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This paper documents a study of the potential for using Arc View, a GIS software program, to evaluate possible interactions between timber harvesting impacts and recreational uses of adjacent forest roads and trails. Data on hiking, biking and horse riding was used to define recreational uses on specific trails. Harvesting was modeled using basic stand data: stand age, species and assumed rotation age. As a result of this study the author concludes that Arc View is a powerful, adaptable software program that is well suited to the evaluation of zones of influence upon recreation of management activities such as logging . In addition it was concluded by the author that for Arc View to be used to its full potential the input data should be descriptive of relatively small geographic units: in this case forest stands and trail segments.

Predicting and Quantifying Recreation and Harvesting Interaction With a Geographic Information System

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Chapter 1
INTRODUCTION

The popularity of recreational use of the forest is growing. People go to the forest for a variety of recreational activities, from hiking and Sunday drives to camping, mountain biking, hunting, and fishing

The amount of land on the earth is finite, yet the number of people inhabiting that land base continues to grow. Consequently, the pressure of people upon the land will continue to increase. With more people venturing into the forest, it is important to consider that, even though an area may not receive recreational use yet, it may in the future. People who venture into the forest will have an influence upon that land. The recreating public have the ability to vote and, therefore, the power to influence what occurs on that property.

The higher the level of recreational use an area receives, the greater the potential for public concern. Information about the presence and quantity of recreational exposure an area receives is key to successful decision making. Forest managers need to know whether anyone will notice forest management activities and, if so, who.

The ability of computers to examine and sort vast amounts of data has made many new predictions and comparisons possible. The focus of this paper is to investigate the use of the personal computer in solving a task related to the management of a multiple-use forested area. Of interest are industrial harvest and recreational uses.

The purpose of this study was to develop and evaluate a system by which a forest manager can determine actual numbers of recreational users affected by proposed timber harvest practices. It was intended that the solution derived through the use of a geographic information system (GIS). There were three main steps in achieving this end result.

1. Select a specific GIS.

2. Develop a method to determine when, where, and for how long disturbances related to harvest use of an area will occur. (This involved evaluation and manipulation of forest data.)

3. Evaluate recreation data.

Existing data was used wherever possible for this study. The McDonald and Dunn Forest, northwest of Corvallis, Oregon, was selected as the study area because of the availability of existing data and proximity.

Chapter 2
LITERATURE SEARCH

Data for the McDonald and Dunn Forest area were available in both ARC/INFO and SNAP software formats. The recreation data was only available in the ARC/INFO format. Because of its ease of use and the ability to create "zones of influence" type buffer areas, ArcView was selected to resolve the questions of interaction between harvest and recreational use in a specific land area.

The decision to pursue the use of ArcView was supported by the work of Howes (1995), whose paper focused on oil spill response and included information about gathering data and data use. This project used ArcView in some of the applications of data sharing and refining. Additionally, the paper commented on the ease with which people could learn ArcView basics in a short time. The potential ability of a forest manager to expediently learn ArcView added to the decision to choose that package. Howes' project, which covered the entire Vancouver Island in British Columbia, was vastly larger in scope and in the detail of the recreation data assimilated.

Nakamura (1995) discussed the use of an ARC/INFO-based GIS to compare three uses in forested areas. The size of the project covered 150,000 hectares (370,656 acres) and dealt with three uses: timber production, recreation, and water storage. This project did not attempt to go into the level of detail that would be necessary with the McDonald and Dunn Forest project.

Fundamentals of ArcView

In order to discuss the interaction of recreation and harvesting, the data must be defined and explained. Most forest managers use desktop or personal computers. The output from any computer is only as accurate as the data stored. In order to make future predictions about harvest and recreation, data must be properly gathered, processed, and applied.

There are two main types of geographic information systems. Vector-based GIS and Raster based GIS. The vector system records and displays only significant features. The significant features are stored by means of a combination of coordinates and equations which express relationships to other features. The Raster system is based on a grid of uniform cells covering the entire area of concern. The Raster system has some identification for all space in a map. Each of the cells must have an identification of some nature. If the cell is empty, then the cell is identified as the category of empty. In a vector GIS, only features are identified. If an area is empty in a vector system, then no information is associated with that area (Figure 1). The result of the difference in methods is that vector-based systems require less memory space in many cases. Software is available that translates one form into another.

ArcView is a program which enables the user to work with existing data. Its purpose is not to digitize and actually create maps. ArcView does have some creation capabilities for building maps with a digitizer or mouse. Digitization is the process in which graphical representations such as maps are created by physically retracing existing maps or drawings with a cursor or digitizer. The niche that ArcView satisfies best

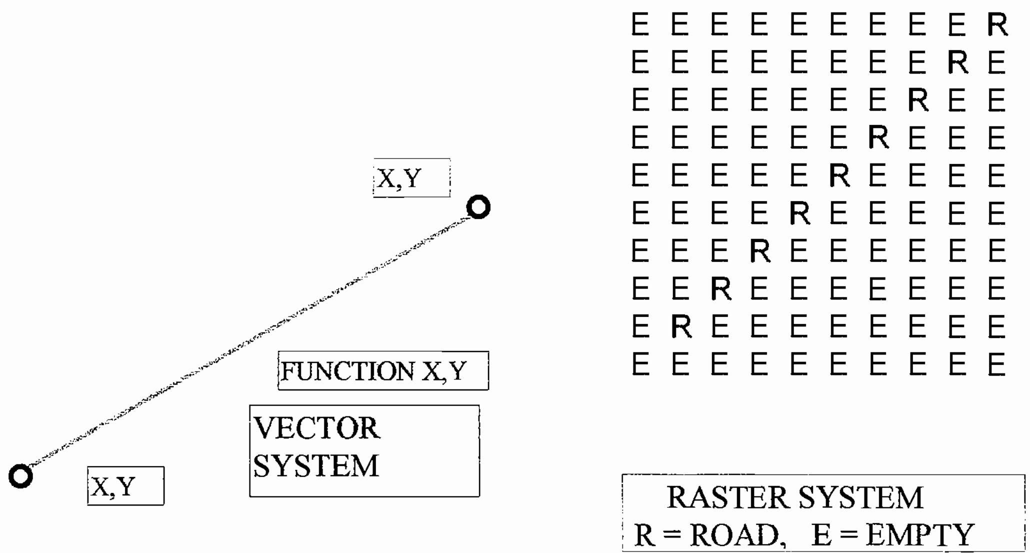

Figure 1. Comparison of vector and Raster representations.

is allowing the user to recombine, edit, add to, make changes to, and keep track of geographic and tabular information created elsewhere.

The most natural place to create graphical information for ArcView is in the ARC/INFO program or a computer aided design (CAD) program, such as Autocad. ARC/INFO is a very complicated and powerful program created by Environmental Systems Research Institute, the makers of ArcView. ArcView is a reduced version of ARC/INFO, which features a graphical user interface (GUI). ARC/INFO claims to be the most widely used format for GIS data storage in the world (Environmental Systems Research Institute, ArcView GIS, 1996 p. 48). Images can be brought in from other sources and modified. ArcView allows the user to easily integrate CAD drawings and files from several other GIS-related packages.

This study investigated the manipulation of a combination of data. The purpose of this exercise was not to create maps and digitize them from scratch. The goal was to use ArcView to efficiently evaluate an existing GIS data set to derive useful information for forest management.

GIS, and more specifically ArcView, applications have been chosen due to the spatial nature of study data. The question of interaction of two uses of single property is one of proximity and possible overlap in time and space. Once the digital representations of the two uses have been created to show use patterns, ArcView can help with the location analysis. ArcView enables the user to place maps (overlays) on top of one another. The result of this process is similar to drawing two maps on transparencies and placing them one atop another to demonstrate the overlap of features. Determining the proximity of features would require using a ruler to measure the distances on the transparency map by hand. The distances would then require conversion to actual distances, depending upon the scale of the maps in question. The distances might also gain error due to the width of the depiction of the features. The advantage of the ArcView program is the ability to do overlay and proximity calculation rapidly and accurately. The scales of the maps in ArcView can be adjusted. Users can zoom in or zoom out of areas of interest. The features in ArcView GIS are stored as actual representations and locations of entities with a spatial relation to each other. This maintains the accuracy of location and proximity, regardless of the scale of the map viewed. ArcView also facilitates the quick calculation of areas, lengths, and other physical features.

Zones of Influence

The concept of zones of influence is crucial to the evaluation of interaction between different uses of a forested area. Operations in the forest impact an area outside the "unit boundary" of that operation. An analogy would be a car on a street interacting with pedestrians in the vicinity. The car travels in a specific space at a specific time on the road. A pedestrian crossing the street could also enter the same space. If both the vehicle and pedestrian used the same space at the same time, one would impact the other. The idea of zones of influence is that the vehicle and pedestrian do not have to occupy the same time and space to influence each other. The pedestrian may be influenced by the noise of the vehicle at a great distance, or the pedestrian may be adversely effected by water splashed from the road at a short distance as the vehicle passes. These are two different zones of influence of the vehicle, one of noise, and the other of water splash.

While both of these examples are short lived, the zone of influence may last for a long time, as in the case of litter thrown from passing vehicles.

Harvest operations on a forested area produce the same type of zones of influence. The influence of noise from a chain saw would extend far but be short lived. The changes in the adjacent forest structure, such as wind throw, would not extend more than a few tree lengths. This wind throw zone could last as long as the decomposition process of the fallen trees. Harvest operations could change the amount of runoff from a specific unit. With the removal of trees, water loss due to transpiration could decrease significantly. The increase in sunlight caused by removal of an overstory could cause growth of different vegetation. Adjacent forest areas could be blackened by an overzealous burning treatment. Some cable logging operations hang skylines and guylines far outside the unit to be logged. It is possible that the skyline could overhang adjacent trails. The skyline hanging outside a unit could damage trees left standing. The view changes of timber harvest can be apparent for miles in some cases but only a few feet in others. Snow accumulation changes can occur as wind structures change. This might be a benefit to cross country skiers and snowmobile users. These are just a few examples of how harvest activities in the forest can produce different zones of influence.

Different zones of influence will be applicable to different areas. The extent of a specific zone of influence varies from location to location. It is probable that different zones of influence will extend from a given unit in a nonsymmetrical fashion. ArcView has the capability to allow the user to drag polygon boundaries. This ability to build asymmetries into polygons allow the user to skew the zone of influence for reasons like slope or adjacent timber type (effects uphill will be different from effects downhill of a unit). The concept of the zone of influence is used to address interaction potentials in a forested area other than those inside the unit.

Chapter 3
METHODS OF STUDY

The predicted forest management activities are paramount to the model. Logging and the associated zones of influences are the focus of the industrial side of the equation. Douglas fir is a valuable crop tree and has an optimum rotation age. This age depends on more than just growth. For any given land area with management objectives, an optimum age for treatment can be determined. For example, if the optimum age for final harvest is 60 years of age and the age of the present stand is 15 years, the final date of harvest would be 45 years in the future (60 - 15). This works well if the stand is in the shape and size of a harvest unit. If the land area of concern is larger than one harvest unit, further breakdown is required.

The previous example shows a method of determining when a stand will be actively harvested. The location of trees to be harvested within a stand must also be known. Predicting where and how to harvest can become a daunting task. There are many rules that govern how harvest operations are to be carried out. The method of harvest often governs the location of units. These rules include not only forest practice regulations but laws of physics as well. There are two methods of mapping a forested area: a stand age based map and a proposed harvest unit map. Stand age separations and harvest units could possibly be the same. However, it is highly probable that the two methods of mapping would yield vastly dissimilar results.

Due to data availability, this project started from a stand-based solution. The forested area to be worked with in this paper is the McDonald and Dunn Forest. This research forest comprises about 12,000 acres to the north and west of Corvallis, Oregon.

There are stand based maps of the forest available in an ARC/INFO format. ARC/INFO files are easily transferable to ArcView for usage. The stands map (Figure 2) contains many delineated contiguous amoebae-like polygons. Each stand represents a different timber age and/or type. With the stands map, the timing of treatments can be approximated with the above-mentioned constraints.

The next step in the process involved the collection and documentation of recreation use. On the McDonald and Dunn Forest, there are three main types of recreation use: walking or hiking, bicycle riding, and horse riding. Although vehicular traffic is normally a popular recreation in forested areas, the McDonald and Dunn Forest is closed for the most part to unofficial vehicular traffic. For the purposes of this comparison, it is important to know and document where and when recreational activities take place. Existing data was used for this purpose as is described below.

The documentation of the infrastructure of roads and trails is a relatively simple process. The paths are mapped and digitized. The usage of this system may present some problems. The problems in usage documentation are inversely proportionate to the budget of the project. On the extreme end of the spectrum is exact observation for long periods of time. A more economical method would involve a statistical sample of the recreation users population. The intensity of the sample would depend upon the degree of accuracy required.

The recreational information used in this examination was gathered in a study by Wing (1998). As part of a separate study, Wing surveyed recreational visitors at different areas in the McDonald Forest. Survey information collected contained the route the recreationalist used. The use information was gathered for three seasons of a calendar year

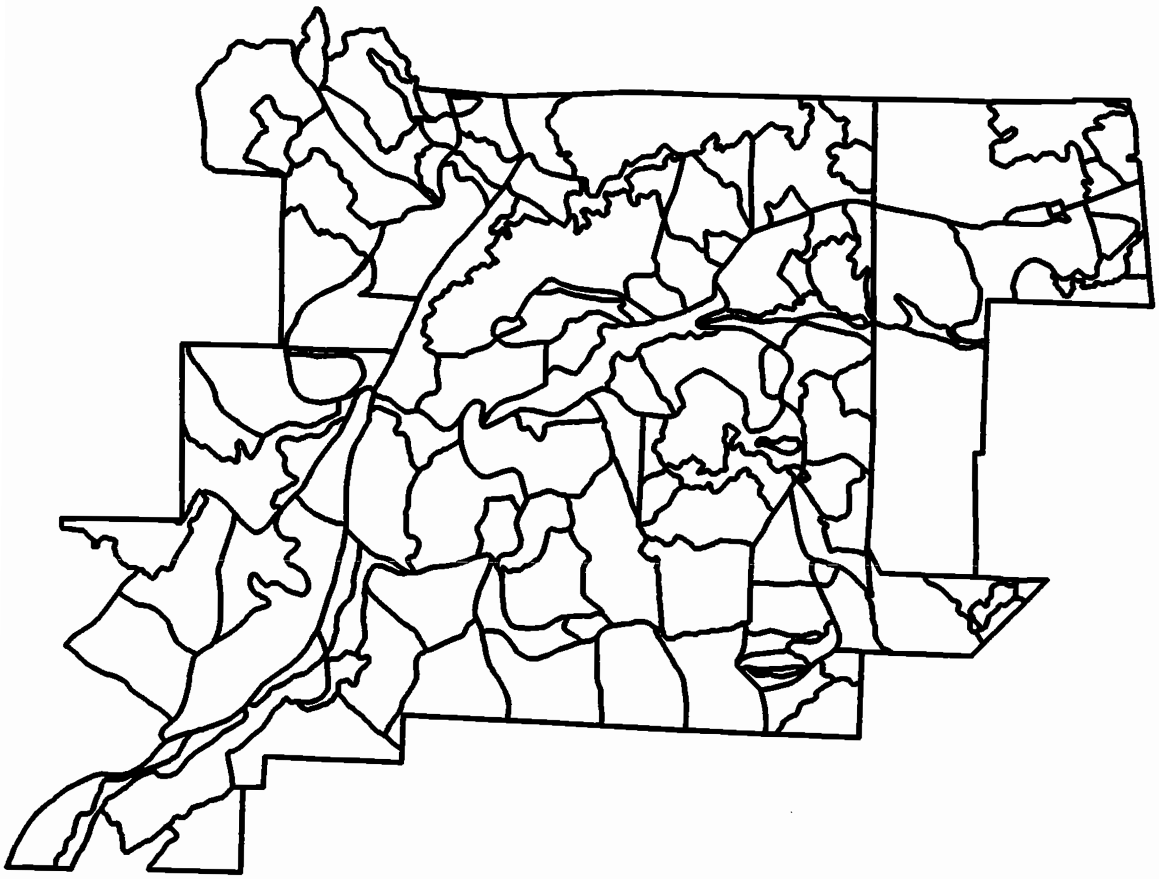

Figure 2. McDonald and Dunn Forest stands map (all polygons are represent delineated timber types). Scale 1" = 2,232'

with winter being excluded. The specific season to be used in the later comparison is the fall of 1994. It is important to note that the data used in this project are the actual recorded numbers of users in fall 1994. The total use for the fall quarter would have to be derived by applying a multiplier to the sample taken. For the purpose of making future predictions, some sort of growth multiplier should also be applied. The net result is that the numbers for use supplied by Wing represent actual use levels rather than total use estimates.

The output of interest to this project is the mapping of paths and trails used by forest visitors and the associated use patterns. Wing started by delineating every road and trail in McDonald Forest. Each segment of path or road was split at intersections assigned a specific numbered code. For example, the same road 540 by the McDonald Forest numbering system was segmented into several sections as it intersected other roads and trails. Figure 3 shows McDonald and Dunn Forest road numbers above the road and Wing's numbers below the road.

This example further illustrates the breakdown into stand-alone information about each segment. In the above example, it is important that segment 310 not be tied to either 170,171 or 300. If segment 310 is selected for proximity reasons, only the use on that segment is of importance. If the use data on segment 300 is to be important, then it would have to be selected itself for proximity reasons. The output results are in hiker segments. For example, if both segment 300 and 171 are selected in ArcView, the use on each segment will be returned. This use could represent the same people. If five people travel on segment 300 then continue on segment 171, summing the use data returned from

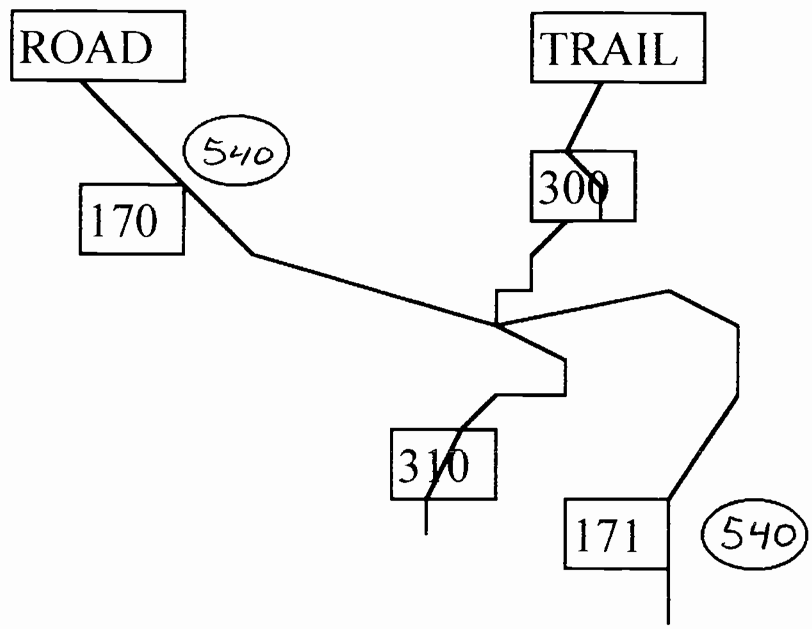

Figure 3. Road and trail numbers on McDonald and Dunn Forest. The boxes represent Wing (1997) system. The circles represent McDonald and Dunn Forest numbering system.

ArcView will return 10 users. This would not represent 10 separate people but 10 hiker segments.

Hardware and Software

In order to efficiently operate the ArcView program with the type of data needed some hardware issues had to addressed. ArcView version 3.0 was used in this examination. This is a 32-bit program and operates most efficiently on a 32-bit operating system. ArcView version 3.0 works best on Windows NT or 95. Graphics files can get very large to the point they will not fit easily on a normal floppy disk. The information can be transported through networks or various E-mail systems and stored on the hard drive. The size of the files to be manipulated in ArcView lend themselves to the use of an Iomega Zip drive. The Iomega Zip drive facilitates the use of removable 100 Mb disks. Without a Zip drive files, must be compressed to fit on a floppy disk for transport.

Example of Use on a Specific Timber Sale

In order to illustrate a method by which management decisions can be organized to create an output, a few assumptions were made. The first was to use the Lakeland timber sale on the McDonald and Dunn Forest. This harvest unit had been previously defined by the research forest staff. The recreation information used consisted of the actual recorded use for fall 1994. The zones of influence used included a 250-foot wind throw and a 1,500-foot noise of operation range.

To begin, the data for harvest and recreation was stored in a directory or drive that could be readily accessed. The hard drive of the computer provided the most rapid access to the data.

The GUI in the ArcView program provides an intuitive method of operating the software. It is recommended to set the working directory in ArcView to the same location as the source data on harvest and recreation. Maintaining the same directory for all data saves time in searching for files in subsequent uses.

ArcView combines themes (maps) by putting one atop another on-screen. A *view* is the entire map or picture, and a *theme* is a component or one overlay in the view. The result of this is that the program will visually cover information that is "stacked" below other files. As an example, the theme "titled stands" has information for the entire forest. This stands cover is a series of polygons covering the whole area. The specific result is that if the theme titled trails is made active first, and the stands theme is combined on top, the trails theme will not be visible. This is analogous to placing a pencil on a sheet of paper: You can see them both. But if you put sheet of paper on a pencil, you will only see the sheet of paper.

Because of this tendency toward masking, the stands layer was worked with first by activating a new view. In this specific example, the Lakeland timber sale was a subset of the stands in the stands cover.

The Lakeland timber sale chosen by the staff of the McDonald and Dunn Forest comprises six contiguous stands of the stands theme. Since the Lakeland sale alone was the focus of the search for interaction, these six polygons were combined and moved into a separate theme. The smallest subset of the stands theme that will contain all six of the

Lakeland unit stands was selected. This subset was then be converted to a separate shapefile. The new shapefile was labeled with a relevant name, and the new file was added to the current view. With the two themes in the active view, stands polygons that are not part of the Lakeland unit were removed. This was done by choosing “Start Edit” from the theme menu. The remaining crucial six polygons were selected. With “Union Features,” from the edit menu, all six were combined to one polygon. The stands theme will show the selected polygons from which the Lakeland unit was created were created by double clicking on the label of the theme in the area to the left of the graphics of the theme. The polygons were deselected before continuing. Trails and roads were added to the active view (data from Wing, 1998).

For the purpose of demonstration two zones of influence were chosen. The first zone of influence was that of 250 feet for potential wind throw. A subset of the trails and roads theme that are within 250 feet of the Lakeland unit were chosen. In ArcView the graphical representation of the trails are tied to the use data in the associated table. Once the paths were chosen that have a portion within the specified proximity of the Lakeland sale, the associated information in the use table appeared as highlighted. A subset of the trail data theme was selected by activating the theme and choosing “Select by theme” from the theme menu. A “proximity query” was selected from the dialog box and “Select features that are within distance of.” The Lakeland sale polygon was selected as the source for the zone of influence. In the last dialogue box, the distance of the zone of influence was entered. Upon choosing “new set,” the original view appeared with all of the trails in yellow that were at least partially within the 250-foot zone of influence. At this point, the question of proximity of trails was graphically answered on the screen. All the selected trails appeared in purple (see Figure 4). The power of ArcView is its ability to convert a graphic selection into tabular form. To display the actual number of recreationalists segments effected by the 250-foot zone of influence around the Lakeland sale area, the table associated with the trails theme was displayed. It appeared with specific lines highlighted in yellow. Each line represented a use count for the selected trail segment. ArcView has a function to condense the selected rows of the table. The 11 trails selected occupied the top 11 rows in the table of 329 (see Table 1). ArcView 3.0 allows the user to export tables or specific portions of tables for further modification in Excel (Microsoft, 1996) or other spreadsheet programs. The 11 titles on trails spreadsheet only two are numbers derived by Wing (1998). Table 2 shows all the information contained in Wing's user table. The column LENGTH was also generated by ArcView and may have relevance to the amount of interaction concerns. Only the columns NUM, which shows the label number of a trail segment, and FASECCNT, which shows the user count of that segment, were not system-generated information. The final question of the number of recreationalists segments effected by the wind throw zone of influence could easily be determined in a spreadsheet software package such as Excel. One hundred fourteen hiker segments were in areas directly effected by the Lakeland timber sale wind throw zone of influence in the fall of 1994.

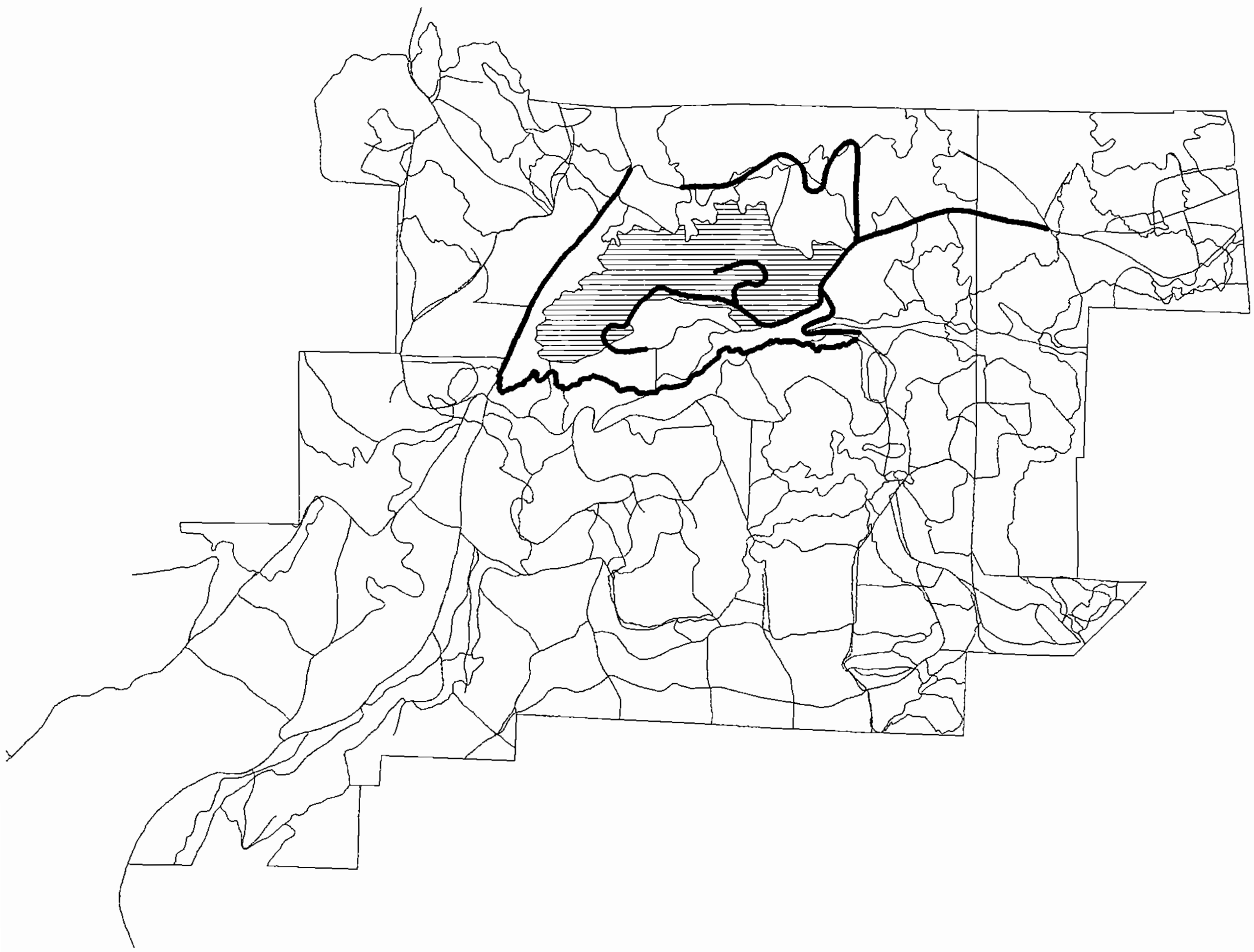

Figure 4. Lakeland timber sale unit. Scale 1" = 2,232'
Green Hatch : Lakeland Harvest Unit
Purple : Trails within 250"
Red : Trails not in zone of influence
Black : Stands Polygons

Table 1

File Contents for 250-foot Case

feet **LENGTH**	trail **NUM**	users count **FASECCNT**
1544.0	372	2
2354.6	195	2
2384.1	206	2
720.5	194	4
1356.0	211	1
1272.2	210	1
1403.0	193	7
2489.7	212	1
2900.2	209	1
1432.3	348	39
4060.2	357	54

The number of recreationalists to be influenced by a 1,500-foot noise of operation zone of influence was determined by the same process as demonstrated in the previous example. All selections previously made to any theme were cleared. A subset of the trails data was selected on the basis of a 1,500-foot proximity to the Lakeland timber sale. The associated table of information showed 44 highlighted trail segments that could be condensed to fill the top rows. This specific subset of the table was exported to Excel for manipulation purposes. In Excel, sum functions led to the final answer that 596 hiker segments were recorded as being in the effected area in the fall of 1994. Also, from the Excel spreadsheet, it was determined that 11.1 miles of trails and roads used for recreation had at least a portion within the 1,500-foot noise of operation zone of influence.

Table 1
File Contents for the 1,500 Foot Case

feet LENGTH	trail NUM	users FASECCNT
762.8	208	1
1544.0	372	2
727.2	207	
1011.3	218	
738.1	222	
2354.6	195	2
2384.1	206	2
1210.4	217	
245.0	221	
720.5	194	4
1356.0	211	1
1040.2	216	
2166.5	220	1
1272.2	210	1
1403.0	193	7
89.8	382	8
2489.7	212	1
3340.2	365	1
2900.2	209	1
721.3	215	3
1432.3	348	39
4060.2	357	54
289.3	234	9
125.0	236	18
993.8	171	21
1603.9	356	47
543.2	214	3
542.1	213	5
99.8	223	18
1080.3	358	51
325.0	235	19
377.8	355	45
334.1	237	28
255.0	366	37
151.1	182	13
577.5	173	10
1081.8	174	1
5293.7	172	15
910.4	170	32
1223.1	176	12
1357.3	354	38
1172.1	177	2
1322.7	141	29
4928.1	140	27

Future Example

The use of the Lakeland sale provided a specific look at determining the interaction of recreational and industrial use around a specific chosen timber sale. ArcView offers the ability to help in the prediction and selection of future timber. For the purpose of demonstrating the ability of ArcView to select future harvest units and evaluate potential future interaction. The optimal harvest age for the stand was assumed to be fall season 10 years in the future, and the unit must be cable logged. Based on these assumptions, the unit with the least potential interaction can be identified.

The potential unit areas for this example were selected differently from the Lakeland example. In the Lakeland example, the unit area was known and merely needed to be separated graphically from the rest of the stands layer. In this example the location was not known. The timber needed to be within 5 years of 55 and the slope class of the units needed to be above 35%. The area had to have been in the south zone due to availability of recreational use data.

The stands.101 theme was activated. The "query builder" was used to select all records with an age of 50 to 60. This initial query returned 115 of the 676 stand polygons. This subset was then exported to Excel and condensed further. ArcView allowed further condensation on the basis of the next criterion. Another query was constructed choosing only yarder ground (slope >35%), and the subset was further condensed to 11 of the initial 676 records. These 11 records corresponded to 11 polygons in the stands theme. By converting the 11 records to their own shape file and theme, they were examined without involving the other 665 polygons. The year 2008 yarder ground became a separate theme.

Visual inspection showed that one of the polygons was in the north zone. Due to the lack of recreation data, the one polygon in the north zone was deleted. The removal of this polygon left 10 potential units. By first selecting each of the 10 stands then selecting the trails in the 1,500-foot zone of influence, the number of effected recreationalists for each stand was determined. Solely on the basis of which stand showed the least interaction with recreation traffic, the furthest unit to the north was found to be the most appropriate. This unit to the north showed an interaction with only nine hiker segments. Other units showed interaction at the 1,500 foot range as high as 166 hiker segments. The previous example shows the capability of ArcView to help the user predict the interaction of harvest and recreational use on a land area.

Haul Route Example

The third example of interaction analysis utilized some of the same techniques as the Lakeland example and the future example. This third example dealt with the materials transport route to and from a proposed harvest unit. The main difference is the direct overlap in space and potentially in time of the use of the road system. The trail and road segments were organized to show both direct overlap of use and those trails that begin or end with the haul road.

The affected recreationist was identified by the same sort of analysis processes used in the Lakeland example. A separate theme was created with only the haul route segments. This theme had attached data on the direct overlap numbers. In the case of the haul route from the Lakeland unit, 13 segments were included. These 13 segments showed 345 recorded hiker segments over the approximate 2 1/4 mile length.

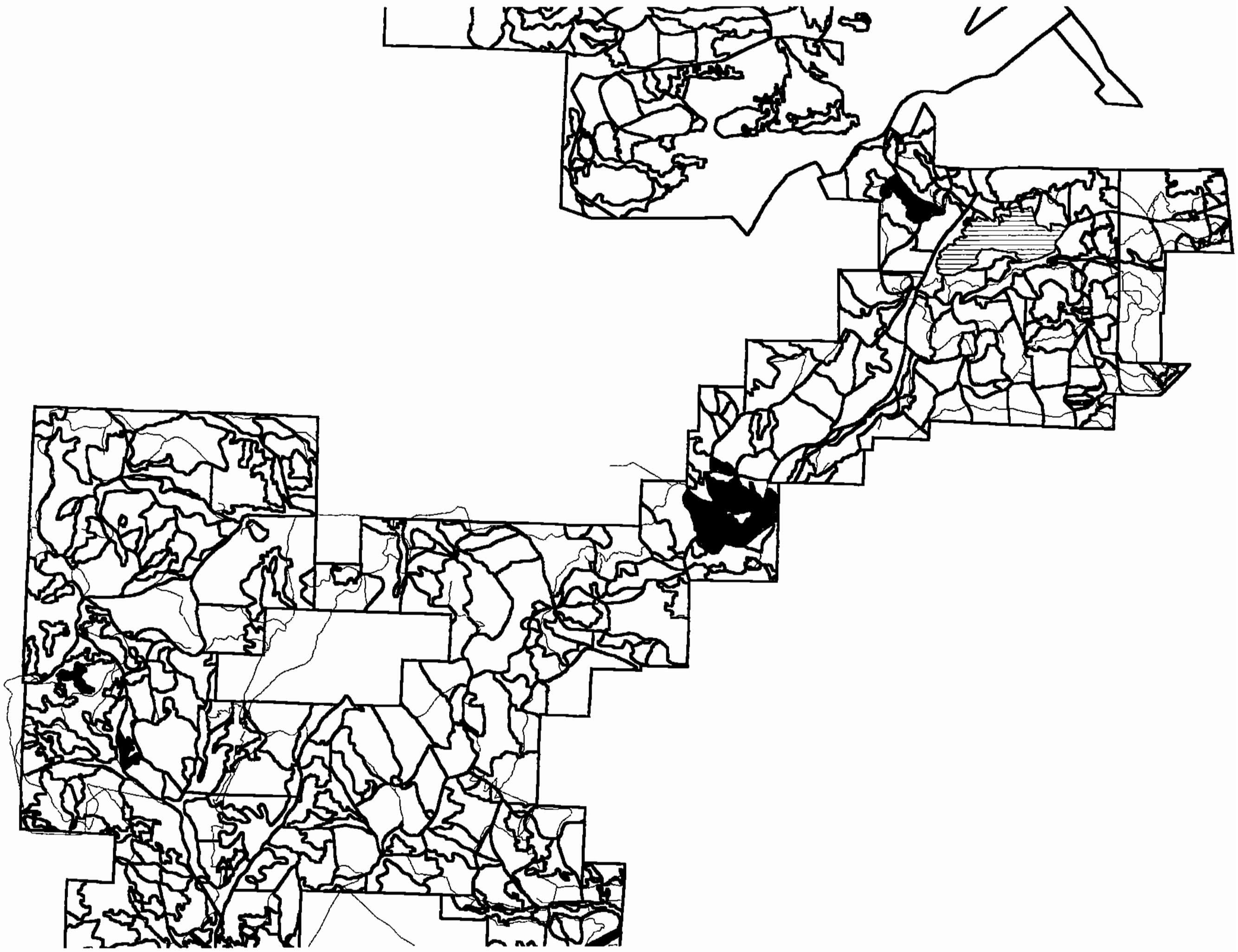

Figure 5. Potential harvest sites are identified in ArcView. Sites shown in blue

Scale 1" = 5,000'

A zone of influence was then applied to the haul route. (For example a 50-foot zone of influence for dust from truck travel). The 50-foot zone of influence captured 24 segments and 563 recorded hiker segments. The net effect was the capturing of an additional 218 recorded hiker segments. At this juncture, a forest manager would need to make a value judgment on the importance of the two types of interaction potential: 345 hiker segments overlap directly, and 218 hiker segments touch the zone of influence. The question is whether a overlap use should be treated different than proximity use.

Chapter 4
CONCLUSIONS

The basic concept gained from this exercise is that data needs to be gathered in the largest level of detail feasible at the time. The process of combining data into larger pieces is preferable to cutting data into useable pieces. An example is the Lakeland unit. It is a simple process in ArcView to combine the six polygons that make up this unit. The converse is that it would be difficult to be required to cut the Lakeland unit out from a block of data that contained more. The recreation data gathered by Wing (1998) facilitated ease of comparison. Organizing the data per segment of the path between intersections provided the best information. The data supplied by Wing did not contain a time reference. It would be desirable to have information about the amount of time in fall 1994 that the data represents. The question is how many hours of what days does the data represent? The recreation data provided by Wing provided a glimpse of recreation use in 1994. To accurately predict recreation use numbers, this sample data needs to undergo some modifications. The first would be to expand the sample numbers to estimate the population. The second would be to tie the recreation data to a population growth factor. If queries were run for a period 10 years in the future, the data would need to be expanded to represent population growth in that time. A third modification might include increases which reflect increasing use trends. The STANDS data collected by the research forest staff was also assimilated into the smallest useable increment.

The collection of the data involved in this project's examples would not be inexpensive. The time and money required to gather this type of detailed information on the stand composition of the ownership may be justifiable due to other management objectives. The medium-size land owner may *presently* have trouble justifying the expenditure required to capture recreation use patterns and map the trails.

The zones of influence to be used and their value can change for applications. On-the-ground analysis is needed to set the length of various influences. The example of wind throw would change dramatically from a 300-year-old coastal redwood stand to a 50-year-old Douglas fir stand to an eastern Oregon bull pine stand. The importance of the various zones of influence will vary due to the site-specific nature of those influences. Some treatment areas will be visible for great distances. Other units can go unnoticed from a short distance. If the unit is to receive operation in the rainy season, dust is of less concern than runoff issues.

A GIS is a powerful tool analyze and manipulate spatial data. For the purpose of multiple-use planning, GIS has the potential to be very useful. ArcView allows the quick examination of a number of options. ArcView has the ability to produce both tabular and graphical results. ArcView can query to select information both graphically and with equations. The end result is that ArcView is a powerful tool able to produce both map and tabular output data.

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