPUTS | AREA CONTROL

Period	DBH	HT	Volume	Density	Species	Size Class	Density Class
1	0.0	0	9.00	0.0	LP	SAW	4M
2	0.0	0	9.00	0.0	LP	SAW	4O
3	0.0	0	0.90	0.0	LP	SAW	4O
4	0.0	0	0.90	0.0	LP	SAW	4O
5	0.0	0	0.90	0.0	LP	SAW	4O

Road Project Costs

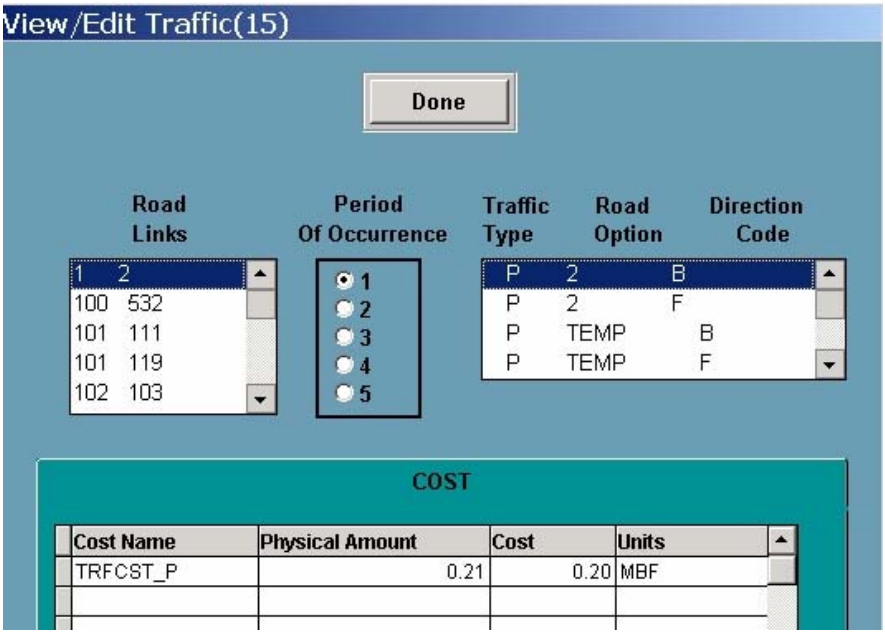
The upper portion of this form is organized in a manner similar to the resource projects form: each link is listed (using the from-node to-node identifier) and all road options are listed.

Exhibit 55. Road Project Costs



Traffic (variable) costs are displayed by link, period, traffic type (same as timber product) and road option. Click on the link, the period button, the traffic type- road option - direction code item to view the cost

Exhibit 56. Traffic Costs



Generate Model

Generate Model runs the MPS matrix building procedure. This procedure has to be run before the MPS solver can be used. When it is run, it clears out any previously existing model and scenario setup information. This procedure takes from a few minutes to an hour, depending on the size of the problem and the speed/RAM of the machine.

Delete Model

Delete removes the LP matrix. It will have to be regenerated before any solutions can be calculated. Before any changes to either Planning Framework or Project Area can be made, both the matrix and the Prematrix tables have to be deleted. Select Delete to delete the LP Matrix. When this is done, the Scenarios form becomes unavailable. If changes to the planning framework or the Project Area data are made, the Organizing Tables have to be regenerated before the LP Matrix can be (re)built.

Scenarios

This form is used to setup and solve then display planning scenarios. A planning problem or "Scenario" includes the selection of an objective function (maximize or minimize), and any constraints and decision variables the user wishes to impose on the solution. Setting constraints on a solution consists of setting limits on selected Effects Functions, and selecting Decision Variables consists of forcing IN to solution selected resource projects, or excluding selected projects from the solution.

During the solution procedure, MAGIS eXpress selects resource projects and road projects, calculates the resultant traffic routing and volume, projects vegetation changes through time based on succession and the selected activities, and calculates the values of all defined Effects Functions (harvest volumes, revenues, and costs). The process is repeated until the maximum (or minimum) value of the objective function is reached.

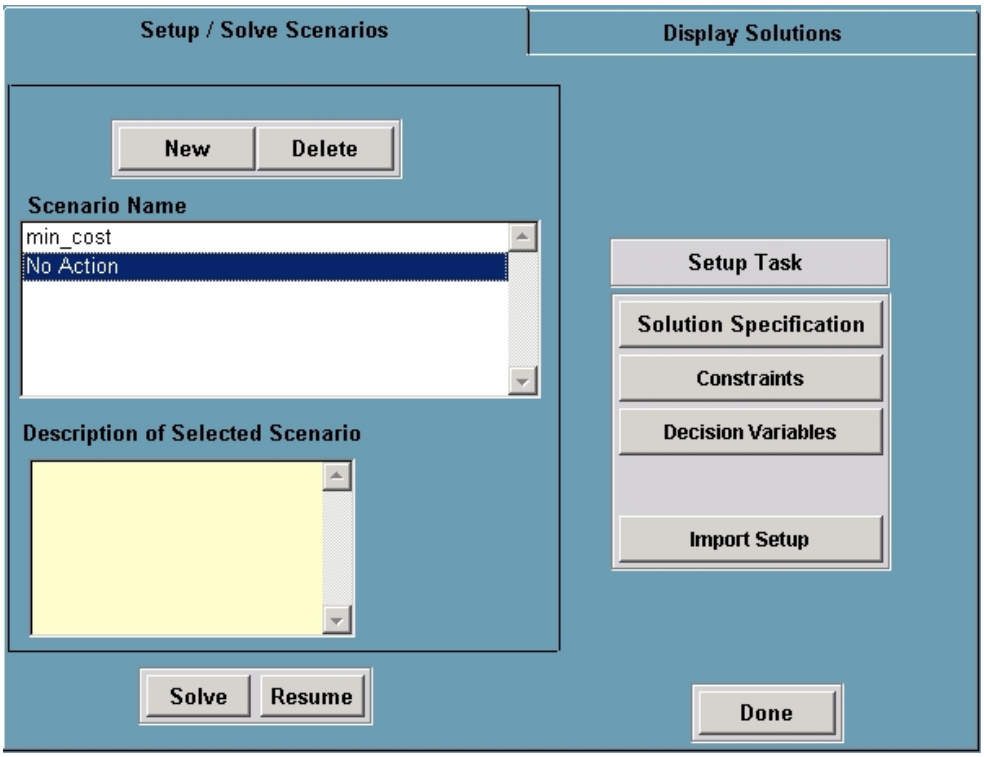
Setup and Solve Scenarios Tab

This page (displayed in Exhibit 57) includes a list of all defined scenarios, various command buttons for setting up a scenarios, and the 'Solve' button to run a solution. To create a new scenario,

select New and enter a name, then edit the solution specifications by selecting from the command buttons along the side. To edit or solve an existing scenario, click on a name on the list to select it.

Solution Specifications (required) include the selection and 'direction' of the objective function, and various parameters needed by the solver. This step is required. Decision Variables are optional, and include any preset or excluded resource and road projects. Constraints are optional limits on Effects Functions. Solutions that have been previously saved for this data set can be imported to use as a new scenario

Exhibit 57. Setup and Solve Scenarios tab



New – Click to enter a new scenario name. Enter the name and click OK. Names can be up to 30 characters with spaces.

Delete – select a scenario to delete, then click Delete. A warning box will be displayed; click OK if it is all right to delete the scenario and all its information. If the scenario was part of a previously saved zip file, the scenario will not be deleted from the zipped copy.

Scenario Name – List of already-defined scenarios. Select one by clicking on it. This allows the user to edit and re-solve existing scenarios. If a scenario that has been solved is selected, the solution has to be deleted before proceeding to edit the scenario. If one wishes to compare an edited version with the original, use the Import Setup routine to create a second scenario with the same setup information as the original, which then may be edited without deleting the solution from the first scenario.

Scenario Description – Editable display of description. May be edited any time.

Solve – Click to solve the selected scenario

Resume – When running a MIP problem, MIP stopping rules may enjoin the solver to stop before an acceptable solution is reached. Click this button to continue running the MIP solution. Number of nodes will be reset to 0 (so, for example, if the user has 2000 set as the number of nodes, and the first run reached 2000 nodes before selecting resume, another 2000 nodes will be used.)

Solution Specification – Click to enter the Solver Specifications Form displayed in Exhibit 58. On this form you can enter the desired type of solution procedure for the optimizer. This is where the objective function is selected and whether it is to be minimized or maximized. The solution type is also selected; the choices include linear programming, mixed integer programming for roads only, mixed integer programming for roads and resource projects, or simulation.

Constraints – Click to display the form used to set (optional) constraints on the model. See details below.

Decision Variables – Click to display the form used to set decision variables into the solution or exclude decision variables from a solution. (Optional)

Import Scenario – Click to display a form that allows the user to 'import' the results of a previous scenario as the setup for a new scenario, or to import the setup from a previous scenario in a new scenario.

Solution Specification

In this form, the user selects the objective function from the list of Effects Functions, whether to minimize it or maximize it, and the solution process to be applied.

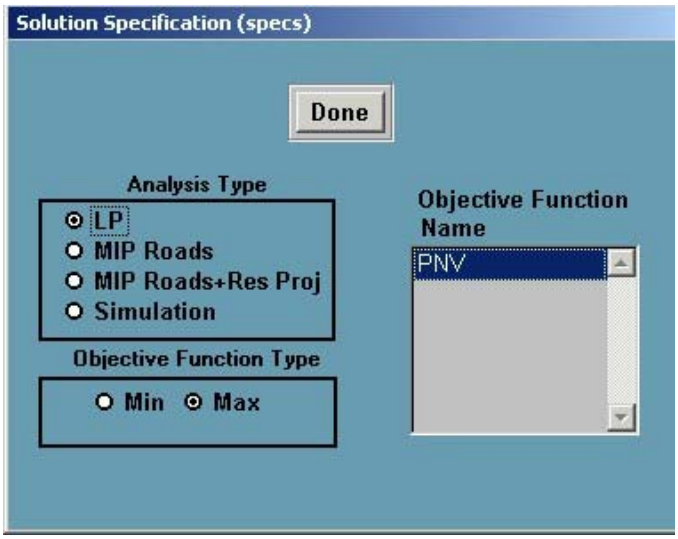
For problems with no road decisions to be made, or to get a "quick and dirty" solution to a problem, select LP; this process is much quicker and produces a true optimum result. For planning problems where road construction/reconstruction is important, select MIP Roads. MIP, or "mixed - integer programming" allows non-integer solutions for resource projects (i.e., MAGIS eXpress can select to clearcut only 50 percent of a treatment unit, rather than cutting the entire unit.) but only allows integer solutions for roads. This means that a road project will either be selected (a value of 1) or not selected (a value of 0). This prevents the unrealistic result that parts of roads are to be constructed, which violates network continuity. The MIP process is more time consuming than LP, but results in a more realistic solution for roads. When MIP is selected, the user defines the "stopping rules," that is, the rules by which the MIP process accepts a solution and stops "looking" for a better solution. Since the MIP process can be very time consuming, and since a true optimum solution may not be very different from one that is found early in the process, the user may elect to have the MIP process stop at the FIRST integer solution it finds. This is likely to be within a reasonable range of the true optimum and can vastly shorten the solution process. It could be used as a first approximation to a solution. If this option is selected, the user can further elect to resume the solution process after the first integer solution, to have the MIP process find the next integer solution. This may or may not be closer to the optimum solution, but by repeating the process the user may see an indication of how close these first solutions are to a truly optimum solution, and may find that the solution is "close enough."

To have MAGIS eXpress select only entire resource projects and entire road projects, select MIP Roads and Resource Projects. This will do the same thing for resource projects that it does for roads; it will not allow partial selection of a project. Either the resource project will be carried out for the entire treatment unit (a value of 1) or it will not be carried out at all (a value of 0).

To run a "what if" scenario, select Simulation. This informs MAGIS eXpress that the user will be selecting all the decision variables for road projects and resource projects. The solution

procedure calculates the values of Effects Functions and traffic routing and volume, but does not optimize. The user does not need to specify “no action” for roads or treatment units; if no project is selected, the default is “no action.” Min or Max does not need to be selected, since MAGIS eXpress will not be optimizing a solution. Selecting the objective function instructs MAGIS eXpress to calculate the value for the Effects Function listed at the top of the solution report. The only effect of selecting the objective function on the solution may be on traffic routing; the user doesn’t preset traffic volumes, so traffic routing and volumes are determined during the solution process.

Exhibit 58. Solver Specifications



Done - Click to exit the window; changes will be saved automatically.

Analysis type

LP – Click to select the Linear Programming mode; LP calculates non-integer solutions for both road and resource projects.

MIP Roads – Click to select Mixed Integer Programming for Roads; non-integer solutions allowed for resource projects, integer solutions for road projects

MIP Roads and Resource Projects – Click to select Mixed Integer Programming for both roads and resource projects; only integer solutions will be allowed.

Simulation – Click to run a simulation in which the user sets all decision variables; MAGIS eXpress will calculate the values of Effects Functions but will not select any resource or road projects Objective

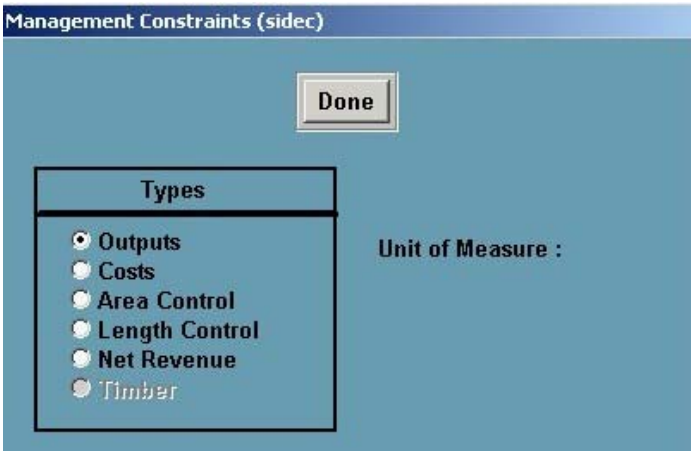
Function Name – Click on an objective function to select it. Press Enter to select it as the objective function for the scenario.

Objective Function Type – Min\Max - Click Min to have MAGIS eXpress minimize the objective function, Max to maximize.

Constraints form

Management Constraints are limits on Effects Function values that occur in a solution. The user can set constraints on any combination of Effects Functions. Constraints can consist of upper or lower limits, or a range of values. Constraints can be set to equal a specified value, but caution should be exercised with this feature; it is likely that there is no solution in which the value of some particular Effects Function equals the specified value. There may, however, be a solution in which the value is close to the desired value, so setting a range rather than an exact value is more practical. In the top of the form (Exhibit 59), select a type of Effects Function by clicking the radio button to the left of the type name. This list is the same as the list of Effects Function types in the Effects Function definitions form. See the Effects Function form for a more detailed discussion of Effects Functions types and definitions.

Exhibit 59. Set Constraints selection (top)



Outputs – Click to select timber product volume (amount) Effects Functions.

Costs – Click to select cost Effects Functions. If the Total Cost function is used as the Objective Function, it will not be available for selection.

Revenues – Click to select revenue Effects Functions. If the PNV function is used as the Objective function, it will not be available for setting as a constraint.

Acreage Control – Click to select from all Effects Functions that calculate acres of activity or vegetative parameter.

Length Control – Click to select from all Effects Functions defined to calculate miles of road option (types).

Done – Click to exit the form. Changes are saved only when the Apply button is clicked.

Once the selection is made, a grid is displayed (Exhibit 60) including all the Effects Functions that can be used to set constraints, that belong to this type of function. The units for each type of function depend on the definition: Outputs (timber products) are the defined units of volume for the product(s), costs and revenues are dollars, acreage control units are acres, and length control units are miles. To use the grid, first enter an option (an operator) that is either =, <, >, or R. We recommend not using = unless you are setting a value to 0 that you know can be 0 (like volumes,

costs or revenues). When the option is entered, one or both of the limit columns will become available for data entry. If the < is selected, the Upper Limit column is active. For the = or the > option, the Lower Limit is active. If R is selected, both columns are active. A column left blank is ignored.

Exhibit 60. Set Constraints Area Control example

Constraint Name – list of Effects Functions of the selected type. Not editable.

Option – Click in the cell to enter one of the four allowable values (>, <, =, or R). Once the value is entered here, one (or both) of the limit columns will become active. A blue column is not editable.

Lower Limit – When active, click in the cell (or use the tab key to move the cursor) to enter the lower limit or the lower limit for a range of values.

Upper Limit – When active, click in the cell (or use the tab key to move the cursor) to enter the upper limit or the upper limit of a range of values.

Apply – Click to apply the entered values. If this button is NOT clicked, the entered values will NOT be saved.

Once desired constraints have been set (Apply button clicked) for the selected Effects Functions, click Done to exit the form and return to the Scenarios form.

Set Decision Variables form

Decision variables are the resource projects, road projects, amount of traffic (flow variables) and traffic volume at exit nodes(final demand or mill nodes.) that form a solution. When MAGIS eXpress is run without presetting any decision variables, all decision variables in the solution are selected by the solver. The user can elect to preselect some or all of the resource decision variables to be included in the solution, or to exclude some decision variables from the solution.

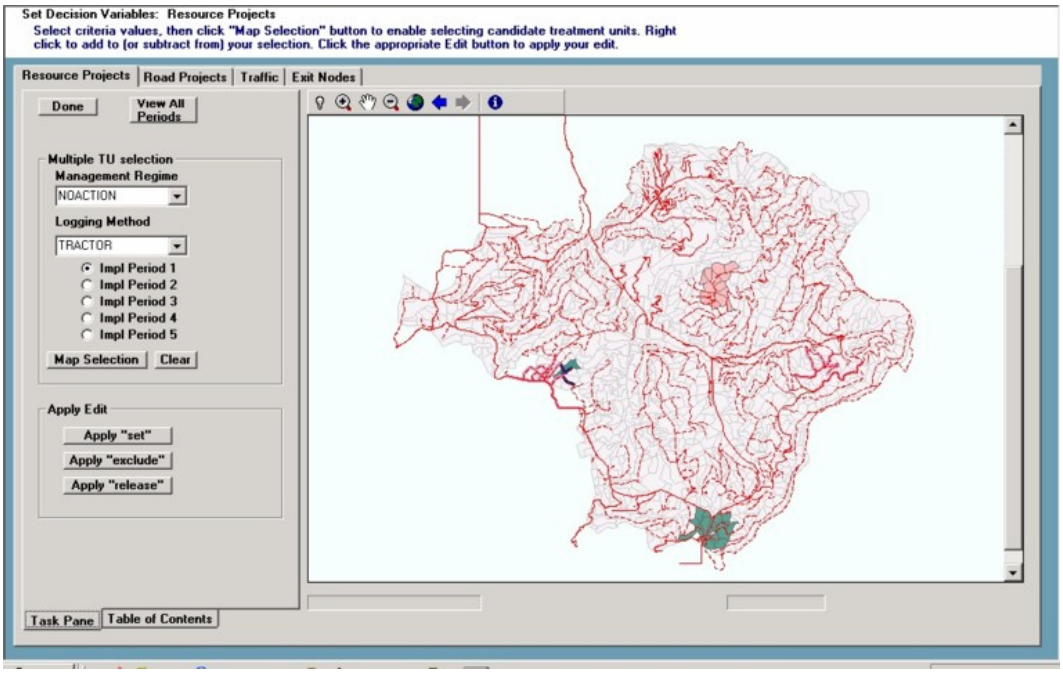
This form is used to preset decision variables if desired. Users can ‘Set’ (force into solution), Exclude (force out of solution) or Release (allow solver to choose) model decision variables. Each type of decision variable is addressed on a separate tab page of this form. It is used to control specific parts of a scenario, to run ‘what-if’ or simulation analyses, or to manage smaller areas

within a larger planning project in a specific way (or even to include activities that have already been planned … .)

If the user sets ALL of the decision variables, MAGIS eXpress is no longer calculating the optimum solution, just the results of a user-defined solution. There is no specific limit on the number of decision variables that can be set, however, the more constraints and decision variables the user puts into the scenario, the more difficult it becomes for the solver to find ANY solution - the likelihood of infeasibility increases with the number of constraints and decision variables, and it is easy to inadvertently set a constraint against decision variables that creates the infeasibility.

The main page of this form (shown in Exhibit 61), displays the default map for implementation period 1 for Resource Projects. The order of work here does not affect a solution; one can move from page to page as needed. The interface remembers the currently selected period of implementation for a page as you move from that page to another and back again. It also retains the most recent visible map extent as you work on one page or move to another page.

Exhibit 61. Main page Set Decision Variables Form



Resource projects Decision Variables

This page is used to set resource projects into solution, or exclude resource projects from solution. Only one resource project per treatment unit polygon can be 'Set' into a solution. All but one resource project for a given treatment unit may be excluded from the solution. Values in the display table field SET are edited as a result of user interaction with the interface. The default value for the STATUS field is "RELEASED", indicating that the resource project is available for selection (by the solver) in a solution.

Use the Task Pane (shown in Exhibit 62) to select criteria (Logging Method and Management Regime) Select an implementation period option button. The period 1 map is shown by default on startup. Use the map display and Table of Contents (TOC) to locate the desired treatment unit(s) and resource projects (further refinements in the selection can be made using the display table.) The map display changes whenever a period different than the current period is selected.

Click the Select on Map button to display the Selectable features meeting criteria layer, launch a display table listing records matching that layer, and to enable selecting features on the map or in the table. The selection mode is automatically set to Add.

Select treatment unit polygons by clicking on individual polygons or dragging a rectangle through one or more polygons. Repeat as needed.

Use the Table of Contents tab (Exhibit 63) to view (or adjust the views) of the layers displayed in the map for resource projects. Note the name of the map printed at the top of the TOC.

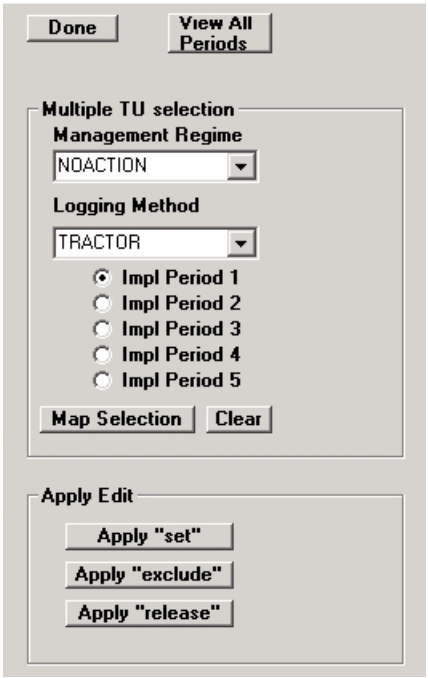
If you need to unselect any polygons, right click and select Subtract to change the selection mode to removing polygons. Then select any polygons that you want to remove from the selection.

When the desired table records or polygons meeting criteria are selected, click one of the three action buttons on the Task Pane: Set, Exclude, or Release. The action will be applied to all selected items.

Task Pane for Resource Projects Decision Variables

Use this pane (shown in Exhibit 62) for selecting criteria and applying the desired edit. Use the TOC and period buttons to check work. It is not necessary to click Clear when switching between tasks. Consider selecting the "All" criteria to check the full complement of management options available for treatment units.

Exhibit 62. Task Pane for Resource Project Decision Variables.



Done – Click to close window. All "Apply" edits are saved as you work.

View All Periods – Click for an overview map for all periods or implementation. In this mode, no editing is allowed.

Management Regime – Click and select one management regime to select for action. "All" will provide a comprehensive listing of all resource projects, however only ONE (per scenario over all five time periods) may be set for a given Treatment unit.

Logging Method – Click and select ONE logging method for the selected management regime. The selection is not screened for inconsistencies, but if no records exist for the selected criteria (for example, if you select a Prescription Burn and then 'TRACTOR', a 'No Records' error message will be displayed) a dialog box with that information will be displayed.

Impl Period 1 … Impl Period 5 – Select ONE period to work with. Resource projects set in a different period (see Table of Contents information on how to check this) will affect the 'selectibility' of resource projects in the current period. For example, if Treatment Unit 121 has a Prescription Burn SET in period 1, it will not be available for setting any other resource projects in any other period.

Select on Map – Click to create and display a 'selectable features' layer, and to enable selecting those features on the map or selecting matching records in the table. (If NO features meet the selection criteria, an informational message box will be displayed.) Click and drag the tool to select one or more links. Links can be added to the selected set by repeating the click-and-drag operation on more links. To remove a link from the selected set, right-click with the tool in an inactive space and select Subtract from the popup menu. The tool stays in the subtract mode until the menu is activated again (with another right-click) and Add is selected. Add is the default mode.

Clear – Click to restart a feature selection or clear the selected set and current criteria. If Set has been clicked, changes have already been saved.

Set – Click to preset setting selected decision variables into solution the selected resource project(s) for the selected treatment unit(s). Only one resource project per unit may be set for a solution. The objective and constraints for a solution will be satisfied after the selected projects are set into solution (for example, if the user sets the objective to minimize costs, but sets a mechanical thinning into the solution, the solution will include the costs of that mechanical thinning.)

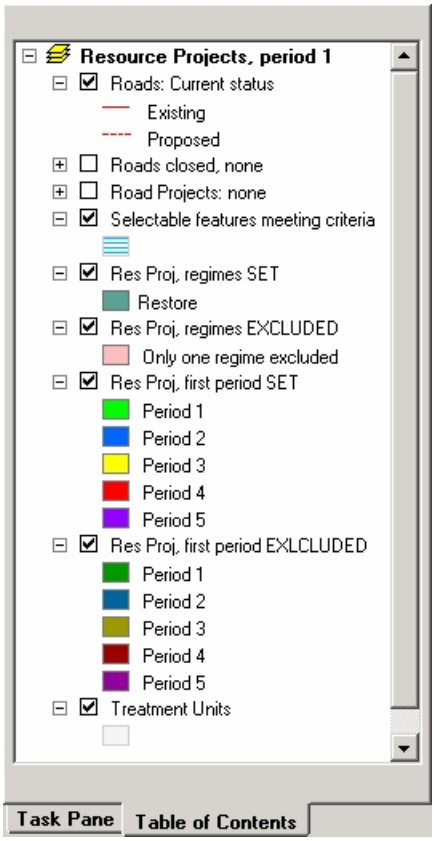
Exclude – Click to preset excluding selected decision variables (the selected resource project(s) for the selected treatment unit(s)) from the solution.

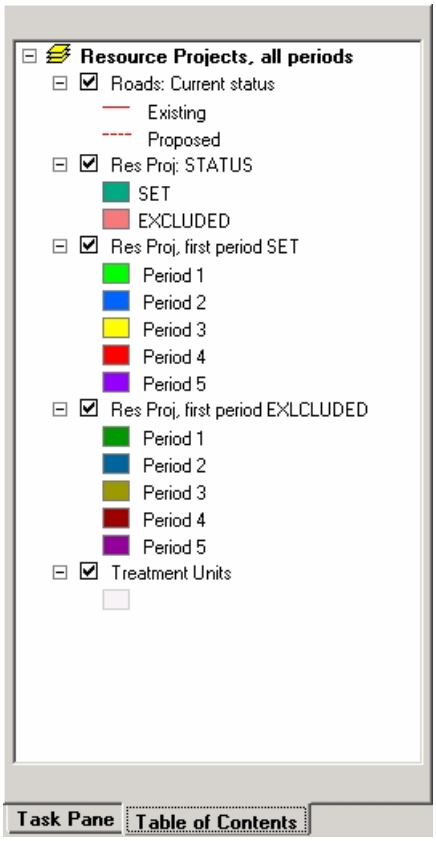
Release – Click this button to release previously preset decision variables. Clicking Release for projects that have not been preset has no effect.

Table of Contents (TOC) for Resource Projects Decision Variables

Click on the Table of Contents (shown in Exhibit 63) tab to view map layer legends for layers updated in the map display.

Exhibit 63. TOC for Resource Project Decision Variables, period 1 and 'all periods'





Road projects are included in this display for the users convenience. When resource projects involving harvest are set into solution, the road projects needed to route the traffic (product) to the appropriate exit node are automatically selected. It is therefore important not to exclude or otherwise set up infeasibilities when setting decision variables for resource projects AND road projects. As with other Table of Contents displays, the visible layers may be dragged up or down, the legend areas expanded or collapsed, and the visible layers unchecked to view underlying layers. Additionally, the symbol colors may be changed by clicking on the symbol and choosing a different color. Changes are saved for some layers. Move the mouse over a layer title or legend symbols to see a tool tip indicating whether changes are saved. Classes may not be edited in the Decision Variables Table of Contents.

Layers Present in Single Period view (See left side of Exhibit 63)

When Select on Map is active:

Selectable features meeting criteria. – This layer is only present while the user is trying to select links. Links that meet the criteria (the road option type and selected option) are colored blue (the default color, however, the symbol color can be changed). Using the map select tool, the user may click on or drag a rectangle across links to be selected.

Always present:

Roads: Current Status - Road line symbols are drawn over the other layers to indicate existing or proposed links. Move the mouse cursor over a link to see the From_node-To_node value pair for the link. Symbology displays existing v. proposed links

Roads closed – If the user has excluded any road options (by closing them to traffic on the Traffic page), that information will be displayed in this layer. The layer is not visible (not checked) if none have yet been preset as closed.

Road projects, periods 1 – current period – If the user has preset any road projects in to solution (Road Projects tab) for any period preceding or up to the current period, they will be displayed in this layer. The default is not visible (not checked) if none have been preset.

Res proj, regimes SET –This layer will display only resource projects (by management regime name) that have been preset as SET into solution for the current period.

Res proj, regimes EXCLUDED - This layer displays only resource projects (by management regime name) for the current period, that have been preset as excluded. If none have been excluded, the display legend has no values.

Res proj, first period SET - This layer displays values for all possible planning periods, colored by the first period they were set. For example, if the current period is 2, and a treatment unit has a resource project set in period 1, the Res Proj, regimes SET layer will NOT show this project, but it will be colored green (for this layer)

Res proj, first period EXCLUDED - Similar to the above layer, this displays values for all possible planning periods, colored by the period for which the regime has been preset as EXCLUDED.

Treatment Units base layer*:* – This layer is for continuity of display.

Layers present for the All Periods map display (see right side of Exhibit 63)

Roads: Current Status - Included to display Existing and Proposed links for the users reference.

Res proj, period SET,EXCLUDED - Displays treatment units which have projects set or excluded (in any period.)

Res proj, first period SET - Displays the period in which resource projects are set.

Res proj, first period EXCLUDED - Displays the period in which resource projects were excluded.

Treatment Units: base layer - Included for reference.

TOC Usage Notes

The currently selected management regime name and period are printed at the top of the TOC for reference.

The legend for each layer in the TOC may be toggled (expanded) between visible and not visible.

Drag layers up or down to rearrange the order of display if needed.

To change individual legend item symbols, left click directly on a symbol. A color palette dialog box will appear; make your selection and click OK to close the dialog (use <ESC> key to close the dialog box without making changes).

To change all symbols for a layer legend in one operation, right click on the layer name. The layer has to be visible (checkbox checked) before this legend editor is active. A symbology tab dialog box for the particular type of legend for that layer will appear. First reselect the highlighted attribute table field from the field list, and then make your edits to the legend.

Tool tip text is displayed while moving the mouse over a layer name for any layer whichis visible on the map. The information indicates whether legend changes for a particular layer are saved.

Map Display for Resource Projects – The map pane provides display of GIS layers, interactive selection of treatment units (as resource projects) to set, exclude, or release projects. Included are a standard map toolbar, mouse-over display of treatment unit identifiers, and a display table (during selection mode) of individual records for selection. Use the map selection tool to select one or more links, other tools to modify the view or the selection (use the right-click menu to set the mode for selecting links). When the selected set is satisfactory, use the apply edit buttons to complete the task. No changes are saved until one of the apply command buttons is clicked

Right click menu action modes

Add - Click to add features or individual table records to the current selection set after using a tool on the toolbar.

Subtract - Click to deselect features or individual table records from the current selection set. Clicking on the feature removes all records for the selected feature from the selection set.

Map Toolbar

Standard map navigation tools and an Identify tool are included on the toolbar. These tools include:

Stop Map Tool – After using one of the OTHER map tools, Click to revert to the pointer (default cursor). Right-click and select a mode to reset the tool for selection.

Zoom In Click this tool and drag or click in the center of the area desired for zoom in.

Pan hand – Click this tool and drag to move the map display in the pane.

Zoom Out – Click and drag a zoom rectangle, or click in the center of the area desired to zoom out.

Zoom to full extent – Click to reset the map display to the fullest extent of the largest layer

Back extent (left arrow) – Click to change the map display to a previous view.

Forward extent (right arrow) – Click to change the map display to a previous view. Views are saved in order; if more than two views are in the ‘stack’ the left arrow moves to earlier views and the right arrow moves to more recent views.

Identify – Click this tool to select the tool, then point and click on a feature. Attributes for that feature will be displayed in a popup window. This window must be closed before other actions can continue.

Distance – Click this tool and drag to form two endpoints. Distance is displayed in the same units the data is projected in (usually meters) at the bottom of the map pane.

Management regimes query tool - A custom Identify tool is provided on the toolbar for the Management Regimes layer. Click the tool and then click on a treatment unit feature on the map to see the management regimes for each planning period for that treatment unit. This is available for ‘single-period’ maps and also for the ‘All periods map.

Status bar – During selection of features the total selected acres (Resource projects) or miles (Road projects, Traffic) is displayed in the panel at the left. The panel at the right always displays coordinates in map units

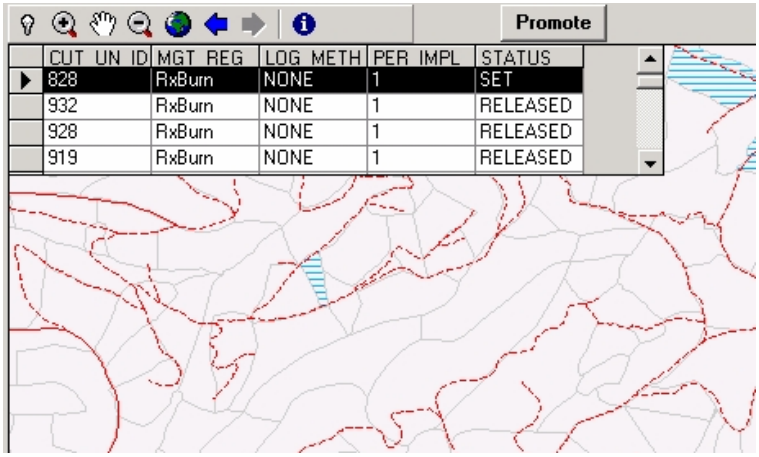
Table Display for Resource Projects Decision Variables – The table of resource projects (shown in Exhibit 64) meeting the criteria is displayed when the map selection button is clicked. Use the map navigation tools to view features which might be initially displayed beneath the table. The table is not resizable or movable. This table may be used to select records to be preset to SET,

EXCLUDE, or RELEASE. It operates in conjunction with the map display selection (i.e. for each treatment unit feature selected on the map, the corresponding records are selected in the table and vice versa.)

The display table in this interface allows the user to sort the TR_UNIT and MGT_REG fields in ascending or descending order by clicking the corresponding field header.

The user may select/unselect records and edit the field named “SET”. To select one or more records, click in sequence (in Add mode) to the left of each record to be edited. To unselect one or more records, use the right click menu to toggle to Subtract mode, then click to the left of records to be unselected. One way to edit the field is to enter a value in the text box in the Task Pane and press Apply Edit. The entered cost will appear in all records which were selected. To edit the SET field directly in only one record, click once (do not double-click), type in the desired value, and click once anywhere in another record or click the desired apply edit button. (One may enter only the first letter (“S”, “E”, or “R”), and autocomplete finishes the word.)

Exhibit 64. Table Editor for Resource Projects Decision Variables.



Map Tips

Map Tips are the small balloon displays associated with cursor. Use the Map Tip display in conjunction with viewing the Res project, period SET and Res project, period EXCLUDED layers. The Map Tip SET management regime name corresponds to the management regime set for the first period of implementation of any management regime set for that treatment unit. The Map Tip “EXCLUDED” indicates only the first period of implementation.

Road Projects Decision Variables

The user may select road projects to be included in the solution, excluded from the solution, or released for selection by the solver. A road project is defined by a combination of link, road option, and time period. Some road options may be applied to existing roads and some to proposed roads. Any link, for which no road project has been set by the user, is to have one or more road projects remaining available for selection by the solver. Values in the display table field STATUS are edited as a result of user interaction with the interface.

Select a current road status value and a road option value from the combo-box lists for your first round of editing. These define a Selectable features meeting criteria layer.

Select an implementation period option button. The period 1 map is shown by default on startup. The map display changes whenever a period different than the current period is selected.

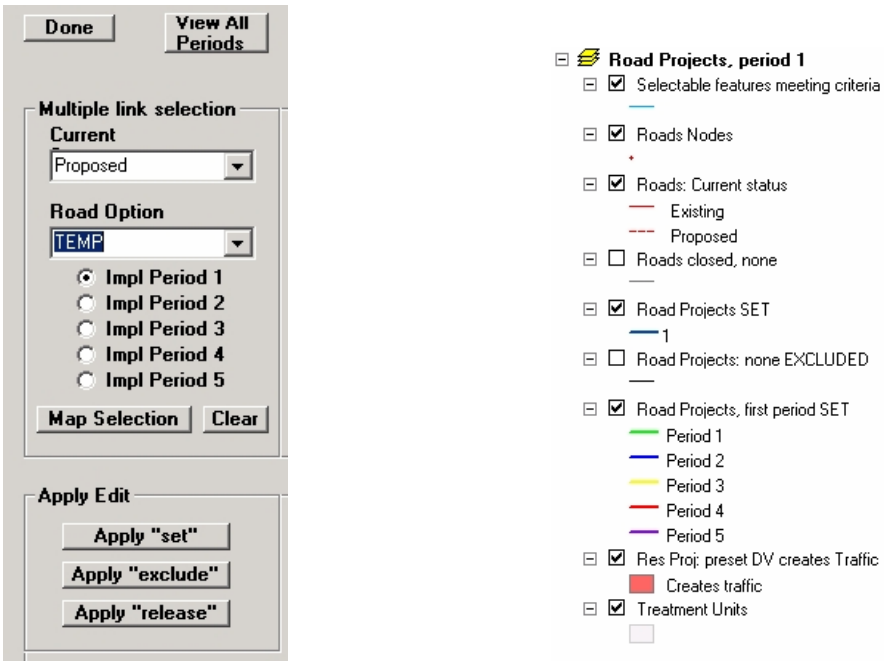
Click the Select on Map button to display the Selectable features meeting criteria layer, launch a display table listing records matching that layer, and to enable selecting features on the map or in the table. The selection mode is automatically set to Add.

Select road network links by clicking on individual links or dragging a rectangle through one or more links. After selecting one or more link features, click one of the apply edit buttons. Initially, either Set or Exclude road projects. The apply Release button may be used to reverse previous edits (presets).

Task Pane for Road Projects Decision Variables

Use the task pane (shown in Exhibit 65) to set up criteria for selecting road projects for specific links. Three criteria are used: the linkp status (existing or proposed), the road option, and the period in which the project is to be set. For road projects management regimes, a road option is 'in effect' from the period set (which becomes the period it is implemented in solution) until the end of the planning horizon (although temporary roads are only OPEN during the period of implementation, the project is in effect and cannot be changed in a later period).

Exhibit 65. Task Pane and Table of Contents (after Select on Map has been clicked) for Road Projects Decision Variables



Done – Click to exit the form and return to the 'Scenarios' form. Any edits are already saved.

View All Periods – Click to view a map display of all periods; this is for information only and is not used for setting or excluding projects. This display allows the user to see for which links projects have been set or excluded and in which periods. To view the specifics of a SET or EXCLUDED road project, select the period for which the preset was made.

Current Status – Select “Existing” or “Proposed” from this dropdown list to set the road status criteria for links to be selected. Existing links may only have ‘Classified’ or ‘Decommission’ road options assigned. Proposed links may only have ‘Classified’ or ‘Temporary’ options assigned. The existing option for the existing link serves as the ‘no action’ option for that link.

Road Options – Select an option from the dropdown list to serve as criteria for selection of links. Only links which meet both the selected current status and selected road option criteria will be included in the Selectable features meeting criteria layer (see Select on Map below) and be selectable for the next operation (set, exclude, or release). A message box is displayed if no links in the model meet the selection criteria.

Impl Period 1... Impl Period 5 – Select a period of implementation to work with. A road option SET in any one period is “in effect” from that period to the end of the planning horizon. Setting a temporary option is also “in effect” from then on in some sense; even though the link is only OPEN for the period selected, other options are no longer available for that link in later periods.

Select on Map – Click when the period and criteria desired have been selected. The criteria will be applied to the available links and links meeting the criteria become ‘selectable’ on the map or in the display table. If there ARE no links meeting the criteria, a message to that effect will be displayed. Potential road options can only be added in the Road Options form (before the model is generated).

Click and drag the tool to select one or more links from the Selectable features meeting criteria layer. Links can be added to the selected set by repeating the click-and-drag operation on more links. To remove a link from the selected set, use the right-click menu to toggle to Subtract mode. The tool stays in the subtract mode until the menu is activated again (with another right-click) and Add is selected. Add is the default mode.

Clear – Click to clear the selected criteria and selected features. Any edits already applied are saved.

Set – Click to preset “SET” the selected projects into solution. If the existing option for an existing link (the ‘no action’ option) is SET into solution, other options (reconstruction or decommission) are no longer available to the solver.

Release – Click to “RELEASE” projects that have previously been set. Releasing projects that have NOT previously been set has no effect.

Apply Exclude – Click to preset “EXCLUDED” for the selected project(s). Excluding the ‘no action’ option for an existing link will force a reconstruction or decommission option. Exclusion of ALL options for an existing link is not allowed.

TOC for Road Projects Decision Variables

Click the Table of Contents tab (Exhibit 65 on the right) to view or modify the legends for layers displayed in the map for road projects. Layers may be dragged up or down, checked (visible) or unchecked (not visible), legends expanded or collapsed (+ and -) and symbol colors modified as in other map tables of contents.

Layers Present in the TOC for Road Project Decision Variables

When Select on Map is active:

Selectable Features meeting Criteria - This layer is only present while the user is trying to select links. LinkLinks that meet the criteria (the road option type and selected option) are colored blue (the default color, however, the symbol color can be changed). Using the map select tool, the user may click on or drag a rectangle across links to be selected.

Always present:

Roads Nodes – Displays road nodes for reference.

Roads: Current Status - Displays status of all links as existing or proposed.

Roads closed - Displays links that have been closed on the Traffic page.

Road Projects SET - Displays any road projects which have already been preset as “SET” into solution for the current scenario. If none have been set, the legend will have no values.

Road Projects EXCLUDED - Displays any road projects that have been preset as “EXCLUDED” from the solution for the current scenario. If none have been excluded, the legend will have no values.

Road Projects First Period SET - Displays any road projects that have been “SET” by period.

Res Proj Preset DV creates Traffic - Display of treatment units that have resource projects set into solution. If the resource project set into solution has a timber product output (i.e. creates traffic on the network), it is colored as “Creates Traffic”. Other projects (such as prescription burning or pre-commercial thinning) which do not have timber products are marked as preset, but are colored with the “Does Not Create Traffic” symbol color.

Treatment Units - Base layer for reference.

TOC Usage Notes

The legend for each layer in the TOC may be toggled (expanded) between visible and not visible.

Drag layers up or down to rearrange the order of display if needed.

To change individual legend item symbols, left click directly on a symbol. A color palette dialog box will appear; make your selection and click OK to close the dialog (use <ESC> key to close the dialog box without making changes).

To change all symbols for a layer legend in one operation, right click on the layer name. The layer has to be visible (checkbox checked) before this legend editor is active. A symbology tab dialog box for the particular type of legend for that layer will appear. First reselect the highlighted attribute table field from the field list, and then make your edits to the legend.

Tool tip text is displayed while moving the mouse over a layer name for any layer whichis visible on the map. The information indicates whether legend changes for a particular layer are saved.

Map Display for Road Projects – This pane provides a display of GIS layers, interactive selection of links (as road projects) to set, exclude, or release road projects. Included are a standard map toolbar, mouse-over display of link identifiers, and a display table (during selection mode) of individual records for selection. Use the map selection tool to select one or more links, other tools to modify the view or the selection (use the right-click menu in the map display pane to set the mode for selecting links). When the selected set is satisfactory, use the "Apply" edit buttons to complete a current task action. No changes are saved until one of the three apply edit button is clicked.

Map Toolbar Description

Standard map navigation tools and an Identify tool are included on the toolbar. These tools include:
Stop Map Tool – After using one of the OTHER map tools, Click to revert to the pointer (default cursor). Right-click and select a mode to reset the tool for selection.
Zoom In Click this tool and drag or click in the center of the area desired for zoom in.
Pan hand – Click this tool and drag to move the map display in the pane.
Zoom Out – Click and drag a zoom rectangle, or click in the center of the area desired to zoom out.
Zoom to full extent – Click to reset the map display to the fullest extent of the largest layer
Back extent (left arrow) – Click to change the map display to a previous view.
Forward extent (right arrow) – Click to change the map display to a previous view. Views are saved in order; if more than two views are in the 'stack' the left arrow moves to earlier views and the right arrow moves to more recent views.
Identify – Click this tool to select the tool, then point and click on a feature. Attributes for that feature will be displayed in a popup window. This window must be closed before other actions can continue.
Distance – Click this tool and drag to form two endpoints. Distance is displayed in the same units the data is projected in (usually meters) at the bottom of the map pane.

Right click pop-up menu action modes:

Add – Click to enable cursor add features or individual table records to the current selection set, especially after using a tool on the toolbar.

Subtract – Click to enable the cursor to unselect features or individual table records from the current selection set.

NOTE: After using a map navigation tool, use the right click menu to set the selection mode to select or unselect features/individual records for the current task. The identify tool reports attribute values for the underlying base layers only, i.e., roads and treatment units. The toolbar also includes a custom Promote button to move selected records to the top of the display table (see Display table).

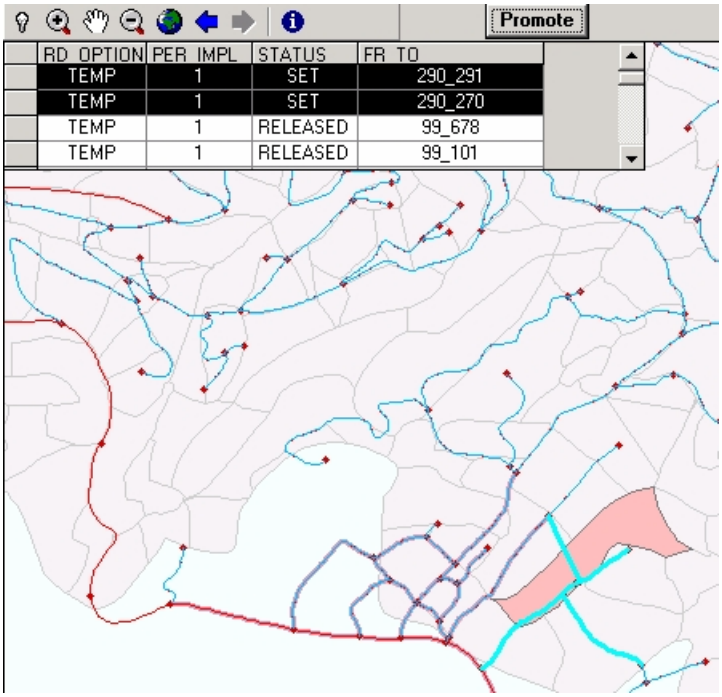
Status bar - During selection of features the total selected miles is displayed in the panel at the left. The panel at the right always displays coordinates in map units.

Table Display for Roads Decision Variables - The table of road projects (similar to the display table for resource projects) meeting the criteria is displayed when the map selection button is clicked (see Exhibit 66). Use the map navigation tools to view features which might be initially displayed beneath the table. The table is not resizable or movable. This table may be used to select records to be preset to “SET”, “EXCLUDED”, or “RELEASED”. It operates in conjunction with the map display selection (i.e., for each link selected on the map, the corresponding records are selected in the table and vice versa.).

The display table in this interface allows the user to sort the FR_TO, RD_OPTION, and STATUS fields in ascending or descending order by clicking the field header.

The user may select/unselect records and edit the SET field. To select one or more records, click in sequence (in Add mode) to the left of each record to be edited. To unselect one or more records, right click on the map and select Subtract, then click to left of records to be unselected. One way to edit the field is to enter a value in the text box in the Task Pane and press Apply Edit. The entered cost will appear in all records which were selected. To edit the SET field directly in only one record, click once (do not double-click), type in the desired value, and click once anywhere in another record or click the Apply Edit button. (One may enter only the first letter (“S”, “E”, or “R”), and autocomplete finishes the word.)

Exhibit 66. Display Table for Decision Variables Road Projects



Map Usage Tips:

It is sometimes convenient to select “All” Current Status and/or “All” Road Options as criteria, in order to see an overview of decision variables which have been set and/or excluded for one or more selected links. The corresponding table records for each selected link are displayed as highlighted in the immediate viewing area of the table. Click the Promote button to move highlighted records for all selected links to the top of the table.

Traffic Decision Variables

Use this page to close links to 'traffic' as a way of controlling road options and routing. There are no MAGIS eXpress restrictions on how many links or for which time periods these values may be specified by the user. Caution must be employed by the user however in closing links; make sure that no decision variables have been set that have to use the link to carry traffic; conflicts (infeasibility) are created in this case.

To use the form, select a period of implementation option button on the Task Pane. The map redraws whenever the period is changed.

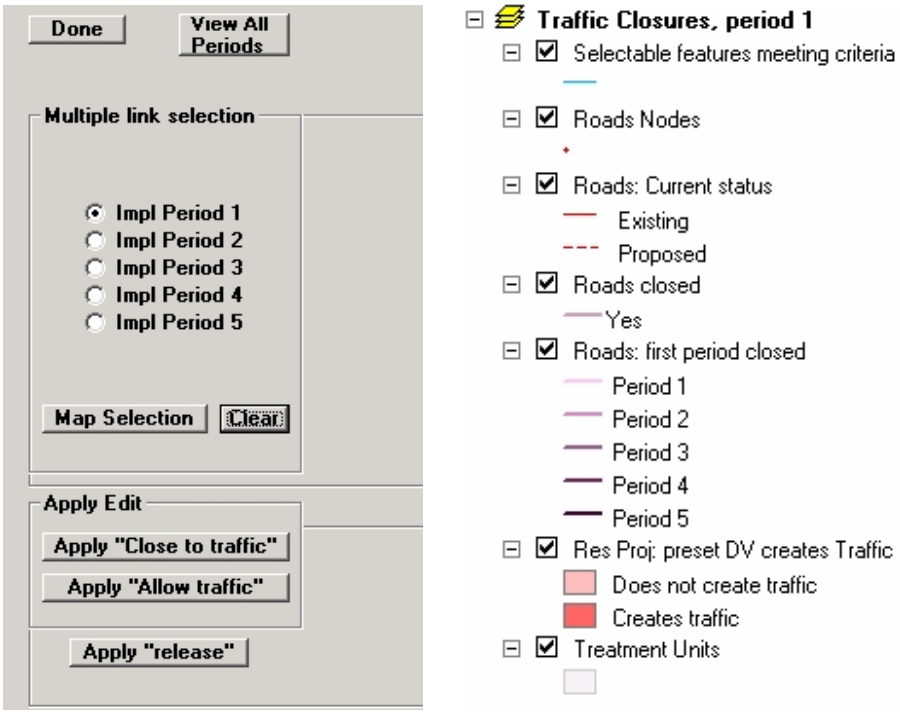
Click the Select on Map button to display the Selectable features meeting criteria layer and launch a display table listing records matching that layer. This also enables selection of features (links) on the map or in the table. The selection mode is automatically set to Add.

Select road network links by clicking on individual links or dragging a rectangle through one or more links.

Task Pane for Traffic Decision Variables

The Task Pane for Decision Variables (see Exhibit 67) for traffic has only periods as a selection criterion, and two apply edit actions. Select the period, then select Select on Map to select links on the map or in the display table. Select Close to Traffic or Allow Traffic after selecting one or more links (or table records). Use Clear Select to restart a selection set or change the time period and start a new selection set.

Exhibit 67. Task Pane and Table of Contents for Set Decision Variables for Traffic



Done - Click to exit the form and return to the 'Scenarios' form. Any 'Apply' edits have already saved.

View All Periods - Click to view a map display of all periods; this is for information only and is not used for presetting road closures. This display allows the user to see for which links traffic has been closed for the current scenario and in which periods. To view the specifics of a closed link, select the period for which the preset was made.

Impl Period 1 ... Impl Period 5 - Select one of the period option buttons to serve as the criterion for selection of links. Only links which may be open during the selected period *Selectable features meeting criteria* layer (see "Select on Map" below) and selectable for the next operation (close to or allow traffic).

Select on Map - Click when the period has been selected. The criterion will be applied to the available links, and links meeting the criterion become 'selectable' on the map or in the display table. If there ARE no links meeting the criterion, a message to that effect will be displayed.

Click and drag the tool to select one or more links from the *Selectable features meeting criteria* layer. Links can be added to the selected set by repeating the click-and-drag operation on more links. To remove a link from the selected set, right-click with the tool in an inactive space and select Subtract from the popup menu. The tool stays in the subtract mode until the menu is activated again (with another right-click) and Add is selected. Add is the default mode.

Clear - Click to restart the current selection set or continue to the next operation. Any "Apply" action edits have already been saved.

Close to traffic - Click to preset road closure for the selected links into solution.

Allow traffic - Click to allow traffic for the current scenario. That it, the solver may select such links for hauling products.

Table of Contents for Traffic Decision Variables

Layer present only when Select on Map is active"

Selectable features meeting criteria – This layer depicts the links that may have an edit action applied for the selected period.

Layers always present :

Roads Nodes – Display of nodes for reference.

Roads: Current Status – Display of link status as existing or proposed, for reference.

Roads closed – This layer displays the links that are closed during the current period (they may or may not have been closed THIS period, but closed in an earlier period.

Roads: first period closed - This layer displays the period for links for which the user has set projects that close the road, or has set traffic closed

Res Proj Preset DV creates Traffic - Display of treatment units that have resource projects set into solution. If the resource project set into solution has a timber product output (i.e. creates

traffic on the network), it is colored as “Creates Traffic”. Other projects (such as prescription burning or pre-commercial thinning) which do not have timber products are marked as pre-set, but are colored with the “Does Not Create Traffic” symbol color.

Treatment Units - Base map layer for display purposes

TOC Usage Notes

The currently selected period is printed at the top of the TOC for reference. The legend for each layer in the TOC may be toggled (expanded) between visible and not visible.

Drag layers up or down to rearrange the order of display if needed.

To change individual legend item symbols, left click directly on a symbol. A color palette dialog box will appear; make your selection and click OK to close the dialog (use <ESC> key to close the dialog box without making changes).

To change all symbols for a layer legend in one operation, right click on the layer name. The layer has to be visible (checkbox checked) before this legend editor is active. A symbology tab dialog box for the particular type of legend for that layer will appear. First reselect the highlighted attribute table field from the field list, and then make your edits to the legend.

Map Display for Traffic Decision Variables – This pane provides display of GIS layers and interactive selection of links to close or release them for traffic. Included are a standard map toolbar, mouse-over display of treatment unit identifiers, and a display table (during selection mode) of individual records for selection. Use the map selection tool to select one or more links, other tools to modify the view or the selection (use the right-click menu to set the selection mode). When the selected set is satisfactory, use the ‘Apply Edit’ buttons to complete the task. No changes are saved until one of the ‘Apply’ command buttons is clicked.

Map Toolbar Description

Standard map navigation tools and an Identify tool are included on the toolbar. These tools include:

Stop Map Tool – After using one of the OTHER map tools, Click to revert to the pointer (default cursor). Right-click and select a mode to reset the tool for selection.

Zoom In Click this tool and drag or click in the center of the area desired for zoom in.

Pan hand – Click this tool and drag to move the map display in the pane.

Zoom Out – Click and drag a zoom rectangle, or click in the center of the area desired to zoom out.

Zoom to full extent – Click to reset the map display to the fullest extent of the largest layer

Back extent (left arrow) – Click to change the map display to a previous view.

Forward extent (right arrow) – Click to change the map display to a previous view. Views are saved in order; if more than two views are in the ‘stack’ the left arrow moves to earlier views and the right arrow moves to more recent views.

Identify – Click this tool to select the tool, then point and click on a feature. Attributes for that feature will be displayed in a popup window. This window must be closed before other actions can continue.

Distance – Click this tool and drag to form two endpoints. Distance is displayed in the same units the data is projected in (usually meters) at the bottom of the map pane.

data

After using a map navigation tool, use the right click menu to set the selection mode to select or unselect features/individual records for the current task action. The identify tool reports attribute values for the underlying base layers only, i.e., roads and treatment units. The toolbar also includes a custom Promote button (except for Exit Nodes) to move selected records to the top of the display table (see Display table).

Right click pop-up menu action modes:

Add – Click to enable cursor add features or individual table records to the current selection set, especially after using a tool on the toolbar.

Subtract – Click to enable the cursor to unselect features or individual table records from the current selection set.

Table Display for Traffic Decision Variables - The table display shows the selectable records and allows direct editing of particular fields. Use the map navigation tools to view features which might be initially displayed beneath the table. The table is not resizable or movable. This table may be used to select records to be preset to close or allow traffic in a scenario solution. It operates in conjunction with the map display selection (i.e., for each link selected on the map, the corresponding records are selected in the table, and vice versa.)

The table allows the user to sort the FR_TO and CLOSED fields in ascending or descending order by clicking the field header.

The user may select/unselect records and edit the field CLOSED. To select one or more records, click in sequence (in Add mode) to the left of each record to be edited. To unselect one or more records, right click on the map and select Subtract, then click to left of records to be unselected. Allowable values are YES and NO (upper case). YES means that the link is 'Closed' to traffic in a scenario solution, NO means that traffic is allowed. One way to edit the field is to enter a value in the text box in the Task Pane and press one of the Apply buttons. To edit the CLOSED field directly in only one record, click once (do not double-click), type in the desired value, and click once anywhere in another record or click the Apply Edit button. (One may enter only the first letter ("Y" or "N"), and autocomplete finishes the word.)

Status bar - During selection of features, the total selected miles is displayed in the message panel at the lower left. The message panel at the right always displays coordinates in map units

Map Usage Notes

Click on the Table of Contents tab to view map layer legends for layers updated in the map display. Modify the table of contents layers legends symbols as needed for interpretation of information depicted by the layers. Click the Promote button to move highlighted records for all selected links to the top of the table.

Use the View All Periods button for an overview map for all periods or period of implementation.

Exit Nodes Decision Variables

Lower and/or upper limits for traffic volume for one or more exit nodes for one or more traffic types may be preset. This has the effect of either limiting the total harvested volume (if all exit nodes for that type are limited), or simply limiting how much volume is routed to a particular mill. Only values in the fields 'Low_Lim' and 'Upp_Lim' are edited with this graphical interface. The value of 'Low_Lim' must be equal to or greater than 0. A value need not be specified for

‘Upp_Lim’. Limits may be set for each traffic type - period combination for each exit node. Values entered are in traffic capacity units of measure. Type the range for the amount of allowable traffic or preset to zero to close the exit node to traffic.

Task Pane for Exit Nodes - The Task Pane contains only the lower and upper limit entry fields, plus the Apply Edit button. The entered values appear in the table.

Lower Limit - The lower limit defaults to 0. Setting the lower limit to a number greater than 0 forces harvesting activity into the solution (to generate the timber output or “traffic”). This can create infeasibility.

Upper Limit - The upper limit for timber products (“traffic”) for the select node and period. Units are the same as the volume of product.

Apply Edit - Click to apply the limits set for the selected records.

Exhibit 68. Task Pane and Table of Contents for Exit Nodes

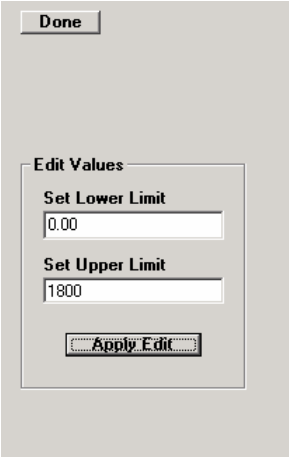


Table of Contents (TOC) for Exit Nodes Decision Variables

Exit Nodes – These are the exit nodes, for the displayed road network, chosen by the user on form 2 of the GIS Import Wizard.

Roads*:* Current Status – Display of link status as existing or proposed, for reference.

Treatment Units – Base layer for display purposes

TOC Usage Notes

The legend for each layer in the TOC may be toggled (expanded) between visible and not visible.

Drag layers up or down to rearrange the order of display if needed.

To change individual legend item symbols, left click directly on a symbol. A color palette dialog box will appear; make your selection and click OK to close the dialog (use <ESC> key to close the dialog box without making changes).

To change all symbols for a layer legend in one operation, right click on the layer name. The layer has to be visible (checkbox checked) before this legend editor is active. A symbology tab dialog box for the particular type of legend for that layer will appear. First reselect the highlighted attribute table field from the field list, and then make your edits to the legend.

Map Display for Exit Nodes – This provides display of GIS layers. Included are a standard map toolbar, mouse-over display of exit node identifiers, and a display table of individual node records for selection. Click to the left of one or more records in the table to select a node and period; selection mode is always to Add to the current selection. Use the toolbar tools to modify the view. When the selected set is satisfactory, use the Apply Edit button to complete the task action. No changes are saved until the apply command buttons is clicked.

Map Toolbar Description

Standard map navigation tools and an Identify tool are included on the toolbar. These tools include:

Stop Map Tool – After using one of the OTHER map tools, Click to revert to the pointer (default cursor). Right-click and select a mode to reset the tool for selection.

Zoom In Click this tool and drag or click in the center of the area desired for zoom in.

Pan hand – Click this tool and drag to move the map display in the pane.

Zoom Out – Click and drag a zoom rectangle, or click in the center of the area desired to zoom out.

Zoom to full extent – Click to reset the map display to the fullest extent of the largest layer

Back extent (left arrow) – Click to change the map display to a previous view.

Forward extent (right arrow) – Click to change the map display to a previous view. Views are saved in order; if more than two views are in the 'stack' the left arrow moves to earlier views and the right arrow moves to more recent views.

Identify – Click this tool to select the tool, then point and click on a feature. Attributes for that feature will be displayed in a popup window. This window must be closed before other actions can continue.

Distance – Click this tool and drag to form two endpoints. Distance is displayed in the same units the data is projected in (usually meters) at the bottom of the map pane.

data

Table Display for Exit Nodes – The table is always displayed. Records in the table correspond to features in the exit nodes layer'. Selecting features on the map highlight records in the table and vice versa. Use the map navigation tools to view areas which might be initially displayed beneath the table. The table is not resizable or movable.

The display table in this interface allows the user to sort any field in ascending or descending order by double-clicking the field header.

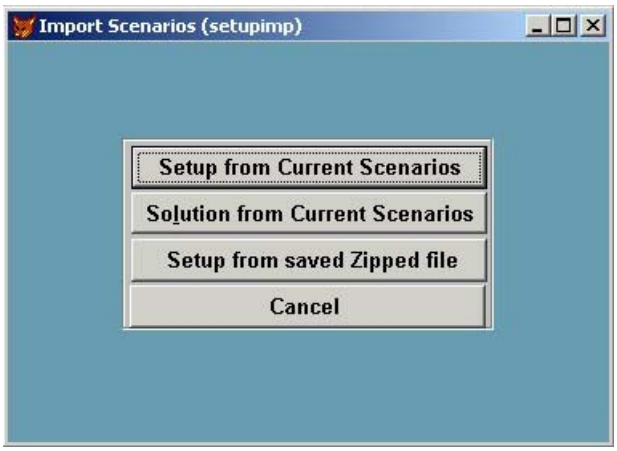
The user may select/unselect records and edit the LOW_LIM and UPP_LIM fields. To select one or more records, click to the left of each record in sequence.

Import Setup form

Use this option (form displayed in Exhibit 69) to select either a setup or a solution from either a current scenario or a saved zip file (but the model has to be based on the same GIS data and Effects functions) to use as the setup for the current scenario definition. Using 'setup from a current

scenario' will copy the setup information to the currently selected scenario, overwriting any definitions in place.

Exhibit 69. Import Setup form

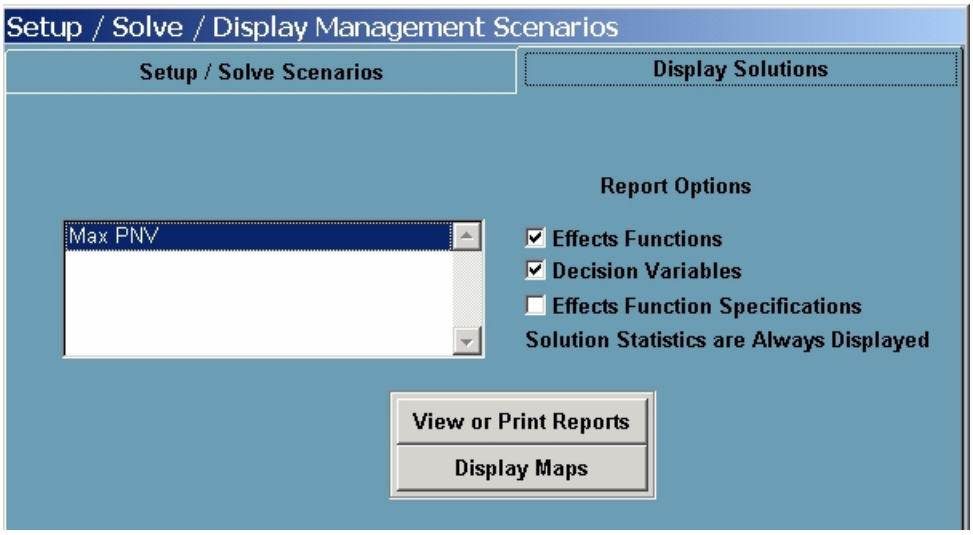


Setup from Current Scenarios
Solution from Current Scenarios
Setup from saved Zipped file
Cancel

Display Solutions Tab

On the Display Solutions tab of the Scenarios form (see exhibit 70), there are two modes by which to view the solution: tabular reports or the GIS display maps of the results of a single solution. Select "View or Print Reports" for tabular reports only, or "Display Maps" for the GIS display. The user may select which reports to view, print or save as a text file.

Exhibit 70. Scenarios Form Display Solutions Tab



Tabular Reports

There are three tabular reports available for a MAGIS eXpress Solution. Effects Functions, Decision Variables, and Effects Functions specifications. Effects Functions specifications is only available in a report that also includes Effects Functions. At the top of each report is the Solution Statistics Report (an example is displayed in Exhibit 71). These statistics, for the Commercial Solver, include:

Analysis type - LP is linear programming, MIP Roads is Mixed Integer for Roads-meaning the solution is run so that the decision variables for roads are integer values (1 or 0), MIP Roads and Resource Projects is Mixed Integer : both roads and resource projects are integer values (1 or 0), and Simulation means that the optimizer is turned off: only 'preset' decision variables (other than no action) are represented in the 'solution'.

Objective Function Name - The Effects Function name selected as the objective to minimize or maximize.

Objective Function Value - The solution value of the objective function. This is the maximum (or minimum). Units are indicated. Cost and Net Revenue functions are reported in Thousand dollars (not dollars.)

"Min/ Max" - indicates whether the selected objective function is minimized or maximized.

Feasible or Infeasible - Infeasibility may be caused by setting decision variables and/or constraints that conflict with each other or with the objective function. For example, an infeasibility would occur if you set a constraint of fixed road costs = 0 and then selected a road project decision variable that builds a new road.

Optimal or Suboptimal - Feasible LP solutions are always optimal. MIP solutions (either roads alone or both) have stopping rules allowing the solution to be less than optimal (this allows the solver to find a reasonable solution; sometimes optimality for MIP solutions is difficult to achieve, and can take many hours.

# of Iterations - Number of 'cycles' the solver took to reach the solution.

Exhibit 71. Solution Statistics Report

```
     E X P R E S S    S O L U T I O N     S T A T I S T I C S
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
|                                                                 |
|Scenario ID             : Max PNV                                       |
|Analysis Type           : LP                                                |
|Objective Function Name : PNV
|Objective Function Value:     528.936   Thous. $
|Min / Max               : Max
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
          S O L U T I O N     S T A T U S
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Feasible or Infeasible : Feasible
Optimal or Suboptimal  : Optimal
# OF Iterations        : 23549
```

The Effects Function report (see Exhibit 72) summarizes the values of the Effects Functions in the solution. The solution value is reported in the first column next to the name, then, if the function was used as a constraint the lower and/or upper limit columns are filled in. The "Shadow

Price" column indicates the difference between the Effects Function value in solution and the value of this function

Exhibit 72. Effects Functions Report

```
      E F F E C T S   F U N C T I O N   R E P O R T
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Scenario ID            : Max PNV

                Solution       Lower       Upper          Shadow Units of
Name               Value       Limit       Limit           Price Measure
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
PNV             528.9360        -INF         INF          1.0000 Thous. $
TotCost1          0.0000        -INF         INF          0.0000 Thous. $
TotCost2          0.0000        -INF         INF          0.0000 Thous. $
TotCost3          0.0000        -INF         INF          0.0000 Thous. $
TotCost4          0.0000        -INF         INF          0.0000 Thous. $
TotCost5          0.0000        -INF         INF          0.0000 Thous
```

The Decision Variables report (in Exhibit 73) comes in two flavors. If the "Active Variables Only" checkbox is checked, the report includes ONLY treatment units with selected projects OTHER than No Action. If the "Decision Variables" report checkbox is checked, the report includes the solution assignment for EVERY treatment unit, including the No Action units.

Exhibit 73. Decision Variables Report

```
          SELECTED RESOURCE  PROJECTS (ACTION variables ONLY)
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Trt   --Mgt. Regime---   Log    Period Solution Lower  Upper     Obj.       Shadow
Unit  Exist    Future    Meth   Of Imp  Value   Limit   Limit    Coeff       Price
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
1175   HarvPulp          TRACTOR   1    1.000  0.0000  1.0000     1.605      -0.00
1200   HarvPulp          TRACTOR   1    0.339  0.0000  1.0000     4.276       0.00
1230   HarvPulp          TRACTOR   1    1.000  0.0000  1.0000     3.772      -0.00
1273   HarvPulp          TRACTOR   1    1.000  0.0000  1.0000     0.766       0.00
154    Regen             TRACTOR   1    1.000  0.0000  1.0000     3.248       0.00
210    Regen             TRACTOR   1    1.000  0.0000  1.0000     1.152       0.00
224    Regen             TRACTOR   1    1.000  0.0000  1.0000     0.774      -0.06
263    Regen             TRACTOR   1    1.000  0.0000  1.0000     1.472      -0.00
269    Regen             TRACTOR   1    1.000  0.0000  1.0000     1.512      -0.11
468    Regen             TRACTOR   1    1.000  0.0000  1.0000     0.804      -0.06
470    Regen             TRACTOR   1    0.450  0.0000  1.0000     2.304       0.00
711    HarvPulp          NONE      1    1.000  0.0000  1.0000     0.000      -0.81
```

The Effects Functions Specifications Report (a sample is displayed in Exhibit 74) includes the definitions of each Effects Function in the model. The report is sectioned by Effects Functions types (costs, net revenues, product amounts, acreage control (including activity acres, vegetation parameter acres etc) and length control. Included in Effects Function definitions are name, the relevant period or periods, the zone name and zone classes (if used), and the names of the costs, revenues (outputs), or area control items that make up the function.

```
Exhibit 74.  Effects Functions Specifications Report
ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
º                                                                         º
º                   Resource Relationship - Cost                          º
º                                                                         º
º  Resource                                                               º
º Management              Time                    Zone                    º
º Relations   Discount   periods    Zone Name    Classes       Costs      º
ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
  TotCost1      No      1                                         HARVPULP
                                                               RDCON
                                                               RDDECOM
                                                               RDRCON
                                                               RDTEMP
```

```
                                                        RXBURN
                                                        TRFCST_P
                                                        TRFCST_T
                                                        MECHTHIN
                                                        REGEN
TotCost2      No      2                                    HARVPULP
                                                        RDCON
                                                        RDDECOM
                                                        RDRCON
                                                        RDTEMP
                                                        RXBURN
                                                        TRFCST_P
                                                        TRFCST_T
                                                        MECHTHIN
                                                        REGEN
```

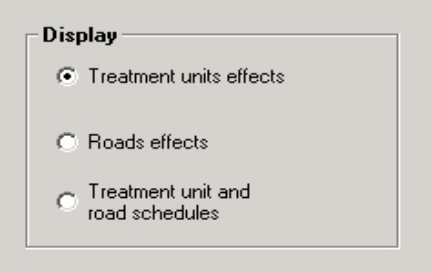
Display Solutions Maps

The Display Solutions grahic interface is comprised of three main windows: the Task Pane for selecting the type of display, the Table of Contents (TOC) which contains legend information and allows the user to modify a view, and the Map Display, which has tabbed page views Effects Functionand standard map navigation tools.

Task Pane

Use the Task Pane (Exhibit 75) to select among the three categories of map displays. Within each view there are one to several layers present; legend/layer displays may be modified somewhat by the user.

Exhibit 75. Display Solutions Task Pane

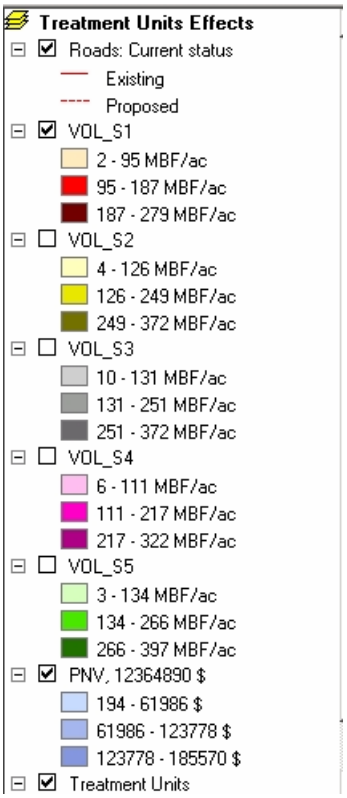


Effects Functions displays for Treatment Units

Table of Contents (TOC)

The Table of Contents for Display Solutions-Effects Functions is displayed in Exhibit 76. This interactive TOC allows the user to customize the view and the information displayed. Each time an Effects Function is selected from the dropdown list, it is added to the Ttable of Contents. The user can modify the view at any time, but there is no provision to remove a layer once it has been added to the view. You can, of course, uncheck the box to turn off the layer (it is no longer visible on the map when the box is unchecked). Each new layer uses the same default colors, so it is advisable to change the colors to a unique set, to prevent analysis errors Treatment Units with values for one layer may not have values for the overlying layer, consequently, colors from the layer 'beneath' may be visible as well. See the Map Display in Exhibit 77 for an example of this.

Exhibit 76. Table of Contents for Effects Functions for treatment units



Layers Present on the Effects Functions page:

Roads: Current Status - Included for reference

Treatment Unit - Base Layer included for referenct.

Effects Functions Layers. The values for the Effects Functions are displayed in automatically derived categories. The legend editing dialog box (right-click on a layer to edit the legend for that layer) allows the user to modify a layer's legend/map colors for a customized display.

TOC Usage Notes

The name of the map is displayed at the top of the TOC pane.

The legend for each layer in the TOC may be toggled (expanded) between visible and not visible.

Drag layers up or down to rearrange the order of display if needed.

To change individual legend item symbols, left click directly on a symbol. A color palette dialog box will appear; make your selection and click OK to close the dialog (use <ESC> key to close the dialog box without making changes).

To change all symbols for a layer legend in one operation, right click on the layer name. The layer has to be visible (checkbox checked) before this legend editor is active. A symbology tab dialog box for the particular type of legend for that layer will appear. First reselect the highlighted attribute table field from the field list, and then make your edits to the legend.

Moving the mouse cursor over the legend causes a tool tip to display, indicating whether legend changes will be saved.

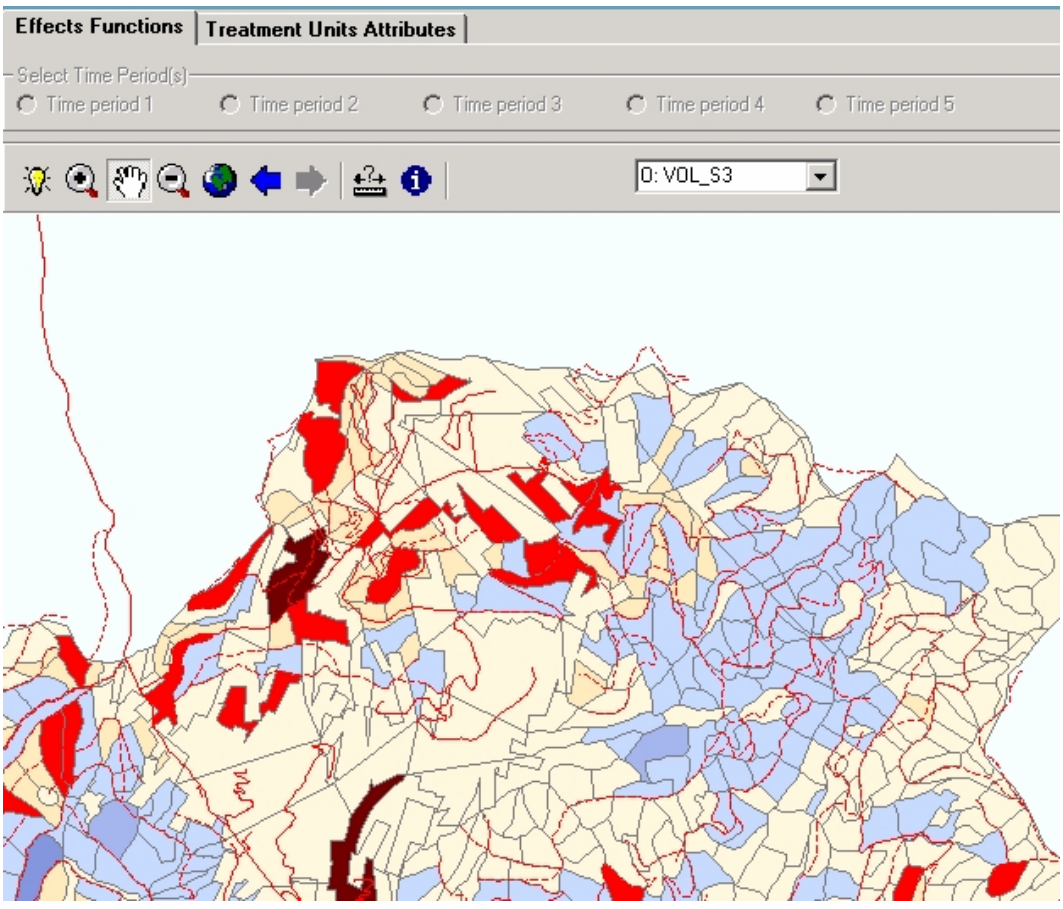
Additional note - Customize legends with the legend editor dialog box: This dialog box (displayed in Exhibit 80) contains numerous customizing tools to create legends that are as detailed as needed. If the layer consists of numeric values, such as the standing volume layer, they will be classified in a default range. The classification, label, and range can be modified by the user, or the symbol colors for each item within the range can be edited. Some caveats include: DO NOT change the "Value" or the "Normalization" fields. The 'equal interval' classification method is specified by program code when a map is first displayed. The classification dialogue however reverts to the 'natural breaks' classification method. For consistency with other layers, it is recommended that you click the Classify button and reset the 'equal interval' classification method, or choose a classification method of your own preference for each layer in the TOC.

Total values for Effects Functions are displayed with Effects Function layer names.

Map Display for Effects Functions – The page displayed when "Treatment units effects" is selected on the Task Pane, is the Map Display of Effects Functions values for each treatment unit polygon, shown in Exhibit 77 (an example might be the PNV). The back tab is the treatment units attributes display which includes the vegetative conditions (an example would be 'size class').

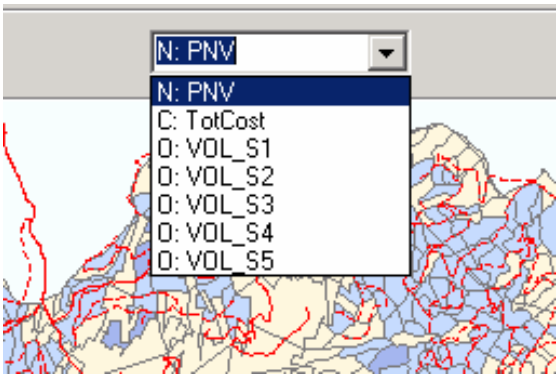
Effects function definitions determine the relevant planning period that is displayed. Use the dropdown list (Exhibit 78) to select Effects Functions to view. Each time a new function is selected, it is added to the TOC for Effects Functions. Users have control of which Effects Functions are to be viewed, which layers are visible, and legend colors and classification categories.

Exhibit 77. Map Display for Effects Functions



Effects Function name – Select an Effects Function name from the drop-down list (Exhibit 78). Each time an Effects Function is selected for the first time, a new layer will be drawn over those already displayed in the map. Switch to the Table of Contents (by clicking on the "Table of Contents" tab at the bottom) to modify the view.

Exhibit 78. Display Solutions Effects Functions Dropdown list

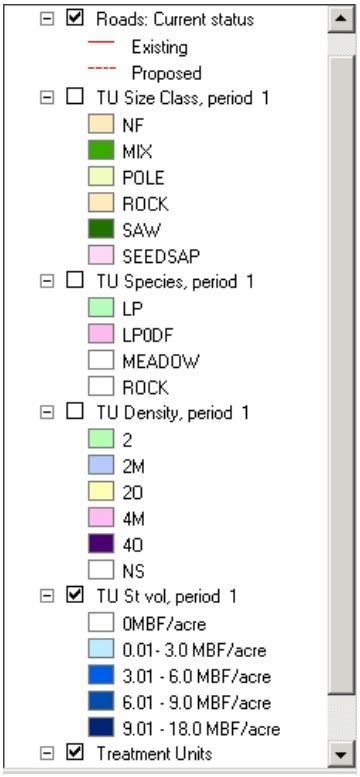


Effects FunctionEffects Function
Treatment Unit Attributes Display

Table of Contents (TOC) for Treatment Unit Attributes

The Table of contents for the Treatment Unit Attributes (seen in Exhibit 79) page is user-modifiable for ease of viewing and analysis of fixed layers. That is, which layers are displayed is fixed, but the user can control the visibility of a particular layer, and can modify the categories for any layer to customize the view. All legend changes made by a user are saved The legend for the standing volume layer is specific to a time period; others persist across time periods.

Exhibit 79. Table of Contents for Treatment Units Attributes



Layers drawn for each planning period:

Roads: Current Status - Included for reference.

Size class - Depicts the size class categories present in the solution for the selected planning period.

Density - Depicts density categories present in the selected planning period.

Dominant species - Depicts all dominant species categories present during the selected planning period

Standing volume - Standing volume as reported at the end of the selected planning period (after treatments are applied and before growth rate is applied for successional change to the next period.

TOC Usage Notes

The name of the map, which includes the selection criteria, is displayed at the top of the TOC pane.The name of the map is displayed at the top of the TOC pane.

The legend for each layer in the TOC may be toggled (expanded) between visible and not visible.

Drag layers up or down to rearrange the order of display if needed.

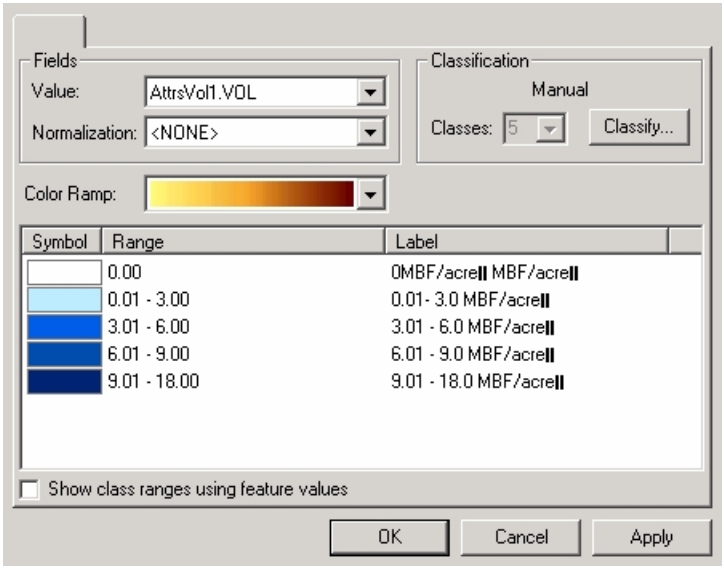
To change individual legend item symbols, left click directly on a symbol. A color palette dialog box will appear; make your selection and click OK to close the dialog (use <ESC> key to close the dialog box without making changes).

To change all symbols for a layer legend in one operation, right click on the layer name. The layer has to be visible (checkbox checked) before this legend editor is active. A symbology tab dialog box for the particular type of legend for that layer will appear. First reselect the highlighted attribute table field from the field list, and then make your edits to the legend.

Moving the mouse cursor over the legend causes a tool tip to display, indicating whether legend changes will be saved.

Additional TOC usage note - customize legends with the ESRI legend editor dialog box: This dialog box (displayed in Exhibit 80) contains numerous customizing tools to create legends that are as detailed as needed. If the layer consists of numeric values, such as the standing volume layer, they will be classified in a default range. The classification, label, and range can be modified by the user, or the symbol colors for each item within the range can be edited. DO NOT change the "Value" or the "Normalization" fields. The dialog box displayed is for editing 'unique value' categories for sz_class, density, and species layers. The dialog box displayed for editing the standing volume legend is for quantities categories.

Exhibit 80. Legend Classification dialog box (ESRI) for quantity categories (standing volume as example).



Map Display for Treatment Units Attributes – This second 'tab' page of the Effects Function 'task' displays by period, the various vegetation state characteristics for each treatment unit in the solution. Planning area totals for each layer are displayed with layer names. Select a period to view by clicking in the radio button. Modify the view using the TOC.

Planning period option buttons - Click one of five period option buttons to display attributes for that planning period.

Roads Effects Functions displays for Network Links

In MAGIS eXpress, Effects Functions can be defined to keep track of road costs. Selecting this category of displays begins map display of the cost IN SOLUTION of the road 'activities'. Users have control of which Effects Functions to view, legend colors and classification categories**.**

Table of Contents (TOC) for Road Costs Effects Functions

The layers drawn on the map for each planning period are:

Roads: Current Status – Included for reference
Treatment Unit – Base Layer included for reference.
Effects functions layers – The values for the Effects Functions are displayed in automatically derived categories. The legend editing dialog box (right-click on a layer to edit the legend for that layer) allows the user to modify a layer's legend/map colors to customized the display.

Map Display of Road Costs Effects functions – In MAGIS eXpress, Effects Functions can be defined to keep track of road costs. Selecting this category displays the cost IN SOLUTION of the road 'activities'. Users have control of which Effects Functions to view, legend colors, and classification categories and visible layers.

Schedules displays for Treatment Units (resource projects) and Roads (road projects)

Exhibit 81. Display Solutions Treatment Schedule table of contents

Exhibit 82. Display Solutions Road Schedule table of contents

TOC for Road and Treatment Unit Schedules

The layers depicted on the map for each selected planning period are:

Roads: Current Status – Included for reference.
Exit nodes - One layer is displayed for each traffic type defined in the model.
All traffic volume - Sum of traffic for all traffic types.
Traffic Volume - One layer is displayed for each traffic type defined in the model.
Treatment units: Activities - This layer represents activity (cost) items occurring ONLY in the period indicated. Activities are PART of a management regime, and do not necessarily occur in the period of implementation of the management regime, nor in every period the management regime in effect. The legend for activities can be modified by the user: activities can be grouped by category for ease of interpretation.
Treatment units: Management Regimes - Any particular management regime selected by the solver occurs in the period of implementation and each period thereafter (we consider it as a management regime that is in effect.) The legend for management regimes can be modified by the user; management regimes can be grouped for ease of interpretation.
Treatment units – **Base layer included for reference.**

The layers drawn on the map for "All periods' are:

Roads: Current Status
Exit nodes – One layer for each traffic type defined in the model.
Traffic Volume – Total for all periods; one layer for each traffic type defined in the model
Road options – First period of implementation.
Treatment units Activities – First period of implementation.

Treatment units Management Regimes – First period of implementation. Treatment units: base layer

All traffic volume – Sum of traffic for all traffic types.

Traffic Volume – One layer is displayed for each traffic type defined in the model.

Road options – Road options selected by the solver for the selected planning period.

Treatment units – Base layer included for reference.

TOC Usage Notes

The name of the map, which includes the selection criteria, is displayed at the top of the TOC pane.The name of the map is displayed at the top of the TOC pane.

The legend for each layer in the TOC may be toggled (expanded) between visible and not visible.

Drag layers up or down to rearrange the order of display if needed.

To change individual legend item symbols, left click directly on a symbol. A color palette dialog box will appear; make your selection and click OK to close the dialog (use <ESC> key to close the dialog box without making changes).

To change all symbols for a layer legend in one operation, right click on the layer name. The layer has to be visible (checkbox checked) before this legend editor is active. A symbology tab dialog box for the particular type of legend for that layer will appear. First reselect the highlighted attribute table field from the field list, and then make your edits to the legend.

Moving the mouse cursor over the legend causes a tool tip to display, indicating whether legend changes will be saved.

Additional TOC usage note - customize legends with the ESRI legend editor dialog box: This dialog box (displayed in Exhibit 80) contains numerous customizing tools to create legends that are as detailed as needed. If the layer consists of numeric values, such as the standing volume layer, they will be classified in a default range. The classification, label, and range can be modified by the user, or the symbol colors for each item within the range can be edited. DO NOT change the "Value" or the "Normalization" fields. The dialog box displayed is for editing 'unique value' categories for sz_class, density, and species layers. The dialog box displayed for editing the standing volume legend is for quantities categories.

Additional TOC usage note for schedules: Customize legends with the custom dialog window. A custom legend dialog box is provided for defining legend categories and symbols for the Activities and Management Regimes layers for individual planning periods. One set of categories may be defined for each of activities and management regimes.

Right click on the Activities or Management Regimes layer name. The legend category definition dialog box for activities or for management regimes will appear.

Select or type in a category name in one of the combo-boxes. The right-most list on the dialog box will now have a heading the same as that category name.

Click on the rectangle to the immediate right of that combo-box. The Symbol Selector dialog window will appear. Select a fill symbol and click OK to apply that symbol to the category.

Transfer activity names or regime names from the select list box to the category list box to assign activities/regimes to a category. (Double-click on a name or use the provided buttons.) Repeat until all activities or regimes have been categorized.

A category may also be deleted by clicking on that category name in a combo-box and pressing the <F3> key on your keyboard.

A category name may be edited. Change the spelling of the name and press the <F2> key.

The Activities legend builder has an additional column of combo boxes at the left of the form. The user may select a priority value for one or more category names as needed.

Click OK to close and apply the category definitions. Cancel aborts any changes to the category definitions. The Reset All button clears all of the category definitions and returns the legend/map display to unique symbols for each activity or management regime.

The legend and map display for the Activities or Management Regimes layer will be updated to display those categories.

Effects FunctionEffects FunctionDouble-click

Exhibit 83. Display Solutions Treatment Schedule tab

Map Display of Road and Treatment Unit Schedules – This map displays the schedule by period for the solution. The user has control of some legend elements and visible map layers. Management regimes and activities can be grouped in the legend for simplified views.

Planning Period option buttons - Click an individual period option button to display schedules for that planning period. Select the 'All periods' option button to see a summary of schedules for all planning periods.

Exhibit 84. Display Solutions Road Schedule

Map Toolbar Description

Standard map navigation tools and an Identify tool are included on the toolbar. These tools include:

Stop Map Tool – After using one of the OTHER map tools, Click to revert to the pointer (default cursor). Right-click and select a mode to reset the tool for selection.

Zoom In Click this tool and drag or click in the center of the area desired for zoom in.

Pan hand – Click this tool and drag to move the map display in the pane.

Zoom Out – Click and drag a zoom rectangle, or click in the center of the area desired to zoom out.

Zoom to full extent – Click to reset the map display to the fullest extent of the largest layer

Back extent (left arrow) – Click to change the map display to a previous view.

Forward extent (right arrow) – Click to change the map display to a previous view. Views are saved in order; if more than two views are in the 'stack' the left arrow moves to earlier views and the right arrow moves to more recent views.

Identify – Click this tool to select the tool, then point and click on a feature. Attributes for that feature will be displayed in a popup window. This window must be closed before other actions can continue.

Distance – Click this tool and drag to form two endpoints. Distance is displayed in the same units the data is projected in (usually meters) at the bottom of the map pane.

Management regimes query tool - A custom Identify tool is provided on the toolbar for the Management Regimes layer. Click on a treatment unit polygon to see the management regimes for each planning period for that treatment unit. This is available for 'each period' maps and also for the 'All periods map.

Status bars - Up to three status bars beneath the map displays are utilized to display certain values when the mouse is moved over a treatment unit feature or road network feature.

For the 'each planning period' maps, the following information is displayed:

Status bar 1

Panel 1: Total traffic for all traffic types.
Panel 2: Activities: period of first implementation.
Panel 3: Management regimes: period of first implementation.
Panel 4: Not used.
Panel 5: Map coordinates in map units.
Status bars 2 and 3
Panels 1 – 5: Traffic amount for up to ten traffic types
For the 'All periods' map, the following information is displayed:
Status bar 1
Panel 1: Traffic, summed over all periods and all traffic types.
Panel 2: Road option name for the period of first implementation.
Panel 3. Management regime name for the period of first implementation.
Panel 4. Not used.
Panel 5. Map coordinates in map units.
Status bars 2 and 3
Panels 1 – 5: Traffic, summed over periods, for up to ten traffic types for the current link

Done - Click to exit the window; changes to the legend groups for management regimes and activities will be saved between solutions.

Help Menu

Online help for MAGIS eXpress. Standard HTML format. Table of contents lists topics (organized similar to menu system) Index and search capabilities

References

Appendices

Scenario strategy tips
GIS data requirements
Exit node to final demand node dummy link
Make a dummy road coverage
Import tables for pathways and growth rates
Glossary
Common Errors
Worksheets