Maintaining the Forestland Base in Minnesota: Forestland Parcelization and Policy Tools

April 2011

by

Calder Hibbard, Leslie McInenly, Lee Nellis, Kayla Block-Torgerson, Jane Prohaska, Michael Kilgore, Brian Ohm, Jean Coleman, Steve Taff and Stephanie Snyder.

Acknowledgements

Funding for this study was provided by the Minnesota Forest Resources Council, Blandin Foundation, the Minnesota State Legislature, and Iron Range Resources.

Executive Summary

Parcelization, the division of larger tracts of forest into smaller tracts of forest, and subsequent development of the forestland base in Minnesota has been recognized as a top concern in sustaining the ecological, economic and social benefits currently provided by Minnesota's forests. Nationally and in Minnesota, conversion of forestland to developed uses is expected to continue over the next twenty years and beyond. Increases in population and seasonal homes, a shift in ownership from industrial owners to investment companies and a high turnover in family forest landowners have contributed to increases in the amount of development and loss of working forestlands in Minnesota. Continued parcelization and development of forestland in Minnesota will have adverse effects on jobs in the forest products sector, access to outdoor recreational opportunities, wildlife habitat, water quality, carbon sequestration and other benefits that flow from large, contiguous blocks of forestland.

There are a number of available policy tools that can be used effectively to alter the pattern of parcelization and subsequent development or to mitigate the associated adverse impacts. These tools include land use planning and zoning, conservation easements, taxation, fee simple acquisition and land exchange, among others. It is important to recognize that these all of these tools do not work well in all situations, especially in isolation, and that a strategic understanding of the strengths and weaknesses of these tools is important to maintaining the forestland base in Minnesota. A review of these policy tools was conducted, informed by experiences in Minnesota, application of the tools in other states, various local and national studies and the experiences of experts and stakeholders. This assessment allows for an understanding of the range, effectiveness and efficiency of various approaches; the need for integrated responses to forest parcelization; and the roles that local, state and federal governments as well as private organizations need to play to retain the forestland base in Minnesota.

Based on the analysis of policy tools, policy options were developed to avoid or mitigate adverse impacts of parcelization and development of forestland in Minnesota. These options were developed to: take advantage of existing program infrastructure; carefully target public investments; foster meaningful partnerships between agencies, groups and programs; and address the full range of benefits that are produced by the forestland base in Minnesota. Recognizing that many of these policy tools are needed and will require integration, the following policy options were developed:

- Use the Department of Natural Resources' Minnesota Forests for the Future program as a platform for a coordinated approach to forestland conservation;
- Empower and encourage local governments to use local planning to maintain their forestland base;
- Develop and execute conservation easements in a deliberate, coordinated and sustainable manner;
- Use and build on current state tax policy and incentives to encourage family forest owners to maintain the forestland base;
- Rely on fee simple acquisition and land exchanges for exceptional cases, small parcels and for consolidation or access to public land; and
- Provide strong support to the counties to foster their management capabilities in order to encourage forest stewardship and retain county administered land.

This page intentionally left blank

Table of Contents

This page intentionally left blank

Forestland Parcelization and Development

The Minnesota Forest Resources Council (MFRC), among a host of other state entities (e.g. Minnesota Department of Natural Resources, Minnesota Forest Resources Partnership), as well as regional and national organizations, have identified the ongoing parcelization of the forestland base to be a threat to the sustainable management of forests in Minnesota and a top priority to address. The size of forest land holdings has shrunk both nationally[1] and as evidenced in land transactions in Minnesota[2]. Parcel size is predicted to continue to shrink over the next twenty years[3]. Unprecedented shifts in industrial forest land ownership coupled with federal tax changes, large increases in the number of family forest owners with changing population demographics, increasing land values that often reflect uses other than traditional forest management, as well as other public policy decisions have all been cited as driving factors in the division and subsequent development of forestland in Minnesota. A growing understanding of parcelization has helped researchers to identify and quantify the many impacts, mostly adverse, from unfettered parcelization, including impacts on forest structure and productivity, timber supply, water quality and aquatic diversity, invasive species, recreational access and land use conflicts.

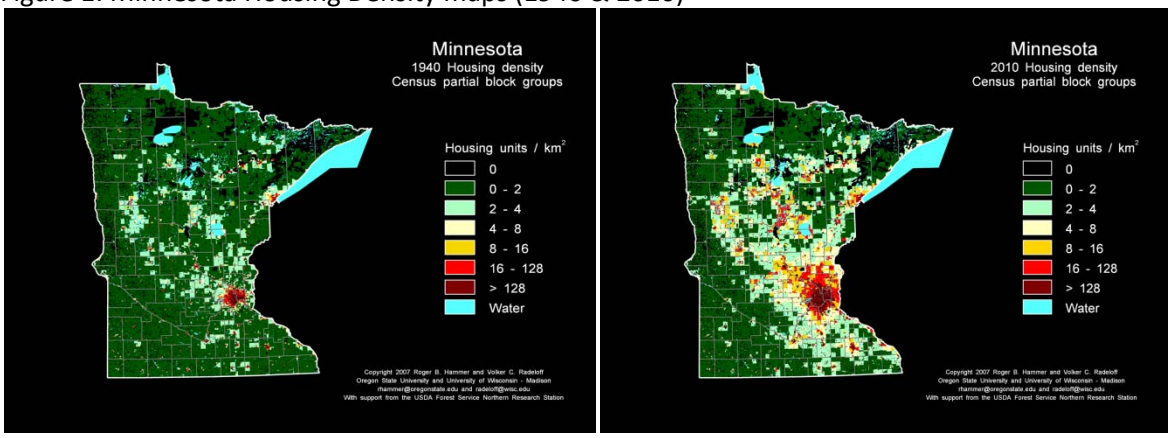
Extent and Significance

Looking across the country, we see large losses of industrial and family forestland to primarily residential and commercial development with 10 million acres lost to development in the 1980s and 1990s. The USDA Forest Service is predicting the loss of an additional 23.2 million acres of forestland over the next 50 years[4]. The main concern, especially in Minnesota, regarding the maintenance of the forestland base, is private lands: industrial, corporate and family forest lands. Public ownership is generally more stable, especially federal and state lands, yet county forestland may be more dynamic in its ownership pattern, with 22,800 acres sold in Minnesota from 1995 to 2005[5]. Family forest land is also an extremely important segment of the forested landscape in Minnesota, as well as nationwide. Over the past decade, forest ownership has grown 1.6 times as fast as the actual human population, and the average family forest land holding has shrunk from 44 acres in 1953 to 24 acres in 1994[6]. In Minnesota, we have approximately 5,390,000 acres of family forestland, about a third of total forestland, and over 170,000 owners. This ownership is quite dynamic, as it is estimated that 15 percent of the owners have changed over the last five years, affecting about 12 percent of the total acreage[7]. The changing nature of the family forest ownership presents many challenges in maintaining the forest land base.

Large industrial, or formally industrial, holdings are of special concern in terms of the reduced public benefits that flow from these lands. Nationwide, it is estimated that from 1981 to 2005, 37 million acres of forestland owned by publicly traded forest products companies has changed hands[8], much being bought by investment organizations such as Timber Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs). In Minnesota, there have been a number of large land sales, with 409,000 acres changing hands in three major land transactions since 1998.

Nationwide, and in Minnesota, there has been a decreasing trend in forestland parcel size[9]. Over the last 30 years, Minnesota has experienced a significant increase in developed land, with sizable increases in housing units and corresponding land use changes. This is expected to continue, with a 54 percent increase in developed area by 2030, a much higher increase than surrounding states (Figure 1)[10]. The USDA Forest Service is predicting a loss of 1.2 million acres of forestland in the Lake States by the year 2030[11].

Figure 1. Minnesota Housing Density maps (1940 & 2010)



Hammer, R. B. S. I. Stewart, R. Winkler, V. C. Radeloff, and P. R. Voss. 2004. Characterizing spatial and temporal residential density patterns across the U.S. Midwest, 1940-1990. Landscape and Urban Planning 69: 183-199.

The extent of forestland conversion in Minnesota has increased in recent decades. From 1982 to 1992, 49,100 acres of land were converted from forest land to urban use in Minnesota[12]. USDA Forest Service's Forest Inventory and Analysis unit estimates that 314,944 acres of forestland were converted to a non-forest condition in Minnesota from 2003 to 2008, with 110,230 acres being converted to urban and right-of-way uses. Although this is a significant loss of forestland, over the same period, 1.2 million acres were converted from a non-forest to forested condition, of which nearly half was from marsh to forest and about one-quarter was a reversion from agriculture[13].

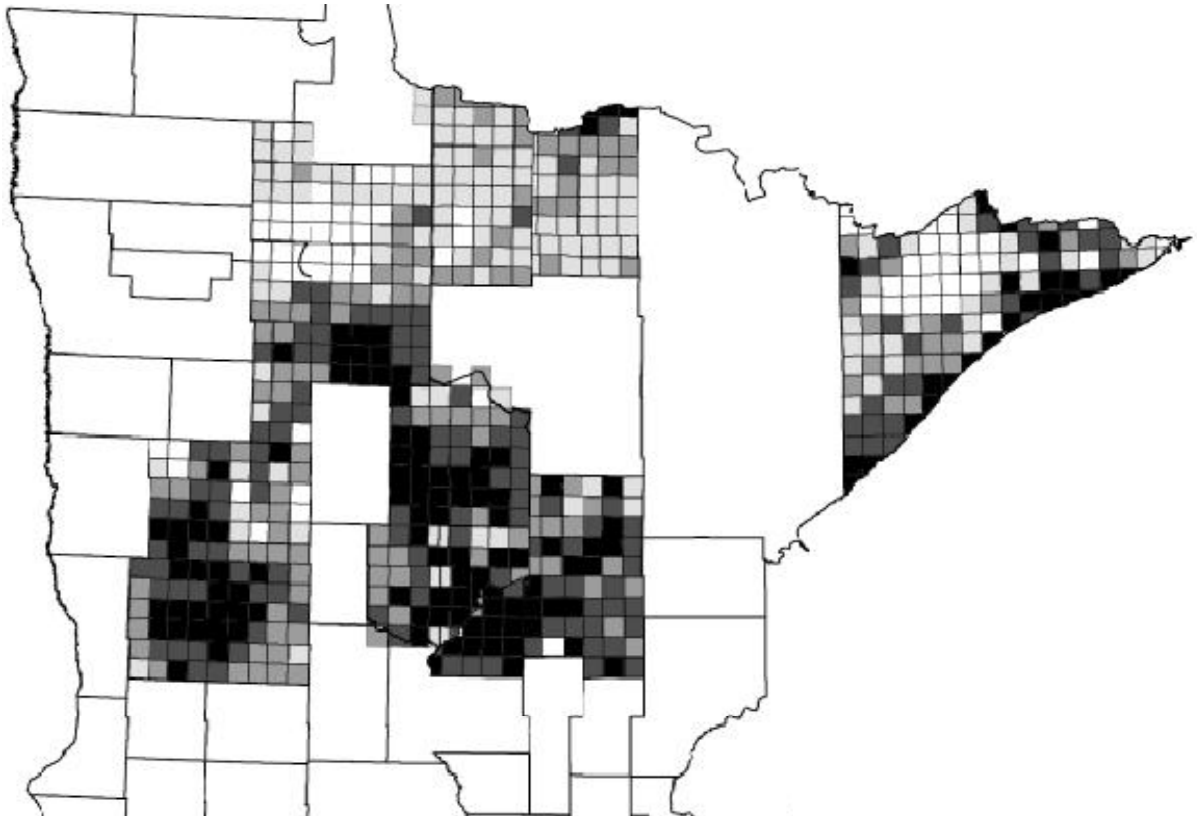
A study in Itasca County found parcelization of forestland to be occurring at a fairly steady rate from 1999-2007, with 0.4 percent of private land in the county being parcelized per year[14]. The study also demonstrated that parcelization activity was strongly tied to subsequent development, with over two-thirds of the parcel splits being developed within seven years.

Building on the previous study mentioned above, the Minnesota Forest Resources Council commissioned a study with the University of Minnesota to expand this analysis of forestland parcelization across 10 additional northern Minnesota counties (Aitkin, Becker, Beltrami, Cass, Clearwater, Crow Wing, Cook, Koochiching, Lake and Otter Tail). Due to county data limitations, the analysis does not include every forested county but includes a diverse representation of forested counties with very varying levels and patterns of development. Again due to data limitations across counties, the researchers were unable to complete a time series analysis and amended their study from one that tracked forestland parcelization activity over time to one that describes the extent to which the landscape is parcelized (one point in time).

The study sought to (1) identify site and proximity characteristics of private forest land in northern Minnesota by township (e.g. number of forested parcels, average parcel size)); (2) evaluate different ways to measure a parcelized landscape; (3) Identify factors associated with a parcelized landscape (e.g. amount of shoreline); and (4) identify forest land parcelization patterns in northern Minnesota (see Figure 2). Through this research, a new metric to measure parcelization was developed which better describes this activity than previous measures. Results of the study indicate that increases in population are associated with more parcelized landscapes. The researchers also found a positive relationship between estimated market value of a parcel and amount of parcelization. Proximity to water was

another predictor of parcelization activity, but it was not significant when parcels less than 20 acres are dropped. The study also demonstrates that for forested parcels greater than 20 acres, adjacency of the parcels to public lands and roads is a significant predictor of parcelization activity. Figure 2 depicts the level of parcelization in the counties list on the preceding page.

Figure 2. Extent of parcelization activity



Using data from the Minnesota State Demographic Center to look forward, potential land consumption estimates were calculated for a number of forested counties, based on various development densities. The analysis estimated the development to be between 123,000 acres and 180,000 acres in twelve counties, as shown in Table 1. As most of the land available for development in these counties is forested, it is safe to assume that a significant amount of these development acres would come from forestland.

Table 1. Minnesota Forested Counties Household and Land Consumption Projections, 2010-2030

all land consumption figures are in acres(A)

	New households 2010-2030 (units)	Land consumption Midwest Average 3.39 A/unit	Land consumption St. Cloud MSA Avg. 3.00 A/unit	Land consumption Duluth MSA Avg. 2.32 A/unit
Aitkin	3,550	12,035	10,650	8,236
Becker	2,740	9,289	8,220	6,357
Beltrami	4,760	16,136	14,280	11,043
Carlton	3,100	10,509	9,300	7,192
Cass	6,060	20,543	18,180	14,059
Clearwater	570	1,932	1,710	1,322
Cook	1,030	3,492	3,090	2,390
Crow Wing	11,600	39,324	34,800	26,912
Hubbard	3,510	11,899	10,530	8,143
Itasca	3,670	12,441	11,010	8,514
Koochiching	220	746	660	510
Lake	750	2,543	2,250	1,740
St. Louis	11,700	39,663	35,100	27,144
TOTAL	**53,260**	**180,551**	**159,780**	**123,563**

*MSA : is a metropolitan statistical area
Source: *Minnesota Household Projections: 2000-2030*, Minnesota Department of Administration, Minnesota State Demographic Center, December 2003.

To further focus the study, a brief analysis was conducted to determine which northern forested counties might be most susceptible to parcelization and development. The counties were assessed as to the amount and rate of population growth, preponderance of second homes, and the importance of the forest economy. Using census data, the regional economic information system, data from the Minnesota Department of Employment and Economic Development and local interviews, a brief assessment of development pressure was summarized in regard to a number of forest counties (Table 2).

Table 2. Assessment of development pressure

County	Fast Growth[1]	Growth[2]	Second Home Deamnd s[3]	Significant Forest Economy[4]
Aitkin				
Becker				
Beltrami				
Carlton				Insufficient Data
Cass				
Clearwater				
Cook				Insufficient Data
Crow Wing				
Hubbard				
Itasca				
Koochiching				
Lake				Insufficient Data
Lake of the Woods				Insufficient Data
Mahnomen				Insufficient Data
Mille Lacs				
Pine				
St. Louis				

1 County population growing faster than the average state rate (indicated in red).
2 County population growing, but not as rapidly as the state, includes those that also are growing at the faster rate (Indicate in red).
3 Demand for second homes based on the ratio of homes held for "seasonal or occasional use" to the number of homes occupied year-round in the year 2000 in each county (red indicates significant demand).
4 Importance of the forest economy in larger counties was determined by comparing the share of local personal income derived from forestry, logging, and related activities in the year 2007 to the state share. For smaller counties affected by disclosure rules, importance was determined based on income data for wood products manufacturing, employment data and/or local inquiries (red indicates significant forest-based economy).

Although there is insufficient data in a few areas, it is readily apparent that the combination of population growth and the number of seasonal homes, as well as significant economic contributions from forest resources in many of these counties, will most likely lead to forestland parcelization and the issues that accompany it.

Driving factors

There have been numerous factors tied to the continuing parcelization of forestland. As noted above, there has been an unprecedented shift of ownership of forestland from primary forest products companies to Timber Investment Management Organizations (TIMOs), Real Estate Investment Trusts (REITs), and other private investment companies and individuals. Global competition, increased expectations for return on investments and the potential for quick financial gains have been cited as important factors in this change of forestland ownership. These have been coupled with tremendous growth in forest land values, and especially values of forestland that reflect other uses than for wood fiber production[15].

Changes in population, and especially population densities, have been found to be drivers of parcelization[16]. Parcelization rates will most likely be magnified due to an aging population, with 93 million acres of forest land being owned by those 65 and older[17]. Changing lifestyles have also been linked to the division of larger ownerships of forest land[18].

Current policies at the local, state, and national level have been correlated and cited as contributors to forest land parcelization. Taxes are often touted as a driving factor, including property, income, and estate taxes[19]. Changes in the tax laws in the 1980s and 1990s are thought to have encouraged much of the industrial divestiture of forest land. Other policies seen as encouraging parcelization include some environmental regulations, subdivision ordinances, large lot zoning and zoning variances[20].

A study in Wisconsin demonstrated that the probability of parcelization in certain counties is related to parcel size, distance to water and amount of water frontage[21]. Proximity to water, public land and developed areas have been identified as drivers of further parcelization and development activity in Itasca County[22]. As noted previously, a study of 10 Minnesota counties identified increasing population, increasing land values and proximity to public lands and roads as predictors of forestland parcelization activity.

Impacts

With a host of economic, environmental, and social benefits emanating from these large blocks of forestlands, there is much concern about the continuation of these benefits as parcels get smaller and, in time, are developed[23]. This is complicated by the fact that over the past 50 years, a third of the development has occurred outside of metropolitan counties. This exurban and rural development, has a much greater impact on forests and other rural land than urban development because it occupies much more land[24]. Many authors note the effect forest land parcelization has on the management of private forest lands[25]. As the parcels become smaller, the ability to manage for timber production, wildlife habitat or other ecosystem-wide benefits becomes difficult or impossible to maintain[26]. This precludes the efficient use of silviculture to influence the productivity, structure, and function of the forest[27]. This may also preclude the ability to return portions of the forest to early successional stages and may artificially encourage the maturation of various forest types[28] .

Forestland is an important economic resource in Minnesota. As of 2007, primary and secondary sectors of the wood products industry employed almost 35,000 people with a corresponding payroll of $1.6 billion[29] . Considering forest parcelization from an economic standpoint, as parcels decrease in size there are diminishing returns from the harvesting of wood fiber, leading to decreases in availability[30] and in the landowner's probability of harvesting timber[31] . Harvest costs also increase with declining parcel size, especially with parcels under 40 acres[32] . This shifting in likelihood to harvest and land use is illustrated by a study in Lake County, where from 1996-2006 land classified as timberland decreased by 61 percent, while land classified as recreational land increased by 708 percent[33].

Development is another important economic driver, but understanding the fiscal impacts of development, especially in the forest, is limited at best[34] . This is especially true in interpreting whether tax revenues from newly developed parcels exceed the additional cost of providing services to these parcels. The American Farmland Trust notes that forestland almost always generates more in property taxes than the cost of providing essential services from local governments. The Trust calculated a 1-to-0.36 ratio in revenue to costs for forest, farm and open space land.

Parcelization and subsequent fragmentation from development can lead to decreasing populations of native wildlife, diminishing biodiversity and increasing the likelihood of the introduction and proliferation of non-native species[35] , as well as to increasing storm water runoff[36] . The parcelization and development of rural forested lands increase the probability of wildfire and complicates fire management efforts. It has also been linked to declines in water quality, aquatic diversity and scenic quality of forested landscapes[37].

From a social standpoint, decreasing forestland parcel size has been correlated with a decreasing likelihood to allow public access on smaller parcels[38] . The new owners of parcelized tracks often have different intentions for the use of their forest land than the previous owners of larger tracks[39]. This has been shown to lead to polarization of interests and landowners, heightened land use conflicts and increased challenges to making cross-ownership land use decisions[40]. A number of studies have shown that as the amenity values of forestland surpass the timber production values, there is more opposition to traditional forest management activities[41]. Although, at least anecdotally, this seems to not be a widespread problem in Minnesota at this point, this may be a consideration in the future. Forest land parcelization has also been shown to decrease scenic quality of forested landscapes (Fidel 2007).

Additional perceived impacts of parcelization in Minnesota identified by stakeholders and decision-makers and not mentioned above include reduced mineral/aggregate access and reduced access to material for energy production.

Policy Tool Analysis

As noted in the previous section, parcelization and subsequent development can have substantial impacts on sustainable forest management in Minnesota. Federal, state and local governments have a long history of using various policy tools to encourage behavior and ensure the provision of public goods and services. Many of these tools have been used to try to influence private forestland owners, or even public entities, through a host of vehicles including tax policy, technical and financial assistance, fee simple or easement acquisition, planning standards and regulatory approaches.

Each of these tools has its strengths and weaknesses. Some work better or more efficiently under some circumstances than others, depending on many variables, often including geography or landowner type. Tools can also be complimentary and work in conjunction with other tools to achieve an outcome unattainable through the use of only one tool. At the same time, application of certain tools can work at cross purposes and negate the effectiveness of other tools, or even make the original situation worse. Others may simply duplicate effort unnecessarily.

A stakeholder analysis conducted in 2008 regarding the maintenance of the forestland base identified conservation easements, tax policy, planning and zoning, fee simple acquisition and land exchange as the key policy tools to investigate to encourage behavior that retains Minnesota's forestland base. This analysis is focused on these aforementioned policy tools, but also acknowledges a broader array of other available tools which may also be effective at maintaining the forestland base. Each of these tools was examined by topical experts who reviewed pertinent literature, past and current status of use of the tool in Minnesota and the use of these tools in other states and sectors. Each tool was in turn assessed as to its effectiveness in maintaining the forestland base, efficiency (benefit versus cost), political palatability, equity and technical and administrative ease of application.

The results of this analysis were used to develop a set of integrated policy options that reflect the findings. The need to integrate the policy options demonstrates the complexity of the problem and elucidates the need for a 'toolbox' approach to adequately address it. Policy options were crafted recognizing current infrastructure in the state, political sensitivities and the current budget situation. The options also indicate the roles and responsibilities of local, state and federal governments as well as private organizations in the retention of forestland. These options are intended to illustrate the range of potential policy options for retaining the forestland base, taking into account their effectiveness, efficiency and other important attributes.

The pages that follow include a short summary of the analysis of the aforementioned policy tools. Further detail can be found in the appendices, with yet further detail in a considerably longer document available upon request to the staff of the MFRC. In addition to these summaries and the policy options, we created a couple of documents intended to help in the interpretation of the developed policy options and to help readers understand the merits of each policy tool and its effectiveness in maintaining the forestland base. The first document is a chart that allows for quick comparison of the strengths and weaknesses of the various policy tools. The second is a description of where on the landscape the various tools are appropriate.

Land Use Planning and Zoning

Land use planning and zoning can be a valuable tool for protecting important resources, including forestland, from the adverse impacts of parcelization and development. In Minnesota, there has been a

long history of planning and zoning activities. Minnesota has also enacted a number of statewide programs that require certain planning and zoning activities by local governments. Most of these state programs relate to water resources but have a significant reach in terms of amount of land covered, due to the prevalence of water in Minnesota.

Planning approaches
Most counties in Minnesota have a comprehensive plan and exercise general zoning authority. However many of these plans and ordinances are inadequate and even counterproductive when it comes to addressing forestland parcelization. A few of the county comprehensive plans address retention of forestland directly, some do so indirectly and a number do not address retention at all. All of the 10 northern forested counties that were interviewed for this project employed some sort of subdivision regulation, and most exercised zoning authority. Some of the counties allow for conservation subdivisions, but the conservation subdivision provisions in county ordinances reviewed as part of this study contained only modest, if any, incentives. A few counties have had serious discussions of increasing minimum lot sizes to reduce the potential for development in forested areas. A few counties and townships have even adopted larger minimum lot sizes in some zoning districts, but these range only up to 20 acres and do not appear to be large enough to consistently conserve forestland.

Comprehensive planning can be an effective tool to address forestland parcelization, but Minnesota law provides counties and municipalities outside the Twin Cities area with little guidance about what should be included in a comprehensive plan. As a result, plan contents and quality vary considerably. Recent legislation has tried to address this problem, but offers only piecemeal improvement. There are good models to follow in Minnesota, such as the Minnesota comprehensive water planning process, but it is important to realize that quality planning is time consuming and requires considerable professional skill. Another lesson from county water planning is that modest or small incentives can be quite effective in encouraging planning. A related issue is that the relationship between planning and implementation tools, like zoning, is not as strong as it could be. Other states have attempted to better clarify the relationship between planning and zoning to improve their effectiveness.

Zoning approaches
With minor exceptions, the way many rural forested Minnesota counties use zoning encourages land parcelization. A number of approaches were analyzed as to their effectiveness in retention of the forestland base in Minnesota. Most counties already enforce at least some sort of basic *subdivision regulations*, which will probably only be effective if they are consistent with a comprehensive plan and zoning scheme. *Very large lot zoning* can be effective at maintaining low development densities, but can actually lead to more extensive sprawl depending on density goals. *Exclusive forest-use zoning* is another tool that can be quite effective at retaining forestland at a reasonable price and has been used in parts of the state for agricultural land zoning. It can be quite controversial, however, and would most likely require an extensive educational effort. Another approach, *open space* or *conservation development*, may be less effective than other planning and zoning approaches, but may be more palatable to the public. A mandatory *transfer of development rights* program is unlikely to work in most forested counties as land values are low and there currently is limited demand for developable property. A voluntary approach, however, would be more palatable and could be used to complement other planning and zoning approaches.

Taxation
Tax policies, in conjunction with the other tools addressed in this report, are often used by governments to attempt to influence forest landowner behavior. Preferential tax policies can include a reduction in

the amount of property tax paid, a rebate of taxes already paid, favorable income tax and capital gains treatment regarding various forest practices and activities and reduced estate taxes. It should also be noted that there are various tradeoffs in employing different taxation policy schemes, such as program simplicity versus equity between landowners or taxpayers.

Property taxation is the most utilized tax instrument to influence forest landowner behavior, especially family forest owners, with all 50 states using at least one forestland preferential property tax program, with some states employing multiple programs. In surveys from across the country as well as in Minnesota, forest landowners have specified that their top preference for management incentives is through property tax incentives and reductions.

Minnesota employs a number of preferential property tax programs or classifications that apply to forestland, the Sustainable Forestry Incentives Act (SFIA) and the newly created 2C classification being the most widely used. Both of these require 20 contiguous acres of forestland and a stewardship plan; however, the enrollment period, need for a covenant and other program elements are quite different. Minnesota has a comparatively complicated preferential property tax scheme with respect to forestland. This has the potential to confuse landowners, potentially making the programs less effective and underused. At the same time, these various options do offer choices to landowners, as one program may be more appealing than another.

The SFIA program has not been as successful as originally envisioned, and seems to have limited visibility with forestland owners. Awareness is key to attracting landowners, and the current state of the program suggests an informational outreach effort to family forest owners would increase the effectiveness of the program. A number of the program elements, especially the requirement for a covenant, are noted deterrents to enrollment. The size of the payment is also often rather small in comparison to property tax amount related to development values, especially close to exurban areas, making the program less effective in these areas. The amount of tax relief and the development value of a parcel must be better aligned to more effectively encourage the retention of forestland. The 2C tax classification is too new to have been assessed relative to its effectiveness at hedging against parcelization.

As for effectiveness of these programs in general, a national survey of property tax administrators found that preferential forestland property tax programs are, at best, a mixed bag in producing or protecting the benefits they are intended to address, including timber production, wildlife and other non-timber benefits, long-term investments and sound forestry practices. In additional interviews, most administrators and resource professionals felt that these programs are especially a mixed bag regarding their effectiveness at maintaining the forestland base, noting that preferential property tax programs work well in some situations and not so well in others. It was also repeatedly noted that these programs often subsidize forestland owners who would have helped to maintain the forestland base regardless of the program.

Income and estate tax policy can also have an effect on forest retention and management by encouraging or discouraging certain practices through the tax code. Most income tax policy regarding forestland and forest practices exists at the federal level, including substantial deductions for the donation of land and conservation easements. However, some states provide general income tax credits or credits for specific activities (e.g. establishing riparian buffer strips), and some local governments provide further relief for landowners. Currently, twelve states have an additional income tax credit for the donation of conservation land or easements. Estate tax reductions may also help to retain forestland by preventing the need to sell parcels of inherited forestland to pay the estate tax.

Land Transactions: Fee title acquisition, conservation easements and land exchange
A well-designed and funded land conservation program, including fee title acquisition, conservation easements, and land exchange can play an efficient and effective role in maintaining the forestland and mitigating the adverse impacts of parcelization. In Minnesota, forestland is acquired, in full or part interest for a variety of reasons. Some current motivations for public forestland acquisition and exchange are to protect significant resources, to ensure access for management on current public lands, and to consolidate public ownership for efficient management and minimize land use conflict.

The use of conservation easements is growing in Minnesota. From Fiscal Year (FY) 1998 to FY 2008, the DNR protected over a 150,000 acres of natural resource land through acquisition of fee simple interest (80,000 acres) and partial interest via conservation easements (72,000 acres). The total cost of fee acquisition was over 4 times that of easements. More than *12,000 easements* protecting approximately *524,200 acres* of land have been identified in Minnesota, of which over 96% are held by government agencies. Almost all easements held by nonprofit organizations are held by a single entity, the Minnesota Land Trust. To a much lesser extent, the state, county and federal governments also use land exchange to adjust land ownership and consolidate forestland.

Fee title acquisition provides the most complete means of affecting land use, development, management and access on a parcel. Public ownership, via fee-title acquisition or exchange, provides a fairly permanent tool to protect against parcelization. Fee acquisition allows the public to actually reverse parcelization through the consolidation of smaller parcels. Counties can also acquire forestland through the tax foreclosure process. Acquisition of fee title is not difficult, but it is expensive and time consuming. Criticisms of acquisition programs include the cost, tax base reductions, loss of available private lands, lack of oversight in negotiations and requirements for payments in lieu of property taxes (PILT) and long-term stewardship. Counties are also concerned about their ability to manage lands into the future with possible reductions in or PILT.

Over time, programs designed to focus on fee acquisition have shifted emphasis to conservation easements and other incentives with the recognition that it is impossible to buy everything and that private and working lands already provide a portion of the benefits sought. ***Conservation easements***, a less-than-fee interest in land, can be as effective though less expensive than fee simple acquisition at limiting development of working forestland. Perpetual conservation easements (>95% of conservation easements in Minnesota are perpetual) require only a single transaction to achieve long-term protection. Land management and related costs typically remain with the landowner, and land under easement remains on local property tax rolls, though often at reduced rates.

Conservation easements often raise other legal and related issues, such as their impact on other interests, duration and the ability to amend or terminate easements. Also many conservation easements currently focus on preservation of resources that are not geared to working forests. Many other concerns are similar to those of public ownership, including potential impacts on property values and tax revenues. Easements can be complicated and time-consuming to negotiate, draft and appraise, thereby increasing transaction costs and requiring a high degree of professional skill. Long-term stewardship via compliance monitoring and enforcement is key to conservation easement sustainability but is handled inconsistently in Minnesota. Few (*no* public agencies) easement holders have funding dedicated to long-term stewardship. Even more importantly, many public agencies do not have a comprehensive understanding of the locations or terms of their easements, making easement monitoring impossible and enforcement based upon complaint.

Cost, as well as the level of current public landownership and other factors, limits land fee title acquisition and protection via conservation easement. Alternatively, ***land exchange*** can be a valuable tool to consolidate public ownership and redirect private development. If administrative costs are constrained, land exchange provides an inexpensive means to adjust land ownership and dispose of isolated parcels that are inefficient to manage. Most valuable in addressing the parcelization of private forestland are exchanges conducted between public and private landowners. Like other acquisition tools, land exchange is opportunistic and limited by interested landowners. Land exchanges are also complicated by the time required to process the disposal and acquisition of parcels, equal valuation requirements, disagreements in appraisal valuation, potential conflicts of interest, difficulties associated with disposing of public land valued by citizens, finding land available to exchange and restrictions on the type of land that can be exchanged. The complexity of the land exchange process also increases when multiple public entities are involved and may take from one-to-many years, resulting in administrative expenses that far exceed those of fee acquisition transactions.

The 2008 Minnesota Legislature approved expedited exchanges of public land to make the land exchange process more efficient. State and local officials indicated the legislation has had little impact on the consolidation of their lands, primarily because school trust lands were excluded from the legislation and acquired forest lands comprise only about 10% of state administered land. Revolving acquisition funds, in use by some jurisdictions at the state and county levels, may provide a more nimble alternative, or act as a facilitating mechanism, to land exchange but have been hindered by current economic conditions and limited funding.

*A Comprehensive Program***.** Minnesota has clear experience in developing and advancing conservation programs and initiatives through collaboration of diverse partners, resulting in additional funding sources, complementary projects and additional support for program initiatives. Any program to limit forestland parcelization should be: structured with a clear vision and organization; collaborative through partnerships and public involvement; and, coordinated through planning to effectively target priorities and use the range of complementary conservation tools.

The tension between strategic planning for protection and quick and efficient land acquisition requires proactive development of conservation priorities. To effectively invest conservation dollars, programs must strategically identify and communicate priorities with public and private conservation partners. Well-drafted program criteria for publicly funded programs can go a long way in providing appropriate levels of oversight and accountability. Designation of an entity to communicate opportunities, share information and coordinate implementation enhances the efficiency of partners. Investments in staff and resources also can fuel partner engagement.

Effective programs throughout the country often involve government agencies and nonprofit conservation organizations with expertise in land transactions and funding as well as the landowners of protected lands. Multi-party public/private partnerships can provide the strength, durability and flexibility needed to insure long-term program success. Providing opportunities for public involvement through open meetings and advancement of locally-driven initiatives maintains program support, provides oversight and fosters a more transparent program.

Acquisition, either by fee-title, by exchange or through a conservation easement, can be an effective tool to protect against parcelization. However, poorly informed land acquisition can be counter-productive, resulting in increased land conversion on adjacent parcels. As a result, land protection and development planning must be coordinated. The need to protect various sizes and types of parcels to minimize fragmentation of protected areas supports application of both full-fee and partial interest

acquisitions, along with other protection tools. Establishment of the Minnesota Forests for the Future (MFF) program, as envisioned by the DNR Commissioner's Advisory Team in their 2008 report, was recommended to:

> *…provide overall guidance for acquisition and stewardship of forest conservation easements and application of other forest conservation tools in Minnesota… [and to] collaborate with public and private partners to prevent the parcelization, conversion, and fragmentation of Minnesota's private working forests…* (Minnesota DNR 2008)

As established by the 2008 Minnesota legislature, the MFF program emphasized working forest conservation easement s and fee title acquisition to the exclusion of other forest conservation tools. Expansion of the MFF program to include the suite of conservation tools as originally defined could provide a platform for a coordinated and more efficient approach to forest land conservation.

As part of a comprehensive program to mitigate forest parcelization, continued use of working forest conservation easements should be supported to maintain private forest stewardship for numerous social and environmental benefits; acquisition in fee should be focused on sites where protection is justified based upon the resource values of the site and where public management will protect and improve the condition of the forest; and land consolidation should be promoted through enhancement of traditional and non-traditional land exchange mechanisms.

A long-term commitment to protect the public investment comes with land acquisition or conservation easements and can be addressed through a variety of approaches. Concerns about easement use can be addressed through appropriate program design. The best way to prevent easement violations is to maintain an active easement management and monitoring program. While a number of nonprofit conservation organizations in the state, as well as the Minnesota DNR, have existing expertise, some training may be necessary. Creating a program that meshes with other available incentives for forestland retention may keep program costs lower. Investing in model documents or templates and relying on existing experienced organizations and entities can also enhance efficiencies. Recognizing the long-term commitment associated with Minnesota's current investments in land merits development of a comprehensive easement stewardship program and similar consideration for the long-term management of acquired natural resources land.

FOREST CONSERVATION TOOL	BENEFITS	DRAWBACKS
Non-Regulatory		
Education	• Good complement to other tools • Effective given audience • Inexpensive relative to potential results • Not controversial • Equitable • Easy to implement	• Not permanent • Takes time
Partnerships	• Effective if clear, shared goal • Shared costs/responsibilities • Relatively Inexpensive • Equitable	• Not permanent • Building partnerships takes time • Dependent on cooperation
Comprehensive Planning	• Effective if done well and implemented • Impacts addressed via public process • Concept is familiar and builds on existing experience	• Can be expensive and time consuming • Some public resistance • Some impacts on social equity • Some training involved to incorporate forest resources • Requires considerable professional skill
Incentives for planning	• Small investments can have big impact • Often popular • Good models (e.g. MN comprehensive water planning process) available • Simple administration	• Requiring planning to qualify for grants could be controversial • Some equity concerns • Administration requires some resources
Fee Simple Acquisition	• Totally effective if properly targeted • Likely permanent • Straight-forward method - buying land is not difficult • Provides full control over management • Provides public access • Voluntary • Consolidates land	• Most expensive– but funding sources exist • Requires willing seller • May not help shape regional growth if critical parcels cannot be acquired • May have adverse effects by shifting development. • Total cost includes long-term management responsibilities • Concerns about loss of tax base or impacts on adjacent real estate values • Benefits/impacts unevenly distributed • Private negotiations
Land Exchanges	• Effective if properly targeted • Likely permanent • Less expensive than fee-acquisition • Consolidates land • Can increase management efficiency • Allows for land adjustment without increasing public landownership • Impacts addressed via public hearing • Voluntary	• Requires interested exchange partners and suitable, equal value lands • Restrictions on some types of land • Often complicated, resulting in administrative costs > acquisition • Often difficult to dispose of public lands – questions about comparability • Subject to conflicts of interest
Conservation Easements	• Effective if properly targeted and incentives are sufficient • Permanent (stay with the land) • Usually costs less than fee-acquisition • Voluntary • Landowner retains land and management responsibility • Retains private land, some potential impacts on tax base	• Requires interested landowner- challenges strategic protection • Requires effective monitoring and enforcement • Negotiations may be time consuming • Less control than with acquisition • Some public objection • Requires considerable professional skill • May limit property resale opportunities • Private negotiations

Tax Policy		
Preferential Assessment	• Preferential property tax programs are common • Limited additional administrative cost • Existing preferential assessments have been accepted • Counties have administrative experience and capability	• Limited effectiveness where development values are high • Participation is voluntary and requires public education • Ineligible taxpayers may object
State Income Tax Credits	• Effective in other states • Politically acceptable • Minnesota administers income tax credits	• Can be complicated • All tax breaks involve equity questions – public perception of benefits is critical • Implementation may be difficult in era of budget shortfalls
Regulatory		
Typical Conventional Zoning	• Limited additional expense • Widely accepted in rural counties • Many counties already administer zoning	• Encourages forest parcelization • Practical equity issues – limited flexibility to address • Not permanent
Very Large Lot Zoning (VLLZ)	• Maintains low densities • Effective if required density is low enough • Simple, inexpensive tool • Provides flexibility in building design/location • VLLZ is widely used for MN farmland protection • Counties administer zoning and are capable	• Spreads development/ may cause sprawl • Fragments forest cover and wildlife habitat • Usually controversial, requires public education and involvement campaign • Some equity concerns • Zoning can be changed to allow in-fill development • Not permanent
Exclusive Forest Use Zoning	• Can be very effective – maintains land in forestry use • Can protect large areas of land • Simple, inexpensive tool • Some protection from nuisance issues • Counties administer zoning and are capable • Some counties already have exclusive farm use zones	• Voluntary participation • Does not provide long-term protection • Usually controversial, requires public education and involvement campaign • Equity issues may rise if owner requests rezoning • Not permanent
Open Space/Conservation Development (clustering)	• Effective in places where the market supports • Flexibility to protect specific areas • May be best compromise available • Many counties already have a version of this	• Less effective than other zoning options • Voluntary • Can result in fragmented resources • Requires professional expertise to review proposals – extra cost • Can be controversial if mandatory (voluntary versions limited impact) • Often results in high-end housing (equity) • Sometimes not permanent
Mandatory Transfer of Development Rights	• Can increase perceived equity • Specific locations can be targeted • A few MN counties use voluntary TDRs for farmland preservation	• Unlikely to work in forested counties due to low land values and demand • Voluntary • Complex and expensive to administer • Requires designated professional staff
Other Tools		
Land Banking	• Can adjust public lands without increasing ownership • Counties and State have acquisition plans and expertise	• Requires upfront expenditures/revolving funds • Does not require exchange lands • Requires willing seller

Maintaining Forests across the Land Use Continuum

		Community Character	Forest Management	Strategies
Urban Center		• "Main Street" and surrounding residential neighborhoods. • Often includes older industrial districts. • Paved streets and central water and sewerage.	• Urban forest is among any community's most important assets.	***Forest land parcelization is not an issue*** in the Urban Center. Cities can help limit the demand for rural residential land by ***promoting attractive infill development***.
Urban Fringe		• Newer residential neighborhoods. • Strip commercial development and light industrial uses. • Residential densities from around **0.5 to 3 units/acre**. • Some multi-family housing on the fringes of larger communities. • Streets tend to be paved. • Most areas have central water/sewerage.	• Forest values unlikely to be sustained due to the potential for conflict with other land uses and the ecological isolation of the remnant forest parcels.	***Not the place to expend energy*** combating forest land parcelization. ***Encouraging attractive infill of vacant land*** here may help reduce the demand for more rural land.
The Interface		• Extensive low-density residential. • Scattered commercial uses, including numerous home businesses, and an extensive network of roads. • **Average parcel size >1 but < 40 acres**. • Scattered larger parcels remaining. • Boundary between the Interface and the Urban Fringe is blurred. The Interface may extend deep into the Forest along roads.	• Forest cover is patchy to nearly continuous. • Overwhelming edge effect. • Limited connectivity between forest patches. • Timber production can occur, but forest management is not as efficient or free of conflict. • Area of maximum wildfire hazard. • Special resources are scattered (e.g. important plant and wildlife habitats) throughout the Interface.	***Too late to preserve large blocks of forest*** here. Good work can still be done in ***protecting and buffering the remaining larger parcels***, especially those with lots of ***special resources***, and in ***limiting wildfire exposure***. **<u>Investment Strategies:</u>** • **Acquisition** to preserve remaining large tracts of forest and special resources where there is some development pressure. • **Conservation easements** have limited applicability here. They may be used effectively in concert with conservation development and density transfers. . **Tax incentives** are unlikely to prevent parcelization where the demand for land is high. **<u>Regulatory Strategies:</u>** • **Average densities and conservation development requirements** to buffer larger forest tracts, minimize the edge effect, and maximize connectivity. Conventional zoning exacerbates the potential for conflict in the Interface. • ***Firewise performance standards*** are critical here, as are standards that help protect special resources.

		Community Character	Forest Management	Strategies
The Lakes		It is hard to draw a transect anywhere in northern Minnesota without hitting a lake or two. ***Forestland parcelization is not the issue in the shorelands environment, however, where state-mandated shoreline zoning prevails***.		
The Commercial Forest		• Forest values - clean water, outdoor recreation, timber, and wildlife – are produced on private land. • Essentially continuous forest cover. May also include recreational facilities, like campgrounds; other resource-dependent uses, like mines; and the occasional hunting cabin. • Only significant areas of residential development are along lakeshores. • **Average parcel size > 40 acres**.	• Road network generally limited to that needed for forest management. • Plenty of interior forest. • Good connectivity where the forest is not continuous. • Encompasses many special resources, including stream corridors, wetlands, steep slopes, archeological and historical sites, and important plant and wildlife habitats.	**<u>Investment Strategies:</u>** • **Ideal environment for the use of conservation easements and a tax program** (property or income, or both) to encourage land retention and sustainable forest management. • **Acquisition** may be necessary to protect special resources or ensure public access for recreational use. **<u>Regulatory Strategies:</u>** • **Exclusive Forest Use Zoning** – is the best regulatory strategy here. Where local governments hesitate at Forest Use Zoning: **Very large** (at least **80** acres) **minimum lot size** can be used **in concert with stringent Firewise and resource protection standards**. Local governments will also want to consider the costs of providing services to remote home sites.
Public Forest Lands		• Forest lands administered by counties, the state, and the U.S. Forest Service. • Produce timber and many other "products," including clean water, outdoor recreation, and wildlife.	• Forest management proceeds in accord with plans developed by the responsible agency. • Active forest management can be affected by incompatible uses on neighboring private lands.	***Parcelization generally is not an issue on public lands***, although a few of the counties occasionally sell a parcel. **<u>Investment Strategies:</u>** • **Acquisition or Land Exchange** – to consolidate public lands. **<u>Regulatory Strategies:</u>** • **Regulatory strategies suggested for the Commercial Forest and Interface areas** – to protect the public's investment in its forest lands. Conservation development regulations should require ample buffers for adjoining public lands, as well as providing for wildlife movement between public lands.

Policy Options for Maintaining the Forest Land Base in Minnesota

The Minnesota Forest Resources Council (MFRC), has identified the ongoing parcelization of the forest land base to be a threat to the sustainable management of forests in Minnesota and a top priority to address. The size of forest land holdings has shrunk both nationally and in Minnesota, and is predicted to continue to shrink over the next twenty years. Unprecedented shifts in industrial forest land ownership coupled with federal tax changes, large increases in the number of family forest owners with changing population demographics, increasing land values that often reflect uses other than traditional forest management, as well as other public policy decisions have all been driving factors in the parcelization of forest land in Minnesota. A growing understanding of parcelization has helped researchers to identify and quantify the many effects of parcelization, including impacts on forest structure and productivity, timber supply, water quality and aquatic diversity, invasive species, recreational access and land use conflicts.

To avoid or mitigate these impacts, the MFRC has endorsed a set of policy options that the state, local governments and other partners can use to limit further adverse impacts to the forest land base. These policy options are not designed to preclude all parcelization and development, but are meant to better guide where these activities are most appropriate and to mitigate the impacts. In developing these policy options, we used the following principles:

- Reliance on incremental changes and enhancement of existing programs, rather than the creation of new programs;
- Importance of carefully targeting public investments and fostering partnerships among state agencies, local governments, and land conservation programs;
- Emphasis on multiple benefits from investments in land conservation, such as protection and enhancement of wildlife habitat and water quality, preservation of jobs and maintenance of recreational access; and
- Recognition that every tool in the box is needed and that the tools recommended herein are interdependent and will not be effective if used piecemeal.

MFRC Policy Options[1]

I. Use Minnesota Forests for the Future (MFF)(§84.66)program as the "platform" for a coordinated approach to forest land conservation. MFF has experience with small and large working forest conservation easements and fee title acquisition, and can effectively address forest land parcelization and its impacts by building on the current program. It can accomplish this by:

1) Increasing MFF's capacity and focus to promote a coordinated approach to forest land conservation, addressing all tools (acquisition, exchange, conservation easements, and tax incentives) and recognizing different tools are effective and efficient under varying circumstances(DNR, BWSR, Legislature);
2) Supporting and building on MFF efforts in developing and communicating criteria and a plan for the strategic targeting of land conservation efforts and investments to determine where, and with which tools, investment in land conservation will have the most impact on forest land parcelization (DNR);
3) Enlarging or restructuring MFF's existing advisory board as necessary to reflect this expanded mission(DNR);
4) Facilitating the engagement of state agencies and non-profits in coordinating conservation strategies (DNR, BWSR); and
5) Maintaining and increasing the MFF's effectiveness by fostering local participation in land conservation, in part by engaging established local and regional entities. The MFF should provide ongoing opportunities for both local and statewide public involvement in land conservation decisions (BWSR, DNR).

[1] Policy options are of two types: a) those that could be implemented in FY11 with no direct additional state appropriations (most of the policy options); (b) those that are longer-term and would require either additional state appropriations or funding from other sources (indicated by the symbol $$). A few of these policy options would likely result in reduced spending (marked $savings).

II. Empower and encourage local governments to use local planning to maintain their forest land base.
Local governments need to be significant partners in efforts to address parcelization. The state and other organizations should work to empower and encourage counties and municipalities to protect productive forest lands. The state could do this by:

1) Developing an informational campaign and training for local government officials regarding the impacts of parcelization and the tools available to mitigate the negative effects of parcelization (MFRC, MN Extension)($$);
2) Adding a more current and complete definition of "comprehensive plan" in M.S. 394.231 and 462.355 that expressly requires forested counties to include a forest resource element (Legislature);
3) Offering small local planning grants for the purpose of adding a forest resources element to the local comprehensive plan (Legislature/Foundations)($$);
4) Requiring that, where a comprehensive plan has been adopted, local land use decisions are consistent with that plan (Legislature);
5) Requiring planning commissions to prepare and disseminate an annual report that documents land use trends, including forestland parcelization (Legislature); and
6) Using grant eligibility to encourage local planning by rewarding communities doing adequate planning for forest resources with eligibility for potential grants for easements or acquisition (DNR, other agencies)($$).

III. Conservation easements should be developed and executed in a deliberate, coordinated and sustainable manner.
Conservation easements are voluntary; are generally less expensive than fee simple acquisition; can be individually crafted to the needs of each landowner, while also meeting public goals; and can prevent the division and development of forest lands while maintaining private ownership. Conservation easements can be effective tools for maintaining the forest land base by:

1) Directing existing funding to land conservation projects that prevent the parcelization of forestlands, utilizing the strategic targeting discussed in Policy Option I (DNR, BWSR, Non-profits, LSOHC, LCCMR);
2) Providing sufficient funding to appropriate government agencies to increase capacity and cover all reasonable costs of negotiating, completing, and holding conservation easements (DNR, Non-profits)($$);
3) Creating efficiencies and accountability in the easement acquisition process by using standardized documents and protocols and sharing expertise among government agencies and nonprofit organizations (DNR)($ savings);
4) Ensuring the long-term management and enforcement of forest conservation easements by establishing dedicated funding or creating and seeding an endowment supported by private and/or public fundraising, capitalizing management costs into future conservation easement acquisitions, and negotiating appropriate management endowment funds when developing new easements (Foundations, Non-profits, Legislature)($$); and
5) Clarifying and providing a consistent approach to the tax treatment of forest conservation easements for property tax purposes(Department of Revenue/County Assessors)[2].

IV. Use and build on current state tax policy and incentives to encourage family forest owners to maintain the forest land base. State tax policy, both property and income, can help to limit the amount of family forest and industrial land parcelization. Building on current tax policy to encourage the maintenance of the forest land base, the state could improve current effectiveness of the Sustainable Forestry Incentive Act (SFIA) and other tax policy by:

1) Enhancing the current SFIA program and targeting outreach and funding to parts of the state where the current payment is effective at discouraging forest parcelization (DNR, Legislature);
2) Actively marketing and informing family forest landowners of SFIA and other programs (DNR, Minnesota Forestry Association, MN Extension)($$);
3) Conducting further research to determine if a two-tiered preferential property tax program for recreational access on smaller parcels and other potential benefits such as carbon sequestration would aid in the maintenance of the forest land base (MFRC, UMN)($$);
4) Evaluating a state income tax credit for the donation of conservation land and easements (Legislature)($$); and

[2] Note that this policy option is also pertinent under the tax policy options.

5) Integrating tax policy with local planning by making preferential property treatment of forest lands under SFIA and other programs at least partially dependent (tiered approach) on the local adoption of exclusive forest use zoning or a comparable program (DNR, Dept of Revenue, Local Governments).

V. Rely on fee title acquisition and land exchanges for exceptional cases, small parcels, and the consolidation of or access to public land. The high cost of fee simple acquisition, including both initial capital and long-term management costs, and the complexity of land exchange will limit use of these tools to exceptional cases and smaller parcels. However, keeping forest land intact has significant benefits, and these are important tools and can be effective in maintaining the forest land base by:

1) Directing existing funding to land acquisition projects that prevent the parcelization of forest lands, utilizing the strategic targeting discussed in Policy Option I in concert with other land protection tools (DNR, BWSR, Non-profits, LSOHC, LCCMR);
2) Using fee simple acquisition for parcels that would protect outstanding resources and/or connect and provide access to public lands (DNR, Counties)($$);
3) Ensuring the long-term stewardship of acquired lands by incorporating long-term management into project funding and decisions and considering opportunities to establish dedicated funding for long-term management;
4) Continuing to conduct land exchanges that consolidate public and private ownerships (Counties, DNR);
5) Continuing to simplify the land exchange process and improve identification and communication of exchange opportunities (DNR, Counties)($ savings); and
6) Continuing, as appropriate, to utilize NGOs to efficiently expedite targeted acquisitions (DNR, Counties, USDA Forest Service).

VI. Provide strong support to the counties to foster their forest management capabilities, and to encourage stewardship and retention of county administered forest land. Minnesota counties manage and retain over 2.8 million acres of forest land in Minnesota. We encourage the retention of these lands by:

1) Continuing state PILT payments on tax-forfeited lands to the counties (Legislature);
2) Encouraging forested counties to create local forest land conservation programs that complement the management of public and private lands (DNR);
3) Utilizing existing revolving fund programs, such as the LCCMR three county pilot program and the MFF revolving account, as a model to more nimbly facilitate the consolidation of lands and provide for more sustainable development patterns (DNR, Counties); and
4) Expanding revolving accounts to forested counties across the state and provide seed grants to enhance their effectiveness in maintaining the forest land base in Minnesota (DNR, LCCMR, Legislature)($$).

The values our forests offer – wood products, jobs, clean lakes and rivers, outdoor recreation, wildlife and more – are essential foundations of Minnesotans' quality of life. Forestland parcelization currently threatens these values and the Minnesota Forest Resources Council believes that consideration of these policy options is necessary to sustain those values for future generations.

From intro section

[1] Butler, B.J. 2008. *Family Forest Owners of the United States, 2006.* GTR-NRS-27. Newtown Square, PA: USDA Forest Service, Northern Research Station.

[2] Kilgore, M.A. and D.G.MacKay. 2007. Trends in Minnnesota's forest land real estate market: implications for forest management. *Northern Jouranl of Applied Forestry.* 24(1): 37-42.

[3] Alig, R. and B.Butler. 2004. *Area Changes for Forest Cover Types in the United State, 1952-1997, with Projections to 2050.* GTR-PNW-613. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 106pp.

[4] Best, C. 2002. America's private forests: challenges for conservation. *Journal of Forestry* 100(3): 14-17.

[5] Brown, R. and M.A.Kilgore. 2008. *Evaluating the Economic Impacts of Retention and Disposal Policies for County Tax-forfeited Land in Northern Minnesota*. Staff Paper #196, Department of Forest Resources, University of Minnesota, St. Paul, MN. 123pp.

[6] Kittredge, D.B., M.J. Mauri and E.J. McGuire. 1996. Decreasing woodlot size and the future of timber sales in Massachusetts: when is an operation too small. *Northern Journal of Applied Forestry* 13(2): 96-101.

[7] Butler, B.J. 2008. *Family Forest Owners of the United States, 2006.* GTR-NRS-27. Newtown Square, PA: USDA Forest Service, Northern Research Station.

[8] Halvorson, J.L. 2007. *Using Tax Records to Track Forest Ownership Changes: Lake County: 1996 to 2006.* M.S. Thesis, Nicholas School of the Environment and Earth Sciences of Duke University. 46p.

[9] Butler, B.J. 2008. *Family Forest Owners of the United States, 2006.* GTR-NRS-27. Newtown Square, PA: USDA Forest Service, Northern Research Station. and Kilgore, M.A., and D.G. MacKay. 2007. Trends in Minnesota's forest land real estate market: implications for forest management. *Northern Journal of Applied Forestry* 24(1): 37-42.

[10] White, E.M, R.J.Alig, S.M.Stein, L.G.Mahal and D.M.Theobold.. 2009. *A sensitivity analysis of "Forests on the Edge: Housing development on America's private forests.* Portland, OR. USDA-Forest Service, Pacific Northwest Research Station. General technical Report, PNW-GTR-792. 35p.

[11] Alig, R.J. and B.Butler. 2004. *Area Changes for Forest Cover Types in the United State, 1952-1997, with Projections to 2050.* GTR-PNW-613. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 106pp.

[12] Wegner, T.D. and S.J.Taff. 1999. Changes in Minnesota agricultural land, 1982-1997. Department of Applied Economics, Staff Paper Series, P99-6, University of Minnesota, St. Paul.

[13] Miles 2009

[14] Mundell, J., S.J.Taff, M.A.Kilgore and S.A.Synder. 2007. *Assessing trends in forest parcelization and development in Minnesota: an Itasca County case study.* St. Paul, MN: University of Minnesota, Department of Forest Resources, Staff Paper Series no. 192, 27p.

[15] Alig, R. 2006. Land-base changes in the United States: Long-term assessments of forestland condition. In *Proceedings of the sixth annual forest inventory and analysis symposium, 2004 September 21-24, Denver, CO.* Gen. Tech. Rep. WO-70. Washington D.C.: U.S. Department of Agriculture-Forest Service. 126p. ; Alig, R. and A. Plantinga. 2004. Future forestland area: impacts from population growth and other factors that affect land values. *Journal of Forestry* 102(8): 19-24.; Fidel, J. 2007. *Roundtable on parcelization and forest fragmentation: final report.* Vermont Natural Resources Council.

[16] Ahn, S.E., A. J. Plantinga, and R.J.Alig. 2002. Determinants and projections of land use in the South Central United States. *Southern Journal of Applied Forestry* 26(2): 78-84.; Butler, B.J. and S.L. King. 2003. Assessment and mapping of forest parcel sizes. In *2003 Proceedings of the fifth annual forest inventory and analysis symposium.* 27-32.; Egan, A., D. Taggart and I. Annis. 2007. Effects of population pressures on wood procurement and logging opportunities in northern New England. *Northern Journal of Applied Forestry* 24(2): 85-90.; and Kendra, Angelina. 2003. *New landowners in Virginia's forest: a study of motivations, management activities, and perceived obstacles*. PhD Dissertation: VPI.

[17] Best, C. 2002. America's private forests challenges for conservation. *Journal of Forestry* 100(3): 14-17.

[18]Creighton, J.H., K.A. Blatner and D.M. Baumgartner. 2004. The future of Washington state family owned forests in an increasingly fragmented landscape. In Baumgartner D.M., editor, *Human Dimensions of Family, Farm, and Community Forestry, March 29-April 1, 2004 symposium.* 51-55.; Donnelly, S. and T.P. Evans. 2008. Characterizing spatial patterns of land ownership at the parcel level in south-central Indiana, 1928-1997. *Landscape and Urban Planning* 84(3-4): 230-240. ; Kendra, Angelina. 2003. *New landowners in Virginia's forest: a study of motivations, management activities, and perceived obstacles*. PhD Dissertation: VPI.; and LaPierre, S. and R.H. Germain. 2005. Forestland parcelization in the New York City watershed. *Journal of Forestry* 103(3): 139-145.

[19] Donnelly, S. and T.P. Evans. 2008. Characterizing spatial patterns of land ownership at the parcel level in south-central Indiana, 1928-1997. *Landscape and Urban Planning* 84(3-4): 230-240. ; Fidel, J. 2007. *Roundtable on parcelization and forest fragmentation: final report.* Vermont Natural Resources Council. ; Hagan, J.M., L. Irland and A.A.Whitman. 2005. Changing forestland ownership patterns in the northern forest and implications for biodiversity: Final report to the national commission on science for sustainable forestry. ; Kendra, Angelina. 2003. *New landowners in Virginia's forest: a study of motivations, management activities, and perceived obstacles*. PhD Dissertation: VPI.; LaPierre, S. and R.H. Germain. 2005. Forestland parcelization in the New York City watershed. *Journal of Forestry* 103(3): 139-145.

[20] Donnelly, S. and T.P. Evans. 2008. Characterizing spatial patterns of land ownership at the parcel level in south-central Indiana, 1928-1997. *Landscape and Urban Planning* 84(3-4): 230-240.; Egan, A., D. Taggart and I. Annis. 2007. Effects of population pressures on wood procurement and logging opportunities in northern New England. *Northern Journal of Applied Forestry* 24(2): 85-90.

[21] Haines 1999

[22] Mundell, J., S.J.Taff, M. Kilgore and S. Synder. 2007. *Assessing trends in forest parcelization and development in Minnesota: an Itasca County case study*. St. Paul, MN: University of Minnesota, Department of Forest Resources. Staff Paper Series no. 192, 27p.

[23] Best, C. 2002. America's private forests challenges for conservation. *Journal of Forestry* 100(3): 14-17.

[24] Radeloff, V.C., R.B. Hammer and S.I.Stewart. 2005. Rural and suburban sprawl in the U.S. Midwest from 1940 to 2000 and its relation to forest fragmentation. *Conservation Biology* 19(3): 793-805.

[25] Alig, R.J., D.G. Lewis and J.J. Swenson. 2005. Changes in land use, forest fragmentation, and policy responses. In: *Laband, D.N., ed. Proceedings, emerging issues along urban/rural interfaces: linking science and society: March 13-16, 2005, Hilton Atlanta, Georgia.* Atlanta, Ga.: Center for Forest Sustainability. pp. 81-84.

[26] Drzyzga, S.A. and D.G. Brown. 1999. Land parcelization and forest cover fragmentation in three forested counties in northern lower Michigan. In *Proceedings of the Society of American Foresters National Convention, Traverse City, MI, Sep 19-23, 1998.* Bethesda, MD: SAF, 129-135.; Kendra, Angelina. 2003. *New landowners in Virginia's forest: a study of motivations, management activities, and perceived obstacles*. PhD Dissertation: VPI.

[27] Best, C. 2002. America's private forests challenges for conservation. *Journal of Forestry* 100(3): 14-17.; Brooks, R.T. 2003. Abundance, distribution, trends, and ownership patterns of early-successional forests in the northeastern United States. *Forest Ecology and Management* 185(1-2): 65-74.

[28] Brooks, R.T. 2003. Abundance, distribution, trends, and ownership patterns of early-successional forests in the northeastern United States. *Forest Ecology and Management* 185(1-2): 65-74.; Gobster, P.H. and M.G. Rickenbach. 2004. Private forestland parcelization and development in Wisconsin's northwoods: perceptions of resource-oriented stakeholders. *Landscape and Urban Planning* 69(2-3): 165-182.

[29] US Census, from http://quickfacts.census.gov/qfd/states/27000.html

[30] Amacher G.S., M.C.Conway and J.Sullivan. 2003. Econmetric analyses of nonindustrial private forest landowners: Is there anything left to study. *Journal of Forest Economics* 9(2): 137-164. ; Conway,M.C., G.S. Amacher, J. Sullivan and D.Wear. 2003. Decisions nonindustrial forest landowners make: An empirical examination. *Journal of Forest Economics* 9(3): 181-203; and Germain, R.H., N.Anderson and e. Bevilacqua. 2007. The effects of forestland parcelization and ownership transfers on nonindustrial private forestland forest stocking in New York. *Journal of Forestry* 105(8): 403-408.

[31] Alig, R. 2006. Land-base changes in the United States: Long-term assessments of forestland condition. In *Proceedings of the sixth annual forest inventory and analysis symposium, 2004 September 21-24, Denver, CO.* Gen. Tech. Rep. WO-70. Washington D.C.: U.S. Department of Agriculture-Forest Service. 126p.

[32] Harris, T., and C. Deforest. 1993. Policy implications of timberland loss, fragmentation, and urbanization in Georgia and the Southeast. In *Proceedings of the1993 Southern Forest Economics Workshop*, ed. D.N.

[33] Halvorsen, J.L. 2007. Using tax records to track forest ownership changes: Lake County, Minnesota: 1996 – 2006. M.S. Thesis: Nicholas School of the Environment and Earth Sciences of Duke University. 46p.

[34] Olsen, E. 2007. Combining landscape histories, spatial policy forecasts, and landscape ecology metrics to compare alternative futures in developing rural areas. Presented at: 48th Annual conference of the American collegiate schools of planning, Milwaukee, WI.

[35] Brooks, R.T. 2003. Abundance, distribution, trends, and ownership patterns of early-successional forests in the northeastern United States. *Forest Ecology and Management* 185(1-2): 65-74.

[36] Olsen, E. 2007. Combining landscape histories, spatial policy forecasts, and landscape ecology metrics to compare alternative futures in developing rural areas. Presented at: 48th Annual conference of the American collegiate schools of planning, Milwaukee, WI.

[37] Fidel, J. 2007. *Roundtable on parcelization and forest fragmentation: final report.* Vermont Natural Resources Council.

[38] Dennis, D.F. 1992. Parcelization and affluence: implications for nonindustrial private forests. *Northern Journal of Applied Forestry* 9(1): 33-35.

[39] Brooks, R.T. 2003. Abundance, distribution, trends, and ownership patterns of early-successional forests in the northeastern United States. *Forest Ecology and Management* 185(1-2): 65-74.; Butler, B.J. and S.L. King. 2003. Assessment and mapping of forest parcel sizes. In *2003 Proceedings of the fifth annual forest inventory and analysis symposium.* 27-32.

[40] Conway,M.C., G.S. Amacher, J. Sullivan and D.Wear. 2003. Decisions nonindustrial forest landowners make: An empirical examination. *Journal of Forest Economics* 9(3): 181-203

[41] Gabriel and Katz 2006; Dart 2005; Dunning 2005; among others

Using taxation to maintain Minnesota's forestland base

As noted earlier, tax policies, in conjunction with the many other tools addressed in this report, are often used by governments to attempt to influence forest landowner behavior. These policies vary across the country, mirroring the diversity of our federal, state and local tax structures. These tax policies generally give favorable or preferential treatment for forestland owners. This may include a reduction in the amount of property tax paid, a rebate of taxes already paid, favorable income tax and capital gains treatment regarding various forest practices and activities, reduced estate taxes, and other favorable treatment of forestland. Some of these policies or programs have been in place for many years (more than a century) and new ones are created every year. These policies are created for many reasons, but are most often meant to encourage certain landowner behavior and accomplish public goals such as protecting water quality or wildlife habitat, sustaining the flow of raw materials to the primary forest products industry or encouraging the retention of large blocks of contiguous forestland. These myriad policies are addressed below, with an emphasis on property tax policy.

Property taxation

The property tax, brought to the United States from Europe, is a tax on real property that generally includes land, improvements to land such as a house and personal items such as a car. These taxes are most commonly a local source of revenue (e.g. county, municipal, school district), but are often controlled at the state level. This type of tax was established because land and other property was thought to be a reliable measure of one's wealth[1] and has been used as a significant source of government revenue in the United States for the past 300 years. Over the last 100 years, there have been many concerns regarding the regressive nature of the property tax. Compounding its regressive nature, the annual property tax is levied on forestland despite the fact that it may often be fifty years or more, if at all, before the owner realizes any income from the land, in contrast to what generally occurs on agricultural land.

Reacting to these problems, as well as other public policy concerns, states across the country have initiated preferential property tax programs for a host of land uses and types, including agricultural and forestland owners. Preferential forestland property tax programs and classifications have existed in the U. S. since the 1860s. Generally, early programs either completely exempted forestland from taxation or delayed the payment of the tax until income was realized from the land after a timber harvest. More recently, every state in the country has adopted some sort of preferential forestland property tax program, mostly in some form of a current use tax. A current use tax, in general terms, is a tax that is based on the value of the land according to its current use, such as forestry or agriculture, often not its highest and best use value. The first of these types of programs adopted in the forestry sector was in Maryland in 1956[2].

Preferential forestland property taxation in Minnesota

Minnesota employs a combination of taxes and programs that apply to forestlands and activities on those lands. Minnesota has constructed its property tax structure to address some of the shortcomings discussed above about this regressive nature. Minnesota, as many other states, uses a multi-tiered tax structure, taxing different land uses or land types at different rates. To further address the regressive nature of the property tax, the state employs a progressive property tax refund policy.

Minnesota employs a number of preferential property tax programs or classifications that apply to forestland. Most prevalently, the state administers the Sustainable Forest Incentive Act (SFIA), a property tax rebate program. The state has also recently created a new tax classification, 2C-Managed Forestland, which reduces the tax burden on enrolled lands with a reduced tax rate. The third forest related program, which is currently under development, is the Rural Preserve Program, enacted into law in 2009 to complement changes made to the Green Acres Program, which is mainly an agricultural preferential property tax program.

Sustainable Forest Incentives Act

In Minnesota, the most widely used preferential property tax program for forestland is the program created by the Sustainable Forestry Incentives Act of 2001, widely known as SFIA. Although not a true preferential property tax program, as the landowner annually pays full property taxes, a qualified landowner receives a per acre rebate payment as a result of enrollment from the Minnesota Department of Revenue, which administers all aspects of the program except for recording the covenant. In order to qualify, the owner must enroll a minimum of 20 contiguous acres, of which at least 50 percent is forested, that do not contain improvements for purposes other than sustainable forest management. The program requires the landowner to obtain a forest management plan and to use the Minnesota Forest Resources Council's site-level forest management guidelines. The enrollee must place a covenant on the property, reflecting a minimum enrollment period of eight years, which becomes a rolling four year period after the initial four years. This means the landowner needs to notify the Department of Revenue of the intent to withdraw four years in advance of the actual withdrawal date. Those owners enrolling in the program with holdings greater than 1,920 acres must allow public access on their land for non-motorized recreation. As of 2008, this requirement only pertained to nine program participants, but accounted for public recreational access on 559,639 acres. Total enrollment in the program as of 2008 is 892,577 acres, corresponding to 12 percent of the total private forestland in the state. Note that the two largest landowners enrolled in the program account for 52 percent of the total enrolled acreage.

After fulfilling the above requirements, enrollees pay their property taxes and receive a per acre payment from the state. From 2002 to 2008, the SFIA incentive payment to landowners has increased from $3.19 per acre to $8.74 per acre. With the increase in payment and modest increases in enrollment, the total payout from the state has increased from $1.6 million to $6.9 million[3] over that some time period.

Issues:

The SFIA program has not been as successful as many had originally envisioned. A recent study indicated that only two percent of eligible family forest land was enrolled in the program[4]. This section provides a discussion about the most substantial challenges facing the SFIA program.

Awareness. Many believe that one of the main reasons the program lacks better enrollment is due to a limited amount of publicity. A 2007 survey of family forest owners in Minnesota demonstrated that only 23 percent of these owners were aware of the SFIA program before receiving the survey[5].

Payment. The SFIA annual payment, though more than doubling over the last seven years, is quite small in comparison to land development values, especially in places where the likelihood of parcelization is greatest. In the same survey identified in the previous paragraph, the author queried family forest owners about their willingness to enter the program as it relates to the amount of the incentive payment. The author found that it would take a $24 per acre payment (almost three times the current payment level) to attract 50 percent of family forest owners[6].

Program requirements. As noted above, the SFIA has a number of program requirements that enrollees need to fulfill. A number of these elements may be the reason that landowners would require such a high payment to enroll, as indicated in the previous payment section. A family forest survey found that landowners especially chafe at the need for a four year advance notice to withdraw from the program and, even more so, the need for a covenant or restriction on the deed[7].

There is a long tradition of public recreational access to Minnesota forestland. Many of the traditional industrial forest landowners and other corporate holders allowed for public recreational access to their lands over many decades. The law preceding the SFIA, the Tree Growth Tax Law, required a landowner to allow recreational public access to enroll. At the time, this requirement was cited as being one of the reasons for the limited use of this program. As noted in the program description, only nine forestland owners have enrolled more than 1,920 acres in the SFIA program, requiring non-motorized public access to enrolled lands totaling more than half a million acres. Unlike in some states, there is no program premium for allowing public access to enrolled land.

A study conducted at the University of Minnesota found that over 70 percent of landowners already post their land to prevent public access. However, in the same study, 57 percent of respondents said they would or would consider giving hunters access to their lands. The study noted that up to 20 percent of landowners would consider allowing public access for $5/acre payment and over half would consider allowing access for a $30/acre payment[8]. As a point of reference, enrollees in Wisconsin's Managed Forest Law are offered a payment enhancement differential for those that choose to allow public access. Less than half of the acres enrolled are open to public recreational access, yet those allowing access make up a substantial acreage of more than 1.2 million acres of forestland.

Targeting. Although not explicitly mentioned in statute as a goal of the SFIA program, maintenance of the forestland base in Minnesota is an important outcome from the SFIA. The SFIA program is not targeted toward any particular type of ownership or land use. The SFIA is simply aimed at private forestland owners across the state, regardless of parcelization or development pressure.

2C – Managed Forest Land

The 2C is a standard tax property rate deduction for those landowners who fulfill the required elements of the tax class. The 2C classification lowers the class rate of eligible properties from 1.00 percent to 0.65 percent. Similar to the SFIA, eligibility requires enrolling at least 20 acres of forestland and also requires a forest management plan. The tax classification has an annual renewal with no recorded covenant. The maximum acreage allowed to be enrolled by one owner is 1,920 acres and none of the enrolled property is required to allow public access. Unlike SFIA, the 2C classification directly decreases the amount of tax owed by an enrollee. As of September of 2008, 47,201 acres have been enrolled in the 2C classification.

Awareness. As this tax classification is relatively new, established in 2008, there have been no comprehensive attempts to assess taxpayer awareness of the 2C program. The 2C classification is part of the tax structure and not an additional program, which may help in making landowners more aware of this classification.

Payment. The 2C classification is a normal part of the assessment and taxation process in each county. Therefore the reduction in taxes is dependent on the local levy and the prominence of the other taxation classes. This fact also makes it a much more laborious task for county assessors. This may also lead to unintended consequences as the distribution of the property taxes may change, but not the amount of the levy.

Program requirements. Several of the program elements from the SFIA program are requirements of the 2C classification, such as having a management plan and minimum acreage. Other elements of the SFIA, such as a recoded covenant and a multiple year commitment, are not part of the 2C classification and may make it more appealing to some landowners. The lack of a multiple year commitment however, does not guarantee a continued flow of public and private benefits from enrolled lands.

Rural Preserve Program

This is a new tax program meant to accommodate some of the changes made to the Green Acres tax program that were made in 2008. This program is still under development and will be fully rolled out in 2011. The program will require a minimum of 10 acres of rural vacant land and a ten-year recorded covenant. The program will also require a conservation plan, but not public access. The land will in turn be taxed at the current use value, not the estimated market value.

Other preferential property tax programs

There are a number of other preferential property tax programs in Minnesota, including the Green Acres program, the Metropolitan Agricultural Preserves Program and the Agricultural Land Preservation Programs. There are also a number of preferential classifications similar to 2C for other land uses such as small resorts or homesteaded agricultural land.

It is important to note that Minnesota has a fairly complicated preferential property tax scheme. This has the potential to confuse landowners, potentially making the programs less effective and under-utilized. However, these various options do offer choices to landowners, as one program may be more appealing than another. That being said, from a theoretical taxation perspective, the program which provides more or continued public benefits should be coupled with the bigger taxation benefits for the landowner.

Preferential tax treatment of forest lands in other states (see Table at the end of this section)

All 50 states use at least one preferential forestland property tax program, with some states employing more than one. Most of these programs are some variation of a current use tax program, meaning that the taxable value of the land is based on the current use (e.g. forestry or agriculture), not the highest and best use or market value. Some of the current use values used in preferential forest property taxes are based on forest or soil productivity classes. A number of states also couple a severance or yield tax with the current use tax, which is collected at the time of timber harvest. A number of other states employ a flat tax, most often coupled with a yield tax. A few states simply exempt certain types of land, including forestland, from any property taxation.

As demonstrated in the section reviewing Minnesota's preferential property tax programs, many states have a number of eligibility requirements for enrolling in their respective preferential forest property tax programs. Almost one-third of the programs nationwide have no minimum or maximum acreage requirements for enrollment. Those programs that do have an acreage requirement, generally have a minimum acreage requirement which varies across the country and ranges from one to 40 acres, with an average of 12 acres required for enrollment. A few programs, aimed at family forest land, have a maximum allowable acreage, ranging from 160 acres to 5,000 acres. About one-third of the programs have some level of stocking or productivity requirement. Some of these stipulations are based on local judgment regarding conditions, others use stocking level percentages or a specified number of trees per acre for eligibility purposes.

Just as the SFIA and 2C classification in Minnesota require management plans, over 40 percent of programs around the country require some sort of forest management plan as a condition of enrollment. The detail and amount of information required, as well as the level of incentives or enforcement to follow the management plan, vary greatly. At least one-quarter of the programs require an enrollment period greater than one year, ranging from 2 to 50 years. Many of these programs, even some with an annual enrollment, have penalties for withdrawal, especially early withdrawal from those programs that require a multiple year commitment. These penalties are often the difference between the taxes paid over a number of years at the reduced rate and what would have been paid at the full tax rate. Some programs also have a penalty or charge interest on the amount of tax savings.

Program Effectiveness

There have been a number of studies around the country conducted at various scales assessing the effectiveness of both forest and agricultural preferential programs. The information in this section summarizes that literature, as well as a number of interviews with program administrators from across the country conducted explicitly for this project.

Studies in the agricultural sector found that counties in both California and Virginia that employed a preferential property tax program were 10 to 50 percent more likely to have retained land in an agricultural use rather than a more developed use[9]. No comparable studies have been found regarding the retention of forest lands in relation to the existence of a preferential property tax program.

A national survey of property tax administrators found that preferential forestland property tax programs are at best a mixed bag in producing or protecting the benefits they are intended to address, including timber production, wildlife and other non-timber benefits, long-term investments and sound forestry practices[10]. Another study found that many of the benefits these programs were designed to encourage would have been undertaken by the landowner regardless of the program, negating the need for subsidizing such activities for many landowners[11]. A review of Pennsylvania's forest property tax programs found that those landowners who enroll in preferential property tax programs are often mostly the ones that are least likely to develop their properties in the future[12]. Other studies also note that preferential tax treatment has a limited effect on the conversion of land[13]. Although not focused on forestland, in 2008 the legislative auditor found the Minnesota Green Acres program, in its current configuration, is not effective at preserving land. A number of other studies also demonstrate the ineffectiveness of currently configured preferential forest property tax programs in protecting forestland[14].

Various authors cite a number of reasons for the ineffectiveness of these programs, as well as a host of ways to improve the effectiveness. One author notes that these programs are not very effective unless property tax burdens are high[15]. In reviewing the Green Acres program, the legislative auditor found that the program provided little benefit in retaining working lands, as there is no requirement for a long-term commitment and the program does not target the most important or threatened parcels. The auditor also found, related to the previous finding cited immediately above, that the tax benefit from the program is rather small as compared to the value for development, which limits its effectiveness in affecting land use decisions. Similarly, Jacobson and McDill (2003), authors of the study examining the preferential property tax program in Pennsylvania found that the penalties for withdrawal from the program are not high enough to be able to compete with development values, making the program ineffective at maintaining the forest land base[16].

In addition to the national review of programs, we conducted interviews of preferential forestland property tax administrators, natural resource administrators and foresters from 11 states, from Maine to Idaho to Texas. The purpose was to further examine some of the programs highlighted in the national review of programs by gaining a better understanding of these programs, their effectiveness at maintaining the forest land base and various perspectives on what makes an effective program.

The interviews confirmed our findings in the national survey of programs that tax programs vary immensely from state to state. Just as demonstrated in the national review, most of the programs are some sort of current use program, with one example of an exemption law. A few of these programs were also coupled with a yield tax. One of the programs further reduced the current use value if lands are classified as riparian or aesthetic management zones, or critical wildlife zones. Of those programs that were evaluated in depth, most required a minimum acreage ranging from 5 to 25 acres with two states capping their programs at 1500 and 5000 acres. Very few of these programs had a stocking or productivity requirement, but most required a management plan. Only three of the 11 programs had a multi-year commitment period, but most had penalties that are assessed over multiple years, even without a formal multi-year commitment.

Aggregating the interviews with program administrators and others, only a few respondents thought that their respective programs were effective at maintaining the forestland base. This is remarkable, as one would assume most of the respondents have a vested interest in maintaining their program. Conversely, a few felt their programs were very ineffective at maintaining the forestland base, noting that some of these programs may actually encourage further parcelization of forestland. Most felt that it is more a mixed bag in relation to effectiveness at maintaining the forestland base, noting that preferential property tax programs work well in some situations and not so well in others. Even programs with high enrollment, exceeding 40 percent of eligible land, are still not effective in all situations. A number of respondents noted that the programs are least effective in influencing high-end developments, as the penalties or withdrawal cost are simply passed on to the end buyer. A number of respondents felt that their programs would be more effective if the penalties were increased, although increasing penalties would most likely have an inverse relation with enrollment. It is also important to note that effectiveness in maintaining the forestland base is not the intent, or the only intent, in instituting these programs. These programs can be valuable ways to encourage other forest management activities that have both economic and ecological benefits.

Respondents noted a number of problems with the current state of preferential forest property tax programs in their respective states. As noted previously, many recognized that large discrepancies between the current use values and development values made it difficult for their programs to be

successful at maintaining the forest land base, and noted that penalties are often tied into the purchase price of the parcels. One state said that rolling the penalties into the future development costs may negatively affect the state's ability to maintain affordable housing. Respondents noted that often the general public has little understanding of these programs, and often considers them to be a give-away to forest landowners or an unneeded subsidy to the forest industry.

A number of respondents noted ways to improve program effectiveness in relation to maintaining the forest land base. Respondents suggested an educational element would buoy effectiveness. Others noted the need for additional resources to run and promote the programs. Another identified theme was the need for more strategic targeting of land, or employing a tiered approach based on the qualities of specific parcels. Linking tax treatment of forest land to land use planning was suggested as a way to further encourage development to be directed to appropriate areas while maintaining the core of the forest land base. A number of respondents, as well as comments in the literature, noted that enrollees often chafed at the requirements of some of the programs that require various forest management activities. Some suggested that in order to increase enrollment, programs should do away with harvesting requirements and shift the focus of the programs to encourage the provision of eco-system services and other non-timber benefits, such as carbon sequestration. Respondents also suggested the need for improving relationships and communication between state departments related to taxation and natural resources.

Income Taxation

Due to the fact that investments in forestry are not immediate, often taking 45 to 80 years or more to be realized, and include a number of risks over time, some have argued successfully for special treatment of forest investments in relation to income taxes. These arguments are buoyed by the fact that these lands, during which no real income is being generated, are producing a host of public benefits, such as carbon sequestration and maintenance of water quality, not traditionally attributed to the landowner.

Income tax policy can have an effect on forest management by encouraging or discouraging certain practices through the tax code. Most income tax policy in regard to forest lands and practices exists at the federal level. The rules deal with the treatment of income from the sale of timber. These policies include the deduction and amortization of land management and tree planting costs that offset income for these lands. Income tax policy is also very important in encouraging the donation of conservation lands and easements, by allowing for income tax deductions for the donation of these lands and easements (see the conservation easement section for more information).

Forest landowners often lose a significant amount of revenue because of ignorance or misunderstanding of the complex tax code[17]. This suggests a need for further education of family forest and corporate land owners about income tax treatment of forestry revenues and costs, increasing the financial incentive to hold onto their forestland.

Income taxation in Minnesota

Minnesota piggybacks on federal tax policy, thereby providing corporate and family forest owners with some benefits that may encourage a landowner to keep from dividing their forestland. (Refer to Appendix C for more detail)

Income Tax Incentives in other States*

Tax provisions related to forest management vary from state to state, Some states provide general income tax credits or credits for specific activities (e.g. establishing riparian buffer strips), and some local governments also provide further relief for landowners[18]. In addition to the charitable deduction for federal and state income taxes that someone can receive for the donation of a conservation easement, currently, 12 states also provide a state income tax credit for the donation of conservation land or easements.

The State of North Carolina was the first state to offer income tax credits for the donation of easements in 1983[19]. The state allows for an income tax credit of one-quarter the value of the donated easement. By 1998, 33,000 acres were protected under this program. The State of Colorado provides an income tax credit for landowners who donate a conservation easement. The credits are equal to the value of the easement, and may be sold to others. This allows cash poor landowners to hold onto lands that might be sold and in turn parcelized or developed in the future. Other states offer a different approach to income tax credits for the maintenance of various types of land and features, such as credits for wetland restoration, reforestation, protection of water quality and protection of sensitive plants and animals.

** For more information on these programs and issues, reference the tax issues section of the acquisition and easement report.*

Estate taxation*

The amount of estate tax owed related to forestland has increased nationally over the last ten years. This may have to do with the larger amount of recent land transfers, 77,000 in the last ten years with a corresponding 79.1 million acres. A recent study in Mississippi found that 38 percent of those inheriting forest lands were subject to the estate tax. Of those, over half paid the estate tax through timber harvest of timber on their inherited lands and close to half sold land to pay the estate tax, as nearly half of the respondents indicated that they had no other source of funds to pay the tax. Note that these are not mutually exclusive options. The author of the Mississippi study estimated that 3,300 landowners nationwide had to sell their inherited land (1.3 million acres) to cover the estate taxes, with 400,000 of those acres being developed[20].

** For more information on these programs and issues, reference the tax issues section of the acquisition report.*

Crosscutting issues

By placing a conservation easement on a piece of land, it should reduce the value and lessen the burden of the estate tax. Federal tax policy recognizes this reduction in value.

Lessons Learned

Both in Minnesota and across the country, property, income and estate taxation policies are used to try to influence land use decisions as well as the application of forest management standards and provision of timber and ecosystem services. It is important to note that taxation is only one tool in the toolbox and may only be effective in reducing parcelization in certain situations. It should also be noted that there are various tradeoffs in employing different taxation policy schemes, such as program simplicity versus equity between landowners. The following are a list of issues that need to be considered in designing tax policy for the purposes of maintaining Minnesota's forestland base.

Appropriateness – Taxation is a much used and appropriate tool to address various forest policy goals. Many landowners note that the biggest barrier to holding onto or managing their forestland is taxes, mainly property taxes. Across the country and in Minnesota, forest landowners have specified that their top preference for management incentives is through property tax incentives and reductions.

Multiple Benefits –The recommendations in this report are not designed to stop parcelization, as some parcelization is desirable, but are meant to maintain or enhance the benefits that come from large blocks of intact forestland in Minnesota. The recommendations regarding taxation provide for important benefits including the protection and enhancement of wildlife habitat and water quality, preservation of jobs and maintenance of public recreational access.

Awareness – As noted in this analysis, awareness is key to attracting landowners to participate in programs intended to maintain the forestland base. Both in Minnesota and nationally, high percentages of private forestland owners are unaware of these preferential tax programs. Authors note that certain levels of participation must be reached to effectively address the goals of these programs. Also, Minnesota has a number of different options to enroll in a preferential tax program. This can be confusing for landowners resulting in lower enrollment. At the same time this structure offers landowners a choice in what program best fits their ownership goals. All of this suggests that an informational outreach effort to family forest owners would most likely increase the effectiveness of these programs.

Paticipation – A couple of academic studies, as well as interviews around the state and elsewhere, noted that at least some of the participants would make the land use decisions that help to maintain the benefits we are encouraging without incentives or programs. This effect may be negated somewhat by better targeting outreach to areas where these types of incentives will work to maintain forestland benefits.

Program Focus – A number of taxation programs across the country include the provision of timber supply as at least one of the benefits they are trying to encourage. A number of studies and interviews indicate that many landowners are unwilling to enroll or later regret enrolling in these programs because they must harvest timber or undertake other forest management activities. Several authors and interview respondents have suggested that to enroll greater numbers in these programs and increase effectiveness at mitigating parcelization, the programs need to be more oriented toward the provision of eco-system services and less toward timber production.

Amount of tax relief – A number of studies and interviews regarding preferential forestland taxation programs noted that the amount of tax relief and the development value of a parcel need to be better aligned to encourage the retention of forestland. The main issue is that the amount of tax relief and the penalty for withdrawal from the program are insufficient to influence land use decisions.

Program Elements and Administration – A number of respondents and researchers noted that the commitment period and lack of substantial penalties compromised the effectiveness of these programs in retaining forestland. Some noted that these weaknesses, at least in a couple of instances, actually encourage future parcelization, serving as a cheap way to hold land until it is developed. Some other states have had changed program elements midstream in landowners' contracts. This undermines these landowners' reasons for enrolling and may further discourage others contemplating future enrollment.

It was also noted that many of these programs are jointly administered through two state agencies and that effective communication between agencies would benefit program effectiveness.

Public Access – Public recreational access to large areas of private forestland has been a long tradition in Minnesota. In trying to maintain this benefit, a two-tiered system, such as the system in Wisconsin, may more equitably compensate landowners for the amount of public benefits provided and may sustain Minnesota's traditional recreational access.

Posting date: 12 May 2010

Appendix #1

Preferential Forestland Property Tax Laws

State	Tax type	Min/Max acreage	Min stocking	Mgmt plan	Duration	Penalties
Alabama	Current use and severance tax	None	None	None	None	Difference in ad valorem over previous 3 years
Alaska	Exemption	none	none	none	none	none
Arizona	Reduction in FMV and severance tax	none	none	none	none	none
Arkansas	Current use based on soil productivity and severance tax	none	none	none	none	None
California	Current use value and severance tax	none	none	none	10 years	Fee
Colorado	Current use	40	10%	required	none	None
Connecticut	Current use value based on forest productivity	25	conditions	Map and short narrative	none	Decreasing percentage over timeof sale price
Delaware	Current use and timberland exemption	10	conditions	required	2 years	Past tax due
Florida	Current use	none	none	none	1 year	Assessed at fair market value
Georgia	Current use and severance tax	none	none	none	10 years	Pay back twice the savings
Hawaii	Current use value based on agricultural production	10	none	required	20 years	Difference in taxes
Idaho	Current use and yield tax	5-5000	none	yes	10 years	Difference in taxes
Illinois	Current use and yield tax	none	none	required	10 years	None
Indiana	Flat tax	10	40 sq ft/ac	required	annual	Up to 10 year rollback + 10%
Iowa	Current use or exemption	2	200trees/ac	none	8 years	rollback for previous 5 years
Kansas	Current use, classified as agricultural land	none	none	none	none	None
Kentucky	Current use	10	none	none	none	Taxed at FMV
Louisiana	Current use	3	conditions	none	none	None
Maine	Current use value based on forest productivity	10	none	required	None	30% of past due tax (decreasing)
Maryland	Current use	5	none	required	15 years	Rollback taxes
Massachusetts	Reduction in FMV and yield tax	10	16.7%	required	10 years	Rollback tax
Michigan	Flat tax and yield tax	Max 160	1200trees/ac	none	none	5% stumpage value
Minnesota	Reduction in FMV	20	10%	required	8 years	Past 4 incentive payments
Mississippi	Current use	none	none	none	none	none
Missouri	Flat tax and yield tax	20	none	required	25 years	Rollback taxes

Montana	Current use and severance tax	15	25cuft/ac/yr	none	none	None
Nebraska	Current use	none	none	none	none	none
Nevada	35% of current use tax	7	none	none	none	20% of deferred tax
New Hampshire	Flat tax and yield tax	10	None	Further reduces taxes	none	10% of FMV at enrollment
New Jersey	Current use value	5	None	Required	annual	Rollback 3 years
New Mexico	Current us and yield tax	1	none	none	none	$25 or rollback
New York	Current use value and yield tax	15	800 trees/ac	none	none	None
North Carolina	Current use and severance tax	20	none	none	none	Rollback + interest
North Dakota	Flat tax	10	non	required	5	Return to FMV
Ohio	Current use value	10	none	none	Annual	Past 3 years tax due
Oklahoma	Current use	none	none	none	none	None
Oregon	Use for forestry	2	standards	none	none	rollback
Pennsylvania	Current use value based on forest productivity	10	stocked	none	none	Past seven year plus interest
Rhode Island	Current use or exemption	10	dense	requried	annual	Decreasing % of FMV
South Carolina	Current use	5	none	None	none	Rollback taxes
South Dakota	Current use based on agricultural productivity	none	none	none	none	none
Tennessee	Current use	15-1500	none	none	none	3 years rollback
Texas	Productivity value	none	none	none	indefinite	5 year rollback + 7%interest
Utah	Current use	5	none	none	none	Rollback tax
Vermont	Current use	25	none	required	indefinite	20%(decreasing past due tax)
Virginia	Current use value based on site productivity and severance tax	20%	40% stocking	Some required	indefinite	Rollback taxes
Washington	Current use value based on forest productivity combined with yield tax	20	none	required	10 years	Rollback 10 years
West Virginia	Current use value and yield tax	10	40%	required	none	Additional forgone taxes
Wisconsin	Flat tax and yield tax	10	none	required	25 or 50	None
Wyoming	Ad valorem	none	none	none	none	none

[1] Canham, H. O. 1992. Property taxes and the economics of timberland management in the northern forest lands region. In *Technical appendix, Northern Forest Lands Council*. Concord, NH: Northern Forest Lands Council.
[2] Arnott, R., R.M.Schwab and J.K.Brueckner. 2006. Effects of property taxation on development timing and density: policy perspectives. Brookings-Wharton Papers on Ruban Affairs, Brookings Inastitution: 189-230.
[3] Rosalez, Julie. 2009. Personal communication. MN Department of Revenue.
[4] Kilgore, M.A., J.M.Schertz, S.A.Synder and S.J.Taff. 2007. *Family forest owner perceptions and attitudes: Minnesota's Sustainable Forest Incentives Act* – Summary of survey results – A report to the Blandin Foundation.
[5] Kilgore, M.A., J.M.Schertz, S.A.Synder and S.J.Taff. 2007. *Family forest owner perceptions and attitudes: Minnesota's Sustainable Forest Incentives Act* – Summary of survey results – A report to the Blandin Foundation.
[6] Kilgore, M.A., J.M.Schertz, S.A.Synder and S.J.Taff. 2007. *Family forest owner perceptions and attitudes: Minnesota's Sustainable Forest Incentives Act* – Summary of survey results – A report to the Blandin Foundation.
[7] Kilgore, M.A., J.M.Schertz, S.A.Synder and S.J.Taff. 2007. *Family forest owner perceptions and attitudes: Minnesota's Sustainable Forest Incentives Act* – Summary of survey results – A report to the Blandin Foundation.
[8] Brown, R.N. and M.A.Kilgore. 2008. *Evaluating the economic impacts of retention and disposal policies for County tax-forfeited land in Northern Minnesota.* Staff paper Series No. 196. Department of Forest Resources, College of Food , Agriculture and Natural Resource Sciences, University of Minnesota: St. Paul, MN.
[9] Lynch, L. and J.Carpenter. 2003. Is there evidence of a critical mass in the Mid-Atlantic agriculture sector between 1949 and 1997? *Agricultural and Resource Economics Review* 32(1): 116-128. and Ladd, H.F. 1998. Land government tax and land use policies in the US. Cheltenham, U.K. Edward Elgar Publishing.
[10] Hibbard, C.M., M.A. Kilgore, and P.V. Ellefson. 2003. Property taxation of private forests in the United States – A national review. *Journal of Forestry* 101(3):44-49.
[11] Kilgore, M.A., S.Synder, S.Taff and J. Schertz. 2008. Family forest stewardship: do owners need a financial incentive? *Journal of Forestry* 106(7): 357-362.
[12] Jacobson, M. and M. McDill. 2003. A historical review of forest property taxes in Pennsylvania: Implications for special forestland tax programs. *Northern Journal of Applied Forestry* 20(2): 53-60.
[13] Malme, J. 1993. Preferential property tax treatment of land. Lincoln Institute of Land Policy Working Paper. 55pp.
[14] D'Amato, A.W., P.F.Catanzaro, D.T.Damery, D.B.Kittredge and K.A.Farrare. 2010. Are family forest owners facing a future in which forest management is not enough? *Journal of Forestry* 108(1): 32-38. And Jacobson, M. and M. McDill. 2003. A historical review of forest property taxes in Pennsylvania: Implications for special forestland tax programs. *Northern Journal of Applied Forestry* 20(2): 53-60.
[15] Ladd, H.F. 1998. Land government tax and land use policies in the US. Cheltenham, U.K. Edward Elgar Publishing.
[16] Jacobson, M. and M. McDill. 2003. A historical review of forest property taxes in Pennsylvania: Implications for special forestland tax programs. *Northern Journal of Applied Forestry* 20(2): 53-60.
[17] Smith, N.R., P.Bailey, H.Haney, D.Salbador and J. Greene. 2008. The impact of federal and state income tax liabilities on timber investments in the Midwest and Northeast. *Northern journal of Applied Forestry* 24(4): 245-251.
[18] Smith, N.R., P.Bailey, H.Haney, D.Salbador and J. Greene. 2008. The impact of federal and state income tax liabilities on timber investments in the Midwest and Northeast. *Northern journal of Applied Forestry* 24(4): 245-251.
[19] Ginn, W.J. 2005. *Investing in Nature: case studies of land conservation in collaboration with business*. Island Press.
[20] Greene, J.L., S.H.Bullard, T.L.Cushing and T.Beauvais. 2006. Effect of the federal estate tax on nonindustrial private land holdings. *Journal of Forestry* 104(1): 15-20.

Using Land Use Planning and Zoning to Maintain Minnesota's Forestland

Current status of land use planning and zoning in Minnesota.

To assess the effectiveness of local planning and zoning activities in addressing forest parcelization, it is critical to know the current status of planning and zoning in Minnesota. Since most forestland is located outside cities (incorporated areas), it is most relevant to focus on the units of local government that regulate unincorporated areas. These areas are governed by the counties and townships; however, counties are the dominant player when it comes to planning and zoning.

A background paper, available upon request, summarizes the current status of comprehensive plans, general zoning ordinances, and subdivision ordinances in Minnesota counties. Of the 85 counties with planning and zoning authority in Minnesota, the background paper includes comprehensive planning information for 76 counties. Of those, 73 (96%) have a comprehensive plan. For the status of general zoning, the background paper includes information for 79 counties. Of those, 68 (86%) exercise general zoning authority. Finally, for the status of subdivision regulations, the background paper includes information from 74 counties. Of the, 64 (86%) have subdivision regulations.

A majority of the county comprehensive plans in Minnesota are fairly recent. The counties adopted 49 of the 73 comprehensive plans since 2000, with 20 completed in the last 5 years. This indicates a fairly good level of recent planning activity by counties across the state. While it is often argued that a "lack of local plans" is a reason for the need to reform Minnesota's planning enabling laws, the information contained in the background paper indicates that the "lack of planning" may not necessarily be an issue. However, the information in the background paper does not assess the quality of these plans.

Minnesota's planning enabling laws include a very minimal definition of a "comprehensive plan." As a result, some of the plans listed in the background paper are very minimal and should in no way be considered "comprehensive." Other plans are a brief series of policy statements included in the county zoning ordinance, and some are a compilation of township plans. More legislative guidance about what constitutes a "comprehensive plan" would help improve plan quality.

A related issue is that the relationship between planning and implementing tools, like zoning, is not as strong as it could be. Minnesota courts recognize plans as a factor in deciding land use cases, but there is confusion about the strength of this relationship. Other states give local governments more clarity about the relationship between planning and zoning.

While both counties and townships can adopt comprehensive plans and adopt official controls such as zoning and subdivision ordinances, if a county has official controls, the township official controls must not be "inconsistent with or less restrictive" than the county's official controls. Minn. Stat. § 394.33. The county's ordinance therefore provides at least a uniform minimum standard for the county. Apparently no accurate data source currently exists as to which townships have adopted comprehensive plans/or official controls. The Minnesota Association of Townships does not have accurate current data. Adding to the difficulty of collecting this information is the fact that towns may exercise partial zoning setting standards for one district, for example, but relying on the county zoning ordinance for everything else. Nevertheless, a study conducted in 1991 by Minnesota Planning found 215 of Minnesota's 1786 organized townships had zoning ordinances. A 2007 survey by the Minnesota Association of County Planning and Zoning Administrators found that of the 64 counties responding to the survey, a total of 238 townships scattered across 31 counties enforced their own zoning ordinance. While the number of

townships exercising their own zoning appears to have increased only a small percentage of townships have adopted comprehensive plans or zoning ordinances.

Status of Planning and Zoning in Counties Where Forest Parcelization is an Issue

To help focus this evaluation of planning and zoning, a brief evidence-based assessment was done to identify where forestland parcelization may be an issue in northern and central Minnesota. The assessment included a review of public documents and personal and telephone interviews with planning and zoning officials in 13 counties (Aitkin, Becker, Beltrami, Carlton, Cass, Clearwater, Cook, Crow Wing, Hubbard, Itasca, Koochiching, Lake and St. Louis). Drivers of forest land parcelization were assumed to include: 1) county population growth at a rate that was greater than or equal to the 2000-2008 state population growth rate; and 2) high county-level demand for second homes. A county's degree of concern about forest parcelization was also assumed to reflect the importance of forest resources as a source of local employment and income.

The status of planning and land use regulation in the 13 counties where forest parcelization has been identified as an issue or a potential issue is summarized in Table 1. The table shows whether a county has a comprehensive plan, when that plan was last updated, and if that plan addresses forest land parcelization by documenting its extent and/or by setting policy. It also identifies whether a county has subdivision regulations and zoning regulations (beyond the shoreland zoning required by state law) and when those regulations were last updated. To indicate whether or not existing regulations might be effective in addressing forest land parcelization, Table 1 also notes whether a county uses very large lot zoning or has provisions permitting conservation subdivisions, the two most likely tools to have been adopted by rural counties.

Table 2 - Status of Planning and Land Use Regulation

	planning			regulation			
county	comp plan (CP)?	CP documents parcellation?	CP sets policy re parcellation?	subdvision regs?	zoning?	very large lots in working landscapes?	allows conservation subdivisions?
Aitken	2000	no	yes, indirectly - but not implemented	since 1969, most recent amendment 2008	since 1970, most recent amendment 2008	proposed in comp plan, but not implemented, minimum lot size is now 2.5	proposed in comp plan, may be possible as a PUD
Becker	2003	no - documents trends, but not document land divisions	only a vague policy on land retention	incorporated into zoning	updated in 2008	discussed, but never adopted	yes
Beltrami	2002	no	no	since at least 2002, last amendment 2005	no	no	plan encourages them, but no implementation
Carlton	since 1967 updated 2001	no	no	since at least 2005	since 1978, updated 2005	20 A in A-1 is largest	both sub regs and zoning, better written than some
Cass	2002?	no	no	since at least 2006, last amendment 2009	since at least 2005, last amendment 2009	no	added in 2008, there are no conservation subdivisions now
Clearwater	2000	no	no	2007	no	no	subdivision regulations "encourage" provision of open space, but include no requirements or
Cook	1997, most recent area plan 2005	present growth scenarios, but no documentation	not directly	2006	1998	no, 20 A in FAR-1 is largest, but see the "no services" zoning provision	in subdivision regulations
Crow Wing	2004	mentions it, no data	forest resources element addresses public lands only	2006	since 2005? most recent amendment 200	barely: 1:20 A for year-round du in Green Space ZD, but 1:2.5 for seasonal; 1:10 in	yes, subject to basic standards; there is a very modest density bonus in the RR 5 and RR 2.5
Hubbard	2005	no	no	since 2006, most recent amendment 2009	no	plan recommends larger lot sizes in rural activity areas, but with no specifics	no
Itasca	2007	STILL NEED INFO	yes	since at least 1997, amendments pending	2009	discussed but not adopted	yes
Koochiching	2001	no	no	since 1981	since 1974		
Lake	2006	no	no	since 1978, most recent amendment 2006	since at least 2006	no	yes, but only 25% open required
Lake of the Woods							
Mille Lacs							
Pine							
St. Louis	compilation of town and area plans, dates vary	no	generic retain land base policy in some township plans, does not specfiically address parcellation	since 1993, most recent amendment	since 1993, most recent amendment 200	NEED MORE INFO	subdivision regs do, via PUD?

What Are These Minnesota Counties Doing to Address Forest Parcelization?

Forest parcelization is not a prime motivating factor for most counties, but many county plans do address the costs of infrastructure provision in remote areas and rural character.

Several counties have introduced the possibility of conservation subdivisions into their plans and regulations. This could help protect large (or at least larger) tracts of forest land and, with proper design, mitigate the potential for conflict with forest management practices on adjacent lands. Unfortunately, exemptions from the subdivision regulations that exist in every county provide an incentive to landowners to avoid platting land divisions or to design and develop conservation subdivisions.

The conservation subdivision provisions in the county ordinances contain only modest (if any) incentives. The counties set a low bar for open space provision, buffering, and other features that would make conservation subdivisions attractive. They typically require that only 50% of the parcel to be conserved as open space and impose minimal design standards. National practice typically requires 70-90% percent open space in a conservation subdivision. More importantly, national practice generally imposes site planning and architectural design standards that ensure a quality experience for those who purchase lots or homes in a conservation subdivision. The anecdotal evidence that conservation subdivisions are unattractive is just as likely to reflect a failure to make them sufficiently attractive as it is to reflect an absence of potential buyers.

A few counties have had serious discussions of increasing minimum lot sizes to reduce the potential for development in forested areas. Some counties and townships have even adopted larger minimum lot sizes in some zoning districts, but these range only up to 20 acres and do not appear to be large enough to consistently conserve production units or protect them from land use conflict.

All of the counties where interviews were done manage significant tracts of public land. Most of these counties are attempting to "block up" the lands they manage to maximize both conservation values and economic returns. This process is a slow one, but to the extent the local land commissioners are successful, their acquisitions and exchanges do reduce the potential for future forest parcelization.

Most, though not all, of the counties where interviews were conducted have the staff resources and organization that would be needed to administer measures to combat forest land parcelization. Professional planners are rare in rural Minnesota, but the paraprofessional staffs in rural forested counties are mostly aware of the issues and could do a credible job of administering additional planning tools if given a mandate to do so.

Why Doesn't Forest Land Parcelization Motivate More Local Action?

Whether forestland parcelization is an issue varies from county to county, but all of people interviewed know that forest land parcelization *could* be an issue in their county. County officials are well aware of local real estate trends, including the disposition of formerly corporate timberlands, but none of them have been motivated to systematically document the past and future consequences of forest land parcelization in their plans, nor have any of them taken potentially effective regulatory actions to suppress forest land parcelization or mitigate its consequences. Even the documentation of the local economic importance of forest resources in local comprehensive plans is spotty.

This is, at least in part, because population and land use change have been relatively slow in rural Minnesota, and it appears that there is a substantial supply of available existing lots in most places. Permitting records show that these counties did experience a real estate "boom" earlier in this decade, but current events (which definitely are reflected in the counties' permitting activities) only reinforce the perception that the long-term trend is one of modest, incremental change. Further, almost all development in these counties has been on lakeshores, not out in the woods. Because lakeshore development is regulated by state-mandated shoreland zoning, it may well seem to local officials that no additional action is needed. Some counties have also focused more on the conservation of farmland. Cass County, for example, has a "right-to-farm" provision in its land use regulations, but does not extend that protection to forestland.

The most commonly reported reason for inaction on forestland parcelization is that the extensive tracts of public lands in these counties provide sufficient open space, eliminating any need to protect private lands other than shorelands. This argument is bolstered by the counties' ability to use the lands they manage to help reduce forest land parcelization.

Vulnerability of Forestland to Parcelization

The interviews and document reviews show that Minnesota counties are highly vulnerable to the rapid parcelization of their forest landscapes, *assuming* there is future demand for extensive development. Given the size of northern Minnesota and the extent of public lands, this vulnerability is limited, but the counties' current planning and zoning programs will not prevent either the continuing incremental parcelization of forest landscapes (which county regulations implicitly encourage) or the loss of resource values that could be caused by a single large project. This is not to say that the counties are "asleep at the switch." Quality varies, but the counties have capabilities and programs on which a planning system that is less vulnerable to parcelization could be built.

Alternative Approaches for Addressing Parcelization through Land Use Planning and Zoning

What is the State Role in Land Use Planning and Zoning?

Beginning around the turn of the last century, all states adopted enabling acts that authorized land use planning and implementation by local governments. Over time many states have assumed a greater role in land use planning, particularly planning for natural resource protection and infrastructure. The American Planning Association has identified six main approaches to land use planning at the state level. None of these approaches exist in a "pure" form, but they provide a basis for understanding and discussing the options Minnesota might consider:

1. State planning. The state prepares a statewide land-use plan and implements that plan with zoning. Hawaii comes closest to this approach because the state directly zones some land. Hawaii is unique, however, because the state is comprised of only five counties and has no other form of local government.

2. State permitting. The state requires permits for certain types of development, with a state agency reviewing original applications and approving or denying permits. Many states, including Minnesota, require permits for very specific types of development, but Vermont has used this approach for most development since the enactment of Act 250 in 1970.

3. State-mandated planning. The state sets mandatory standards for those aspects of land use that involve state interests. Local governments are required to prepare plans consistent with those

standards and the local plans are reviewed by a state agency to ensure compliance. The agency may impose sanctions for failure to comply. Local regulations must be consistent with the approved local plans. Florida, Oregon, and Washington are identified this approach, though there are significant differences in their programs.

4. State-promoted planning. The state sets guidelines for local governments to meet in their planning and offers incentives for compliance. A state agency reviews local plans for compliance. Maine and Georgia are identified with this approach. Maine's program requires local governments to address forest resources in some detail. Georgia makes funding from several major state programs--community and economic development, natural resources, and water and sewer facilities--contingent upon compliance with comprehensive planning requirements.

5. State review (the "mini-NEPA" system). The state requires environmental impact reports for the adoption of local general plans (which would be called comprehensive plans in Minnesota) and for local decisions on many types of development. This imposes a second tier or level of review on local plans and decisions. California has been identified with this approach since the California Environmental Quality Act (CEQA) was adopted in 1970.

6. State enabling. The state authorizes local governments to plan and regulate land use, but there is no review or approval of local plans by the state. States that do not fall into one of the categories explained above are usually included here. The "state enabling" approach includes considerable variation in what states allow local governments to do. Idaho, for example, provides statutory guidance for what local governments need to include in a comprehensive plan, requires that local governments adopt a comprehensive plan, enables local governments to use a variety of implementation tools, and requires that local land use decisions be generally (the Idaho courts have not insisted on precision) consistent with the local comprehensive plan. Until 1999 Wisconsin, did not include any guidance for what to include in a comprehensive plan, did not encourage comprehensive planning, and did not require that zoning and other implementation tools be consistent with a local comprehensive plan prior to 1999. It now does all those things, but still does not authorize local governments to use a variety of contemporary planning tools. Several other states, including Kansas, Michigan, and North Carolina, have also made improvements to confusing and antiquated enabling legislation.

Minnesota's Hybrid Approach.

One would probably categorize Minnesota's approach to local planning as 'state enabling,' but Minnesota, like most other states, uses other approaches as well. The Metropolitan Land Planning Act, adopted in 1976, is an example of 'state-mandated planning.' It requires comprehensive planning by local governments in the seven-county Minneapolis-St. Paul area, defines what must be in a local comprehensive plan, and requires local plans to be consistent with regional policies developed by the Metropolitan Council. The Council reviews local comprehensive plans and ordinances for consistency with regional policy and has the authority to modify local plans if they conflict. The use of official controls (e.g., zoning, subdivision, official mapping) and fiscal devices (e.g., tax increment financing) by local governments must not conflict with local comprehensive plans or regional policy. Under the Metropolitan Significance Law, the Council also has the authority to review and temporarily suspend developments of regional significance.

An example of 'state-promoted planning' in Minnesota is the Metropolitan Agricultural Preserves Program, which is also limited to the seven-county metropolitan area. This program establishes incentives for local governments and farmers to plan for and protect agricultural lands. The Metropolitan Council administers this program, reviewing plans for compliance with a one-unit per forty acres density standard.

In addition to laws limited to the metropolitan area, Minnesota has a number of statewide programs that could be classified as 'state planning,' 'state permitting,' 'state mandated,' or 'state promoted.' Most of these relate to water resources and, due to the prevalence of lakes, rivers, and wetlands have a very significant reach in terms of the amount of land covered. A partial list of these laws follows.

- The Public Waters Work Permit Program requires a permit from the Department of Natural Resources (DNR) for filling, excavation, and other construction below the ordinary high water mark.

- The Wetlands Conservation Act relies on a partnership between the Board of Water and Soil Resources, local conversation districts, and local governments to protect wetlands. The Shoreland Management Act requires local governments to adopt and enforce zoning regulations promulgated by the DNR to protect shorelands.

- The Floodplain Management Act requires counties and cities to adopt and enforce floodplain management ordinances that comply with federal and state standards. The DNR reviews applications for conditional uses and variances before local governments act on them.

- The Minnesota State Wild and Scenic Rivers and Critical Areas acts require local governments to adopt and enforce state-devised management plans for designated reaches of the Mississippi, St. Croix, and other rivers.

- Finally, the Comprehensive Local Water Management Act gives funding priority to local governments that have prepared a comprehensive water management plan.

In addition to these water resource related programs, Minnesota has laws that address general environmental issues, including the Minnesota Environmental Policy Act. While not as strong as CEQA, this act does apply to state agency actions as well as a limited set of local planning issues, giving Minnesota a limited "mini-NEPA" approach. There is also the Minnesota Environmental Rights Act, a unique law that gives citizens standing to challenge actions that harm the environment. As these laws reflect, planning in Minnesota, (as in most states) is a hybrid of approaches. A critical function of planning is to try to coordinate all these various laws and policies.

Key Findings from Other States that May Apply to Minnesota.

Several states require local governments to address forestry issues in their plans and, in some cases, regulations. This section provides a summary of their effectiveness in addressing forest land parcelization, and potential lessons for Minnesota.

Vermont. Vermont's system of direct state land use regulation – popularly known as Act 250 - was a

response to the impacts of the exurban development, including extensive land parcelization, that followed the extension of the Interstate Highway System into Vermont in the mid-1960s. The Act was drafted by a distinguished citizen's commission and adopted in 1970.

A review of Vermont's Act 250 indicates that state land use regulation can protect important resources, including forest lands, from the adverse impacts of major developments. This is especially important in places like Vermont and rural Minnesota, where local governments have limited resources and may have limited political will for effective land use planning and regulation.

The effectiveness of state land use regulation, however, can be seriously compromised by exemptions that permit extensive incremental development, and has been so compromised in Vermont. Vermont's experience also demonstrates the importance of "details" like definitions. An overbroad definition of agricultural soils has actually encouraged exurban sprawl in Vermont's growing communities.

Vermont's experience also makes it clear that state land use regulations will be more effective if they have the support of a well-funded purchase of development rights program that offers landowners an alternative to development. Minnesota's Outdoor Heritage Fund may help fill this need.

In addition, Vermont illustrates the importance of having clear, complete enabling authority for local planning and regulation. Vermont municipalities can confidently adopt any reasonable regulatory strategy, so long as that strategy is consistent with the local comprehensive plan. The state has also provided financial and technical support for community planning.

Finally, Vermont demonstrates that a high level of state involvement in land use issues is not inconsistent with good local planning. Vermont's progressive communities can and do require developers to exceed the requirements of Act 250.

Wisconsin. In 1999, Republican Governor Tommy Thompson signed significant changes to Wisconsin's local government planning enabling statutes into law. These changes, probably most accurately referred to as the "Comprehensive Planning Law," ushered in a new era of planning. The heart of the law is those parts that deal with comprehensive planning. These are the parts of the law that were built by the consensus process involving many stakeholders. The 1999 law made the following changes to Wisconsin's planning enabling laws: provided the state with its first definition of a comprehensive plan (the nine elements defined in statutes: Issues and Opportunities; Housing; Transportation; Utilities and Community Facilities; Agricultural, Natural, and Cultural Resources [including forest resources]; Economic Development; Intergovernmental Cooperation; Land Use; and Implementation). This is a definition that applies to all types of local government in Wisconsin (cities, villages, towns, counties, and regional planning commissions) so there is a common terminology to aid communication and cooperation among local governments. The definition also tries to get communities thinking about the complex relationships of things like jobs, housing, and transportation and moving beyond an overly simplistic focus on land use. The 1999 changes also require citizen participation throughout the planning process and adoption of plans by the governing body, things that were not required under prior Wisconsin law.

The 1999 law established a grant program making approximately $2 million dollars available every year for local comprehensive planning. Finally, the law required that if a local government is going to have zoning, subdivision, or official mapping ordinances, those ordinances must be made consistent with the local government's comprehensive plan. The requirement for consistency took effect on January 1, 2010. This gave local governments 10 years to prepare comprehensive plans to be able to comply with the consistency requirement.

An early assessment of the results of this legislation indicates that as of April 2008, 73% of Wisconsin local governments had adopted or were in the process of preparing a comprehensive plan, a considerable milestone given that ten years earlier a study had found that only about 29% of Wisconsin's local governments had a document that could be called a land use plan and far fewer had anything that could be called a comprehensive plan. Most people who are familiar with pre and post 1999 planning efforts in Wisconsin firmly agree that the quality of local planning has significantly improved. Due to the requirement for citizen participation throughout the comprehensive planning process, more people have been involved with local planning processes than in the past. The requirement that the governing body adopt the comprehensive plan has also brought comprehensive planning into the mainstream of the political process. The 1999 changes have also helped create a culture of planning. Communities that adopted their comprehensive plans five or six years ago are recognizing the need to refine their plans to address contemporary issues and are adding elements to address sustainability, for example, or are creating more sophisticated economic development elements of their comprehensive plans to address the impact of the current economic challenges.

As a result of the consistency requirement, hundreds of Wisconsin communities have updated their zoning and other local ordinances and programs. Many communities had ordinances that were written in the 1960s. As communities update their ordinances, many are incorporating contemporary planning concepts like new urbanism and conservation subdivisions. A few communities have created purchase of development rights or transfer of development rights programs.

While there are many examples of improvements in local planning in Wisconsin, not every community in the state has been receptive to the notion of planning for the future. Some communities have refused to adopt a comprehensive plan even though they have a zoning ordinance. There is considerable opposition to planning in these communities that have not adopted plans. Many of the non-planning communities are located in the forested parts of the state.

It is too early to fully assess the law's impact on the development patterns in Wisconsin. Planning is an incremental process and change happens over the long term. While some changes may be discernible over the course of the next few years as communities begin to implement their plans after January 1, 2010, many of the impacts will not be fully appreciated until probably ten or more years into the future.

Oregon. Oregon's land use program, which was adopted in 1973, revolves around 19 statewide goals. Several are relevant to forest concerns. For example, Goal 7, Areas Subject to Natural Hazards, requires local governments to address wildfire hazards. Goal 4, which addresses Forest Lands, begins:

> *To conserve forest lands by maintaining the forest land base and to protect the state's forest economy by making possible economically efficient forest practices that assure the continuous growing and harvesting of forest tree species as the leading use on forest land consistent with sound management of soil, air, water, and fish and wildlife resources and to provide for recreational opportunities and agriculture.*

The specific Goal 4 requirements local governments must meet are adopted as administrative rules. These voluminous rules require counties to inventory forest lands and place forest lands that are not within urban growth boundaries in a zoning district that strictly limits subdivision (generally new parcels must be at least 80 acres in size and 160 acres is required to obtain a permit for a forest dwelling) and restricts the uses permitted to those that are arguably compatible with timber production and harvest. In terms of forest and farm lands, Oregon dictates even the details of local plans and zoning. Oregon's land use program has succeeded in protecting farm and forest lands from conversion to other uses.

According to the *Final Report to the 2009 Oregon Legislature,* prepared by the Oregon Task Force on Land Use Planning, one percent of wildland forests were converted to other uses from 1975 to 2001. To improve the Oregon land use program as it relates to forest resources, the report recommends allowing for more flexibility in the classification of forest land, authorizing the transfer and/or purchase of development rights for farm and forest lands, and the development of a statewide land trust with incentives for landowner participation in land preservation efforts.

The program's effectiveness is also measured by the numerous challenges–both in the legislature and at the ballot box–it has prompted from rural landowners and developers. One of these, Measure 37, finally passed in 2004. Measure 37 did not repeal the land use program. It simply allowed landowners to file claims for reductions in property values due to land use regulations forcing cities and counties to waive regulations when they could not pay the claims. Oregon voters quickly decided that Measure 37 had unacceptable impacts and adopted Measure 49 in 2007. Measure 49 provided for the settlement of Measure 37 claims and limited new claims. In the end, the essence of Oregon's land use program was preserved while landowners may have gained some flexibility.

Washington. Washington's requirements for local planning include the following goal for forest lands:

> *(8) Natural resource industries. Maintain and enhance natural resource-based industries, including productive timber, agricultural, and fisheries industries. Encourage the conservation of productive forest lands and productive agricultural lands, and discourage incompatible uses (RCW 36.70A.020).*

The Growth Management Act (GMA), adopted in 1990, and administrative code provide more guidance for local planning for forest lands, including an overarching requirement to conserve resource lands and critical areas:

> *(a) The county legislative authority shall adopt a county-wide planning policy under RCW 36.70A.210; (b) the county and each city located within the county shall designate critical areas, agricultural lands, forest lands, and mineral resource lands, and adopt development regulations conserving these designated agricultural lands, forest lands, and mineral resource lands and protecting these designated critical areas … (RCW 36.70A.040(3)).*

The GMA also provides guidance including how to classify such lands and requires counties and cities to adopt regulations which:

> *… assure that the use of lands adjacent to agricultural, forest, or mineral resource lands shall not interfere with the continued use, in the accustomed manner and in accordance with best management practices, of these designated lands for the production of food, agricultural products, or timber, or for the extraction of minerals (from RCW 36.70A.060(1)(a)).*

RCW 36.70A.060(1)(b) requires that all plats and permits approved within 500 feet of designated resource lands bear a notice that the subject property may be affected by agricultural, forest management, or mining activities. Forest lands are defined as follows:

> *(8) "Forest land" means land primarily devoted to growing trees for long-term commercial timber production on land that can be economically and practically managed for such production, including Christmas trees subject to the excise tax imposed under *RCW 84.33.100 through 84.33.140, and that has long-term commercial significance. In determining whether forest land is primarily devoted to growing trees for long-term commercial timber production on*

land that can be economically and practically managed for such production, the following factors shall be considered: (a) The proximity of the land to urban, suburban, and rural settlements; (b) surrounding parcel size and the compatibility and intensity of adjacent and nearby land uses; (c) long-term local economic conditions that affect the ability to manage for timber production; and (d) the availability of public facilities and services conducive to conversion of forest land to other uses. (from RCW 36.70.A.030).

A 2007 report to the Washington Legislature entitled *The Future of Washington's Forests and Forestry Industries* indicates that the conversion of forest lands to other uses is still a concern, as does a 2008 report to the legislature entitled *Meeting the Growth Management Challenge in Growing Communities: The Washington State Growth Management Act Effectiveness Report*. The latter report identifies the shortage of local tools for addressing the issue and discusses several current legislative efforts to provide local governments with additional tools to address forest parcelization.

While Washington imposes less stringent guidance on its local governments than Oregon, Washington voters faced a ballot measure similar to Oregon's Measure 37 in 2006. It was defeated, suggesting that the local plans and regulations resulting from the Growth Management Act are not perceived as unfair by a majority of voters.

Maine. Maine does not require local governments to prepare plans or regulate land use, but it does make many types of state funding contingent on the adoption of a comprehensive plan. The legislature lists one purpose of planning in Maine as being to "safeguard" agricultural and forest resources. The statutes go on to require that comprehensive plans include an inventory of forest resources and:

F. Ensure the protection of agricultural and forest resources. Each municipality or multimunicipal region shall discourage new development that is incompatible with uses related to the agricultural and forest industries; (§ 4326.3-A)

The Maine State Planning Office (SPO) web page includes a checklist of comprehensive plan review criteria, including agricultural and forest resources criteria. In addition to that checklist, the SPO publishes *Comprehensive Planning: A Manual for Maine Communities*, which includes a helpful chapter on agricultural and forest resources.

California. California also requires local governments to address forest resources. In addition, California and several other states require or encourage local governments to address wildfire hazards. California's *General Plan Guidelines* ask cities and counties to consider wildfire in at least three plan elements, including Housing, Open Space, and Safety. Wildfire hazards also must be addressed, where relevant, in the environmental impact report that is required for adoption of a local general plan. In addition to California, Colorado, Montana, and Oregon all provide models of how wildfire protection planning can be integrated into local planning and regulations that are worth considering in Minnesota (refer to Appendix # for more information).

Minnesota's past efforts to improve local land use planning and zoning.

A brief summary of some of the land use law modernization efforts undertaken in Minnesota over the past ninety-five years is provided in additional background documents. County and township zoning were both authorized by the legislature in 1939. In 1959, county planning and zoning authority was expanded considerably with the passage of the County Planning Act, which provides the current framework for county planning and zoning. The Municipal Planning Act, the basic planning and zoning enabling law followed by cities today, was passed by the legislature in 1965. Since the 1970s, several

studies have cited the need to update Minnesota's local planning enabling laws because of the inadequacy of local planning and implementation efforts. While legislators have introduced a number of significant land use enabling law reform bills, the bills have not passed. Although a few targeted bills have passed, making some minor improvements, significant reform remains elusive.

During the 1980s and 1990s, several state initiatives focused on land use reform. In 1991, then Governor Arne Carlson began the *Minnesota Milestones* project to involve the public in setting goals for Minnesota's future. Through the work of Minnesota Planning, the project established long-term goals for the state and developed indicators for measuring the state's progress toward achieving those goals.

In 1993, the Minnesota Environmental Quality Board and Minnesota Planning completed a growth management study entitled *A Question of Balance: Managing Growth and the Environment.* The study concluded that Minnesota's state and local framework for planning and managing land use change was fragmented and uncoordinated. In 1993, Governor Carlson also launched the Minnesota Sustainable Development Initiative. Coordinated by the Minnesota Environmental Quality Board and Minnesota Planning, this Initiative continued to focus on planning law reform. In 1994, the Initiative published *Communities by Design: A Process for Building a Sustainable Future.* That report identified five key issue areas that limit Minnesota's ability to achieve sustainable communities:

●Lack of statewide policies and goals;

●Lack of local plans;

●Inadequate plans;

●Interjurisdictional conflicts; and

●Inconsistent implementation and enforcement

In 1994, a bill relating to sustainable development and statewide comprehensive land use planning was introduced in the Legislature (H.F. 2126). The bill called for the creation of a planning program similar to the program in the State of Oregon--state goals developed and coordinated by a state agency, mandated local comprehensive planning, state review of local comprehensive plans, and creation of a new chapter in the Minnesota statutes related to sustainable development. The bill, which was not a product of the Minnesota Sustainable Development Initiative, did not pass.

The Minnesota Sustainable Development Initiative continued to produce reports into the late 1990s related to planning and needed reforms. The initiative clearly increased awareness about sustainability in Minnesota, but no significant land use planning legislative changes resulted from the work of the Initiative.

In 1997, the legislature expressly enabled the use of transfer of development rights and purchase of development rights by cities, townships, and counties. That year the legislature also passed the Community Based Planning Act, which attempted to create a statewide framework for planning; provided a planning grant program and state technical assistance for local governments to plan cooperatively under the law; established 11 community-based planning goals; and provided for state review of local plans for consistency with the goals. The Act did not replace the existing local planning enabling laws. The law, however, did not have widespread support and sections of the law (including the 11 goals, the funding, and the process for state review of community-based plans) were repealed in 2001.

In 1999, the legislature passed a law directing Minnesota Planning to prepare options for a state development strategy that would guide growth for the next 20 years. In 2000, Minnesota Planning published *Minnesota by Design: Options for a State Development Strategy.* The report evaluated state planning laws in other states and included a series of recommendations for land use reform in Minnesota ranging from technical assistance provide by the state to requiring local comprehensive planning consistent with state goals and planning.

From 1999-2002, then Governor Jesse Ventura pursued a number of "Smart Growth" initiatives including a number of planning related issues, although the reform of the state's planning and zoning enabling laws was not central to those efforts.

While significant local planning and zoning land use law modernization efforts have not come to fruition in Minnesota, various minor amendments have been made to the planning and zoning enabling laws over the past decade. For example, in 2008, the Minnesota Legislature passed the *President Theodore Roosevelt Memorial Bill to Preserve Agricultural, Forest, Wildlife, and Open space Land.* 2008 Minn. Laws ch. 297, art. 1, §§ 56 – 61. This law requires that certain cities, townships, and counties consider adopting comprehensive plans and ordinances that include "goals and objectives for the preservation of agricultural, forest, wildlife, and open space land, and minimizing development in sensitive shoreland areas." Minn Stat. § 394.231 (emphasis added).

Minnesota's ongoing efforts to improve local land use planning and zoning. Various interest groups continue to push for legislation to modernize local land use planning and zoning. For example, a coalition of environmental groups are advocating for land use reform related to global climate change. The land use planning reform components of a bill supported by these groups did not advance. It is anticipated that this coalition will continue to work on these land use reform efforts.

Another bill, H.F. 1035/S.F. 913, introduced in 2009, makes the express legislative finding "that land use reform is a key strategy in the effort to reduce the state's emission of greenhouse gases." The bill proposes limiting development densities in the unincorporated areas of the state to one residential unit per 40 acres and promotes the use of cluster development to avoid fragmentation of farmland, woodlands, and "other significant stands of vegetation." The bill is part of the legislative agenda of the Coalition of Greater Minnesota Cities whose primary concern relates to annexation. The Minnesota Association of Townships is opposed to the bill.

There is also current interest in more general planning enabling law reform among a number of other groups but no specific bill has been introduced. Needless to say, land use issues remain a significant public policy issue for the Minnesota Legislature. It is critical that forest policy interests are represented in these ongoing legislative developments.

Posting Date: 12 May 2010

Land Acquisition, Land Exchange and Conservation Easements

A well-designed and funded land acquisition program can play an efficient and effective role in maintaining the forestland base and mitigating the adverse impacts of parcelization in Minnesota. Acquisition and public land ownership as a land protection tool has a long history of use in the United States and is perhaps the "most widely implemented ecologically-based land-use policy"[1]. Use of acquisition as a land protection tool, through either full or part interest, has increased in recent decades in the United States with increasing recognition of the need to conserve remaining natural lands. In 2003 alone, 2.7 billion dollars were invested in land protection within the United States[2].

Historically used in some parts of the country since the late 1800s and by the federal government since the 1930s, conservation easement activity increased dramatically as states around the country enacted specific conservation easement enabling acts. In the past decade, the use of conservation easements has dramatically increased around the country as conservation agencies and non-profit conservation organizations have recognized that easements can be an effective strategy to meet their missions.

1. Acquisition Tools

These tools include the acquisition of full or partial interest in land, acquired through options including donation, purchase, exchange, tax foreclosure, or condemnation[3]. Conservation easements involve the acquisition of partial interest in land.

Fee simple acquisition is the acquisition of the full interest in land and provides the most complete means of affecting land use, development, management and access on a parcel. Fee simple acquisition can occur via:

> *Donation:* Land can be acquired as a result of a donation by a private landowner. Motivations for such donations include a love of the land and interest in long-term conservation, interest in leaving a legacy, and potential tax benefits, among others.
>
> *Purchase:* Land may be acquired through several purchase options including direct purchase and bargain sales.
>
> *Land Exchange:* Land may be acquired by exchanging (trading) one or more land parcels for another parcel or parcels. Land exchange is attractive for public agencies and units concerned about the amount of land under public ownership or with limited funding sources.

Conservation easements, like other types of easements, involve the acquisition of a partial interest in land. Easements can be acquired in the same manner as any other interest in land (donation, purchase, or exchange). Conservation easements are a very flexible tool with the terms negotiated between the fee owner and the entity acquiring the easement. In general, conservation easements restrict land use and development to preserve or protect specific conservation features of the covered parcel of land. The land itself remains in the existing ownership, with the current landowner and future landowners bound by the terms included in the specific easement document; in most instances in perpetuity. The easement itself is conveyed to and held by an independent party, either a non-profit conservation

organization or a governmental entity, which has the right and obligation to monitor the property and enforce the terms of the easement.

Statutory Authority

Under Minnesota Law, statutory authority is required for all state and local land acquisition. Specific statutes govern state and county acquisition of natural resource lands. Various acts of Congress provide authority for acquisition and disposal of National Forest Land[4]. Land exchange is also governed by Minnesota Statutes, with sections that describe the classes of land, the conditions for land exchange, and other actions needed to facilitate an exchange.

The Minnesota Legislature has adopted the Uniform Conservation Easement Act to enable the use of conservation easements in Minnesota. The Act requires that all conservation easements must have a conservation purpose providing benefits to the public and limits entities that can hold a conservation easement to governmental bodies empowered to hold an interest in real property and private non-profit charitable organizations with a conservation purpose. Private individuals cannot hold conservation easements. An earlier, more limited, statute also exists.

2. Current Use

There have been a number of recent, collaborative efforts to identify and prioritize land protection goals for the state of Minnesota, including the Campaign for Conservation Fifty-Year Vision[5], The Minnesota Forests For the Future advisory report[6], the Statewide Conservation and Preservation Plan[7], and the Lessard-Sams Outdoor Heritage Council strategic planning process[8]. Estimated protection needs for Minnesota's northern forests, identified by these plans, range from approximately 500,000 acres to over 1,500,000 acres. Within these plans, the type of ownership, means of protection or type of acquisition is not always identified.

DNR is responsible for the administration of roughly 5.6 million acres of state land, of which nearly 4.5 million are administered by the Division of Forestry. Most of these lands have been in state ownership for several-to-many decades. DNR divisions continue to acquire lands to protect habitat, biodiversity, scientific and natural heritage values, and cultural heritage sites; to provide scenic and recreational opportunities; and to protect working forestlands though the Minnesota Forests for the Future program for economic, social, cultural and environmental values. Forestland acquisition is informed by Land Asset Management Planning, conducted for all Forestry areas. Primary motivations for forestland acquisition are to ensure access for management on current public lands and to consolidate public ownership for efficient management and land use conflict avoidance[9].

Counties have varying approaches to land adjustment and policies regarding increases in public land. Most forested counties already have high percentages of land under public ownership, including administrative responsibilities for roughly 2.8 million acres of state-owned, tax forfeited land. Land acquisition is primarily used to consolidate ownership, minimize private inholdings and improve access and management efficiency. Acquisition resulting in protection of forestland against development is often secondary, or coincidental, to acquisition for management. Some counties also acquire forestland for natural and cultural heritage purposes and recreation opportunities.

The DNR's 2009-2013 Strategic Conservation Agenda identifies landscape changes from growth and development as one of the four key trends affecting natural resource management in Minnesota. Fee-title acquisition is identified as a "fundamental tool for protecting priority lands and waters as wildlife management areas, state parks, state forests, scientific and natural areas and other DNR-administered units". Conservation easements are recognized as an additional approach to integrated public and private land management. The Minnesota Forests for the Future (MFF) program and the Minnesota Forest Legacy (FLP) program administered by the Division of Forestry are programs specifically focused on forestland protection via fee title acquisition and the purchase of conservation easements.

Minnesota Forests for the Future Program

The Minnesota Forests for the Future program was established by the 2008 Legislature to identify and protect private forestlands throughout the state. Specific acquisition goals of MFF Program are to 1) *Retain and conserve forests with high public benefits*, and 2) *Promote strategic conservation of private forests*.

To meet these goals MFF prioritizes properties that provide public recreational access, commercial forest products, and those that provide exceptional, environmental benefits as well as properties that are large, intact blocks of forest, help consolidate and link other protected lands, are linked to other conservation efforts, and provide management access to public lands[10]. A policy "toolbox approach", including various acquisition tools, was recommended by the MFF Commissioner's Advisory Team; however, working forest conservation easements have been the only tool identified through specific target acreage recommendations and performance measures. The Advisory Team is in the process of revising acquisition targets and project scoring criteria. Completion of an MFF implementation report, with revised targets and criteria is anticipated in May 2010.

Minnesota Forest Legacy Program

The Minnesota Forest Legacy Program (MFLP) is a state program with federal funding, developed to implement the federal Forest Legacy Program. The federal program only allows easements to be held by government entities. As a result, MFLP has focused strictly on conservation easements. However, the program also identifies important forestlands that face potential conversion and is well integrated into MFF.

According to Lands and Minerals Division records, the DNR acquired over 80,000 acres of natural resource land in fee title, at a cost of more than $127 million, from FY 1998 to FY 2008 (Fig. 1 and 2). Over the same time period, the Department spent just over $28 million for the acquisition of easements on nearly 72,000 acres[11]. Minnesotans have also donated over 78,000 acres, since record keeping began, to the Department of Natural Resources[12].

On average the percent of those fee title acres that were acquired by the Division of Forestry was small. In fact, DNR forestland ownership has changed little over the past two decades[13]. Recent Forestry fee-title acquisitions have focused on inholdings within state forests and other state ownerships, parcels that provide access to state land, and protection of critical habitat and corridor linkages.

Fig. 1

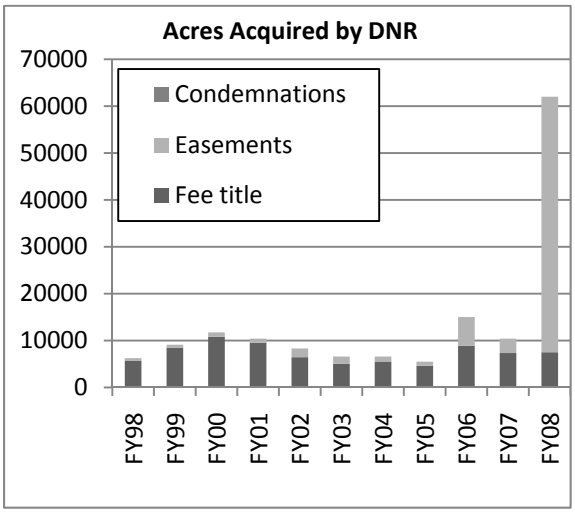
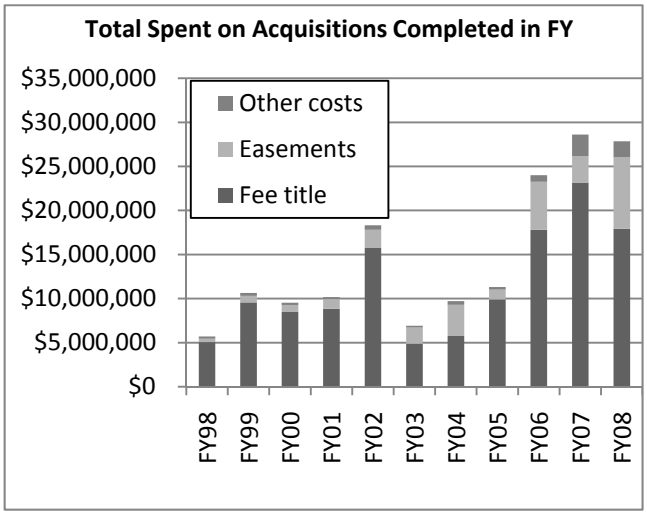


Fig. 2



The MFF and FLP acquired the bulk of the easement acreages obtained by the state. Although the number of easements held through either the earlier FLP or the more current MFF is relatively small (26) the acreage protected (65,864 acres) is quite substantial—with another 8 easements pending that will protect an additional 279,900 acres. These easements have been purchased, primarily at fair market value using comprehensive "before and after" appraisals.

From 1999-2008, the MFF and FLP programs acquired interests in 65,864 acres of land at a cost of nearly $21 million (128 acres were donated; the remaining were all acquired by conservation easements with the state paying 44% of the costs)[12]. The Upper Mississippi conservation easement will add another 187,277 acres at a cost of $45 million, $36 million of which was provided in state funding from the Outdoor Heritage Fund. On average, forestland easements have required only 30-60% of fee acquisition costs. By focusing more recently on the largest tracts of land available, DNR has been able to keep upfront transaction costs to a minimum.

<u>Conservation Easements</u>

Although the use of conservation easements has dramatically increased around the country in the past decade, data on the extent to which conservation easements are used, and by whom, are limited. In an effort to partially address this, some states have required that their natural resource agency be notified when land trusts acquire conservation easements.

The 2005 National Land Trust Census, the only national data compilation on conservation activity, notes that the effectiveness and popularity of private conservation is demonstrated by the vast gains in acreage protected and by the establishment of new land trusts in many communities across the country. This is evidenced by a tripling of the pace of private land conservation, a 148% increase in the use of conservation easements, and a doubling of total acres conserved. Private state and local land trusts have helped protect more than *37 million acres* of land and now hold conservation easements on more than *6,245,900 acres of land*, a dramatic increase from 2000. The Nature Conservancy alone holds easements on another *3.2 million* acres of land.

While conservation easements activity is increasing across the country, much of that conservation activity has taken place in parts of the country that have the longest history of working with conservation easements and private land trusts. In the forested northeast where conservation easements have a substantial history, land trusts held conservation easements on 1,492,000 acres in Maine (with a single easement accounting for half of that acreage), 399,681 acres in Vermont, 191,095 acres in New York and 133,836 acres in New Hampshire, as of 2005. In the west, easement activity focused on huge swaths of unprotected forests and grazing lands. The existence of public funding or other conservation incentives, such as transferable tax credits in Colorado and Virginia, fueled much this conservation easement activity.

TOP 10 STATES WITH THE MOST LAND UNDER CONSERVATION EASEMENTS

HELD BY

STATE AND LOCAL LAND TRUSTS

STATE	ACRES UNDER EASEMENT
Maine	1,492,279
Colorado	849,825
California	427,411
Vermont	399,681
Virginia	365,355
Maryland	191,330
New York	191,095
New Mexico	142,072
Pennsylvania	139,301
New Hampshire	133,836

There is no statewide registry or list of conservation easements or easement holders in Minnesota. In 2006 the Minnesota Land Trust commissioned a study of conservation easement activity in Minnesota; data were updated in 2009. Entities contacted for the study included: *all federal agencies* owning or potentially owning land in Minnesota, *all state agencies* known to hold easements or potentially holding easements, *selected local units of government*[14], and all those *private, nonprofit conservation organizations* known to hold easements or thought to be interested in easements.

Most easements in Minnesota have been acquired through voluntary transactions with the landowner by purchase, gift or bargain sale. A few conservation easements were acquired by the federal government years ago through condemnation along the St. Croix River. Many of the easements held by local units of government have been obtained as part of local transfer of development rights programs or negotiated as part of the local development review and approval process. Most easements currently held by state or federal agencies have been purchased, often but not always at full fair market value. Easements held by non-profit organizations are more likely to be donations or deeply discounted bargain sales.

The DNR, a major conservation easement holder in Minnesota, is currently in the process of comprehensively reviewing and analyzing its easement holdings under a study funded by the Legislative-Citizens Commission on Minnesota Resources (LCCMR). DNR data will be more complete and accurate when that study is completed but is relatively accurate at this stage.

The study identified more than *12,000 easements* protecting approximately *524,200 acres* of land and almost *700 miles of shoreline*—positioning Minnesota as a major state in terms of numbers of conservation easements (Table 1). The level of activity is even greater than indicated when *pending* conservation easement activity that will close in coming months is added. This includes approved and pending very large working forest easements that will protecting approximately *279,900 acres* and the most recent rounds of pending WRP/RIM Reserve easements that will protect an additional *105,000 acres.*

Table 1. SUMMARY OF CONSERVATION EASEMENT ACTIVITY IN MINNESOTA

October 2009

	# OF EASEMENTS			ACRES UNDER EASEMENT		
	Permanent	**Term**	**Total**	**Permanent**	**Term**	**Total**
FEDERAL AGENCIES	4,534	162	**4,696**	164,224	14,062	**178,286**
STATE AGENCIES	6,277	494	**6,771**	289,250	10,028	**299,278**
LOCAL UNITS OF GOVERNMENT	418	0	**418**	6,929	0	**6,929**
CONSERVATION ORGANIZATIONS	423	0	**423**	39,718	0	**39,718**
TOTAL	11,652	656	**12,308**	500,121	24,090	**524,211**

Over 96% of easements are held by government agencies, with approximately one-half of those at the federal level and one-half at the state level. Much more *acreage* is protected by state held easement, an amount that will increase dramatically as currently pending easements close. Almost all easements held by nonprofit organizations are held by a single entity, the Minnesota Land Trust (91%). Ninety five percent or more of all conservation easements are perpetual, with most current easement programs preferring perpetual or permanent easements.

Compliance monitoring of conservation easements is handled inconsistently. Some holders monitor annually, some periodically and some not at all -- a particular problem among public agencies. There is, however, growing recognition of the need to create and implement an easement monitoring program as a hedge against more costly violations and enforcement actions. Few easement holders (and *no* public agencies) have funding dedicated to long-term stewardship and monitoring of easements. Public agencies typically rely on annual appropriations or other general operating dollars.

The DNR monitors MFF and FLP easements annually. In recognition of the importance of monitoring, DNR has included $750,000 for conservation easement stewardship as part of its budget for its pending purchase of an interest in 189,000 acres of land in from UPM/Blandin Paper Company, approved for

funding from the Outdoor Heritage Fund, and is exploring mechanisms for protecting this funding to the extent possible.

BWSR has a long history of extensively working with conservation easements, particularly in the agricultural areas of Minnesota. Operating primarily under the authority of the Reinvest in Minnesota-Reserve Program (RIM Reserve) established by the Legislature, BWSR has used conservation easements to keep marginal agricultural lands out of crop production to protect soil and water quality and support fish and wildlife habitat. To date, easements have been focused on the Minnesota River Valley and other lands predominantly in the prairie/forest agricultural areas of the State. Easements are very restrictive—limiting development and agricultural activity—and are implemented using a standardized document. As a result, the BWSR easements exclude land suitable for even limited development or agricultural activities, averaging about 40 acres in size. Public access is not allowed.

The least amount of information is known about conservation easements held by local units of government. Collectively, contacted local units of government in Minnesota held only 418 easements protecting less than 7,000 acres of land—approximately 1% of easement-protected land in the State. These numbers, however, are marginally accurate. Only a very small segment of local units of government were contacted. In general, easements held by local units of government protect smaller acreages and are less likely to be periodically monitored.

In contrast to some states, only a handful of private, non-profit conservation organizations hold easements in Minnesota, and the vast majority of those are held by the Minnesota Land Trust. Other easement holders include mainly national organizations with Minnesota programs including The Nature Conservancy and Ducks Unlimited. Private nonprofit conservation organizations hold fewer than 500 conservation easements protecting approximately 40,000 acres of land.

Exchange

The DNR has a land exchange program to improve management efficiency, often through consolidation of public lands and targeting of private inholdings. The USDA Forest Service also uses land exchange to acquire lands. Like fee-acquisition, land exchanges are conducted to improve management efficiency, protect significant areas, and help achieve broad conservation goals. Exchanges may be identified as the most appropriate option when a need is identified to both acquire and dispose of lands. Like the state and federal agencies, counties use land exchange to consolidate and provide access to public land and minimize inholdings. Public land exchange transactions may take one-to-many years to complete.

Protection of important natural resources and public benefits are sought and prioritized through the transfer of lands. As a result of fragmented ownership and recent divestments of timber industry land, there has been significant interest in land exchange in Minnesota in recent years, with a focus on land consolidation.

In 2008, the Minnesota Legislature approved legislation to “expedite exchanges of land involving the state and governmental subdivisions of the state” (MN §94.3495). This was an acknowledgment of the mutual interest held by the State and counties to conduct large land exchanges to improve forest management efficiency and intended to make the land exchange process of publically owned lands

more efficient and less costly. The resulting legislation provided for changes in land appraisal and title requirements on public lands. School trust lands[15], which are distributed across the state and often isolated, were excluded from this legislation. Staff from counties and the State indicated the legislation has had little impact on the consolidation of their lands, primarily because acquired forestlands comprise roughly 10% of state-administered land. Some county staff also noted difficulty in finding qualified, certified appraisers. A review of current state land asset planning and regional pilot projects should be conducted to determine whether identification of priorities has resulted in improved decision making or reduced assessment period for land exchange at regional levels. Development of additional pilot projects to test expedited exchange of school trust lands and improved land asset management where appropriate could also be considered.

From FY 2000 to FY 2009, the State of Minnesota conducted 75 Class A[16] land exchanges (exchanging roughly 10,000 acres for 23,000 acres). Land exchanges were primarily conducted to consolidate and provide access to ownerships, acquire inholdings, exchange lakeshore lease land, and resolve trespass problems. According to Land and Minerals records, 95% of state land exchanges (Class A or B) over the past 20 years have been with private landowners (Table 2).

Table 2. State Land Exchange Partners 1990 - 2009

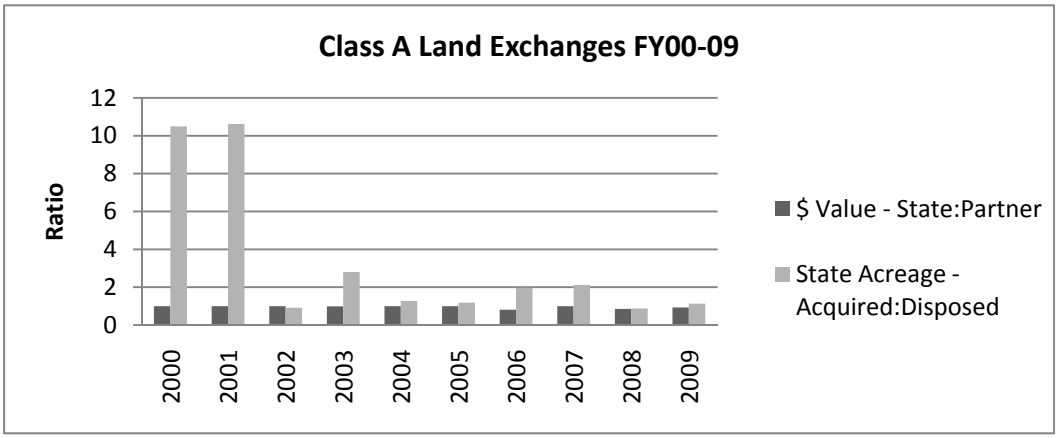
Classification	Ownerships	# of Exchanges
Class A	State and Private	225
Class B	County and Private	180
Class A/B	State and County	17
Federal	State and Federal	6

Through equal value exchanges, the State has gained more acres than it has disposed via land exchange transactions over the past 10 years (Fig. 3). Through land exchange, Minnesota has consolidated and increased public land while redirecting private land ownership. However, over similar ten-year timeframes, fee title acquisition and conservation easements protected roughly 16 to 18 times as many acres as the net gain in exchanged lands.

Currently, most forested counties are using land exchange to adjust ownership patterns. Actual fee acquisition of natural resources land, resulting gains in public ownership, is limited and mainly focused on small parcels for access and recreational opportunities such as trails. Counties are also concerned about their ability to manage lands into the future with possible reductions in or eliminations of payments in lieu of taxes (PILT). From FY 2000 to FY 2009, there were 97 Class B land exchanges that transferred roughly 16,000 acres for 16,000 acres. Unlike the State and Federal governments, recent county land exchanges have not increased public landownership, but they have had the opportunity to

redirect private ownership and development. Counties with the most recent land exchanges include Cass, Crow Wing, Itasca and Lake.

Fig. 3



3. Particular Issues Related to Conservation Easements

Legal and Related Issues

Because of their unique nature, conservation easements often raise other legal and related issues, such as their impact on other interests, duration and the ability to amend or terminate easements.

- A conservation easement does not take precedence over any other pre-existing rights or interests in the land without consent of that party.
- The Uniform Conservation Easement Act specifically allows, and in fact has a presumption in favor of, perpetual conservation easements. But an easement does not need to be perpetual to be valid. Federal tax law requires easements to be perpetual to be deductible as charitable gifts. Most programs now favor perpetual easements.
- The Uniform Conservation Easement Act states that easements may be "released, modified, terminated or otherwise altered or affected in the same manner as other easements." However, the ability to amend an easement may also be subject to restrictions from other sources.
- Conservation easements are designed to be difficult to terminate under most situations. However, there are limited circumstances under which an easement might be terminated.

While conservation easements are now well-accepted in most parts of the country as effective and efficient land protection tools if used under the right circumstances, there are a number of emerging concerns about easement use. Many can be addressed through appropriate program design.

Easement Stewardship and Funding

As conservation easements age, landownership changes and easement violations increase, easement holders and those that fund easements are increasingly aware of the importance of an ongoing easement stewardship and enforcement program. Through its recently created accreditation program,

the Land Trust Alliance is able to advance the importance of easement stewardship with adequate funding. Locally, the Minnesota Land Trust has completed the accreditation process and has become one of the first land trusts in the country to achieve that status. Accreditation provides recognition that a conservation easement stewardship program meets national standards for excellence.

Public agency easement holders, however, often face difficult funding challenges, relying on annual appropriations rather than dedicated funds. Private land trusts often face even more challenging funding issues. Even more importantly, many public agencies do not have a comprehensive understanding of the locations or terms of their easements, making easement monitoring impossible and enforcement based upon complaint. Many believe that easements will be increasingly violated and thereby lose legal, political and practical support if long-term stewardship issues are not systematically addressed.

Monitoring and Enforcement

Effectiveness of conservation easements as a permanent land protection tool is linked to the stewardship of those easements. Specific monitoring and enforcement rights of an easement holder are typically detailed in the easement document itself. Easement enforcement is typically limited to the easement holder or a holder of third party right of enforcement. The best way to prevent easement violations is to maintain an active easement management and monitoring program.

There are no specific legal or regulatory requirements that outline the degree of monitoring required. However, the Land Trust Alliance (LTA) recommends annual monitoring that includes landowner contact, not just evaluations of the land, to prevent easement violations. The LTA has some limited information to support that approach. Historically, public agencies have been less likely than private land trusts to create and implement comprehensive easement monitoring programs. That is now changing as both the public and the private sectors have recognized that conservation easement sustainability may well depend upon well-established easement monitoring programs, coupled with the commitment of easement holders to follow-up on easement violations.

In addition to the recognized need for monitoring and enforcement, conservation easement programs increasingly involve other management responsibilities such as responding to landowner requests for information, handling landowner outlined approvals, and keeping accurate data. Perpetual conservation easement management is not without cost. As suggested by the LTA, many non-profit conservation organizations have established programs to assist in understanding long-term easement management costs and implemented programs for funding these long-term costs. Much of this work has been documented by the LTA.

In the private nonprofit sector, a preferred approach includes building dedicated funds to a level sufficient to generate annual income to cover projected annual easement management costs along with reserves sufficient to cover potential litigation. The Minnesota Land Trust has conducted a comprehensive analysis of its easement stewardship and enforcement costs and estimates that it typically needs approximately $700 annually to cover the costs of stewardship for each easement it holds. Therefore, the Land Trust looks for approximately $14,000 per easement to “endow” these

annual costs along with another $1,000 per project for its enforcement fund. Dedicating funds through this approach is rarely possible for public agencies, requiring that they typically rely on annual budget appropriations for easement management and enforcement.

Tax Issues

Federal (and state) income tax deductions for qualified conservation easements.

Since 1976, the federal tax code has recognized a gift of a conservation easement that meets the requirements specified in the tax code and related regulations as a charitable contribution that allows a taxpayer can take a federal income tax deduction for the value of the easement. The provisions in tax law that allow this deduction are an exception to the general tax rule that taxpayers may take a deduction for a gift only when they give up their entire interest in the property involved[17]. As a result, there are extensive requirements governing conservation easement donations that are designed to make sure that there is a public benefit in any transaction for which a donor is taking a charitable contribution deduction by ensuring that the conservation values of the property are protected in perpetuity in exchange for the tax benefits to the donor.

A limited number of studies indicate that landowners are primarily motivated to donate conservation easements by a desire to protect the land. Nevertheless, it is clear that the significant income tax benefits available from donating easements have encouraged the donation or bargain sale of conservation easements around the country. In 2008, Congress renewed a special rule, for two additional years (until December 2009), expanding the federal income tax benefits of conservation easements from a maximum deduction of 30% adjusted gross income in any year to 50%. The LTA estimates that allowing landowners to deduct a larger portion of their income, over a longer period of time, has *increased* the pace of conservation by at least *535,000 acres over the past two years*. In 2006, there were more than 3,500 federal income tax deductions for conservation easements totaling more than $1.48 billion dollars. The average value of each conservation easement deduction was over $422,000

Federal estate tax benefits for conservation easements.

A federal estate tax is levied on a decedent's estate. Since passage of the Economic Growth and Tax Relief Reconciliation Act of 2001, the amount of an estate that is not subject to tax has increased from $675,000 to $3.5 million in 2009. For tax year 2010, there is no estate tax at all. Without congressional action in 2010, the 2001 law will expire and in 2011, the estate tax will be reinstated with a more limited $1 million credit and with tax rates at the 1997 levels of up to 55 percent from the current level of 45 percent.

As a result of these changes over the past few years, increasingly fewer estates have been liable for any estate tax. Nevertheless, estate tax appears to fall more heavily on those with appreciated assets such as farms and ranches. The U.S. Department of Agriculture estimates that while approximately 1% of all estates owe estate taxes, 4% of all farm estates owe estate taxes. As a result, estate taxes can lead to the break-up, sale and development of family-owned farm, ranch and forestlands, even when landowners would prefer to keep these lands intact.

Other data indicate that the impact of estate taxes may be even greater for forestland than for farmland. Findings from a recent study reported in a publication of the Society of American Foresters indicated that 38% of forest estates owed federal estate tax, a rate obviously many times higher than for U.S. estates in general. In 28% of the cases where estate tax was due, timber or land was sold because other assets were not adequate. In 29% of the cases where land was sold, it was converted to a more developed use. Given concern about this issue, the U.S. Forest Service has recently written an entire book geared at assisting nonindustrial private forest owners with estate planning[18].

State conservation tax credits

While taxpayers who donate conservation easements often qualify for the federal income tax deduction described above, 15 states (not including Minnesota) also provide for more extended state income tax benefits for conserving land by offering a *credit* against state income tax liability. The Conservation Resource Center, a nonprofit organization that specializes in transferring or selling tax credits, concluded in 2007 that effectiveness of tax credit programs to *increase* land protection was dependent upon the *value of the credit* available to a taxpayer and the *transferability of credits*. In short, programs with high-value, transferable credits will drive significant additional land protection.

Property tax issues related to conservation easements

For many rural landowners, high property taxes are a primary reason they sell all or part of their lands for development. Landowners financially stressed by property taxes often look to property tax relief programs as an alternative.

In contrast, local units of government relying on property taxes to support needed local services are typically concerned about programs that either lower land values (and as a result the taxes based upon those values) or otherwise impact property tax revenues. Consequently, many local governments are concerned about programs and practices that limit development, including conservation easement programs, generally believing that development will enhance land values and thereby increase the resultant taxes. There is little direct data, however, regarding the impact of conservation easements on land values, property taxes and property tax revenues in Minnesota.

Minnesota Statute Section 273.117 does recognize that conservation easements can affect land values but leaves the analysis to the discretion of the local assessor:

> *The value of real property which is subject to a conservation restriction or easement may be adjusted by the assessor if:*
>
> - *the restriction or easement is for a conservation purpose as defined in section 84.64, subdivision 2, and is recorded on the property;*
> - *the property is being used in accordance with the terms of the conservation restriction or easement.* [Emphasis added]

In 2005, the Minnesota Legislature tasked the Minnesota Department of Revenue to study property tax assessment practices related to lands enrolled in selected conservation programs in agricultural areas,

some of which involved the use of permanent conservation easements. The study concluded that there was a significant lack of data available, a major factor leading to inconsistent valuation approaches among assessors. The report also concluded that state law provided inadequate guidance to assessors to promote uniformity or consistency in assessing protected land and that the Department of Revenue should play a greater role in this area. Finally, from the limited data available, the report concluded that not all temporary or permanent conservation restrictions negatively impact land value—a conclusion that led to the changes in the statute set out above giving county assessors greater discretion in evaluating an easement's impact.

A later study commissioned by Embrace Open Space, a collaborative of public and private organizations working to conserve land in the greater metropolitan area, evaluated the relationship between proximity to open space and residential home values in Washington County. The study looked at a range of open spaces; including conservation easement protected property, and concluded that homes directly adjacent to open space were worth an average of $16,750 more than those that were not; resulting in a positive impact on Washington County property tax revenues of more than $1.56 million.

There is also very limited data from other states about the relationship between conservation easements and property taxes. A frequently cited 2004 study of Vermont towns assessing overall impact of easements on the local tax base found that conservation easements were either neutral or diminished property taxes over the long run. A 2005 study by the Trust for Public Land (TPL) looked more broadly at the effect of land conservation—both through fee title land acquisition and conservation easements—on municipal property taxes in New Hampshire in comparison to the effect of development on property taxes. The study looked at both short-term and long-term impacts. In the short term, the TPL study found that permanent protection of land generally results in a tax increase to local taxpayers. In the long term, however, and contrary to common perception that development will result in lower taxes, property tax bills are generally higher in more developed towns than in rural towns.

4. Lessons from Land Conservation Programs

Most states have at least one land conservation program, protecting benefits ranging from recreational opportunities to cultural resources to resource industries to open space and biodiversity[19]. Based on an analysis of existing Minnesota programs and review of several major land protection programs and associated literature, the following is a summary of principles that should be maintained or incorporated into Minnesota's forestland protection efforts (including specific examples from Florida Forever, Land for Maine's Future, New York's Open Space Program, and Wisconsin's Knowles-Nelson Stewardship program).

A. STRUCTURE: Developing a Clear Program Structure and Organization

Conservation programs and projects are most successful when they advance a vision developed through collaboration of diverse partners and are grounded in locally-based initiatives[20]. Designation of an entity to communicate opportunities, share information, and coordinate implementation enhances the efficiency of partners. Too often conservation programs are insular, often due to a lack of resources and a need to focus on specific mandates. Minnesota has established land protection programs and funding;

however, the effectiveness of these programs could be enhanced to better address forest fragmentation through increase coordination and directed implementation.

A coordinated program, built on existing, experienced parties can provide information and a strategic perspective. Designation of a "central" entity provides a clear path for communication of new information and a resource for partners that are external to, or from different, conservation networks. Initiatives to create stable sources of funding have been the catalyst for most state land conservation programs, providing the capacity and resources over time to engage partners and leverage funds.

Establishment of the Minnesota Forests for the Future (MFF) program, as envisioned by the DNR Commissioner's Advisory Team in their 2008 report[21], was recommended to:

> *…provide overall guidance for acquisition and stewardship of forest conservation easements and application of other forest conservation tools in Minnesota…[and to] collaborate with public and private partners to prevent the parcelization, conversion, and fragmentation of Minnesota's private working forests…*

The Minnesota Forests for the Future program was subsequently established by the 2008 Minnesota legislature (MN § 84.66), providing an existing platform for a coordinated and more efficient approach to forest land conservation

Like Minnesota Forests for the Future, the Land for Maine's Future (LMF) program was designed to respond to changing land ownership patterns and land uses that threatened natural and cultural heritage values and Maine's resource-based economy. In developing the LMF program, Maine adopted and relied upon a broad set of acquisition priorities. Over the years, locally-driven acquisition projects aided the success of the LMF program, resulting in local support and acceptance of projects. Similarly, local support of forestland conservation can be fostered by the MFF program if the program serves as a source of information and strategic direction based on well-defined priorities.

B. INVOLVEMENT: Collaboration and Partnerships Strengthen Programs

Minnesota has clear experience in developing and advancing programs and initiatives through collaboration of diverse partners, resulting in additional funding sources, complimentary projects, and additional support for program initiatives. Dialogue among partners can be an efficient way to identify mutual goals and objectives. Providing opportunities for public involvement through open meetings, listening sessions and advancement of locally-driven initiatives maintains program support, provides oversight and fosters a more transparent program.

Effective programs throughout the country often involve government agencies and private, nonprofit conservation organizations with expertise in working forest conservation easement transactions and funding as well as the landowners of protected lands. In addition to facilitating negotiations, private nonprofit organizations, as well as public agencies, should be funded to buy land or hold easements as appropriate. These multi-party public/private partnerships can provide the strength, durability and flexibility needed to insure long-term program success.

Successful programs have also recognized the need to make land protection actions relevant to the local economy, as illustrated by New York's Open Space Program which recently advanced protection of 160,000 acres in the middle of the Adirondack region via a conservation easement formally supported by 29 towns whose development needs were incorporated into the project plan.

Both New York and Maine have relied heavily on regional advisory groups with representatives from diverse interests. Based on over two decades of experience with the LMF Program, the most successful initiatives were regionally based and, often, championed locally. As a result, a recent review of the program recommended additional resources be provided to regional planning entities and alignment of state agency resources to support "regional conservation partnerships"[22]. Investments in staff and resources also can fuel volunteer engagement.

Some programs, such as New Hampshire's Land and Community Heritage Investment Program (LCHIP) support regional initiatives primarily through grants to local communities and organizations for the conservation of important natural, cultural and historic resources. Of the 28 land conservation programs recently reviewed by the Environmental Law Institute, 75% administered grant programs for land acquisition and half of the programs protected land solely through grants to units of local government and other entities[23].

C. TOOLS: Information, Planning, and Implementation

Information and Planning

The tension between strategic planning for protection and quick and efficient land acquisition requires proactive development of conservation priorities[24]. Land acquisition targeting for conservation is extensive[25], but the application, implementation and effectiveness of prioritization tools is far from perfected. To effectively invest conservation dollars, programs must strategically identify and communicate priorities with public and private conservation partners. States often adopt prioritization strategies by developing or drawing upon existing conservation plans and data resources.

Effective working forest protection programs incorporate provisions that address issues unique to forest settings and protect lands that provide multiple benefits. To insure that conservation investments most effectively meet program goals, Maine, New Hampshire, New York and Vermont, all with long-standing forest conservation programs, have established mechanisms for setting acquisition priorities and setting criteria for the use of public money. Maine's Land Acquisition Priorities Advisory Committee has developed a set of priorities for acquisition efforts in the northern forest. New York's Open Space Plan, first completed in 1992 and updated every three years, has consistently guided the use of hundreds of millions of dollars from the state's Environmental Protection Fund as well as other conservation strategies. Similarly, the federal Forest Legacy Program requires participating states to identify project areas in which Forest Legacy funds will be spent, insuring that more than $1.5 billion dollars have been focused on the highest priorities.

The recent development of several statewide conservation plans and supporting geospatial data in Minnesota has provided direction for investments; however, the volume of information has limited effective communication of priorities for comprehensive, complimentary conservation. A synthesis of

these and other statewide land protection priorities could be communicated among conservation partners via a strategic document similar to Wisconsin's Land Legacy Report[26]. At the same time, strategic application of conservation measures does not necessarily require a statewide "master" plan as long there is a clear framework of priorities or criteria with which to assess projects[27]. If effectively communicated, priority mapping and criteria refinement underway by the MFF program can provide strategic direction to all forest conservation partners in Minnesota.

The Conservation Toolbox

Over time, programs designed to focus on fee acquisition have shifted emphasis to conservation easements and other incentives with the recognition that a variety of tools are needed and will be applicable in different situations. For example, the LMF program in Maine has increasingly used conservation easements and partnerships in acquisitions and management[28]. In New York, conservation easement projects outnumber fee acquisitions by nearly 9:1[29].

As of 2008, the Florida government has spent approximately $300 million per year on protecting over 2 million acres of conservation lands since 1990 via fee acquisition and conservation easements. Nearly 80% of the acres have been protected by fee acquisition[30]. *Florida Forever*, and its precursor *Preservation 2000*, has been recognized by many as the most ambitious land acquisition program, and one of the most successful, in the nation[31]. Criticisms of the program include the great cost, tax base reductions, a loss of available private lands, and maintenance needs on acquired lands (resulting in annual appropriations for management). A recent review of Florida Forever and other land conservation programs in Florida identified the need to use additional land conservation tools if the conservation programs are to remain effective into the future[32].

Similarly, here in Minnesota, the 2008 Strategic Report of the DNR Commissioner's Advisory Team on the Minnesota Forests for the Future Program[33] recommended that the state

> *use a toolbox approach, in which multiple tools are applied to meet forest conservation goals. The range of tools includes easements, fee title acquisition, land exchanges, tax policies, and cost-share programs.*

While listed as a conservation tool, land exchange is not extensively used in other state land protection programs. In fact, Minnesota's Land Exchange Program has been used as an example of active land exchange programs[34]. Given an average of 10-12 exchanges per year in Minnesota and even fewer exchanges reported by other states, land exchange is either underutilized or too complex to be as effective as other tools.

Revolving acquisition funds are in use by some jurisdictions at the state and county levels, providing a more nimble alternative, or facilitating mechanism, to land exchange. Current examples of revolving funds in Minnesota include the LCCMR 2006 Land Exchange Revolving Fund loans to Aitkin, Cass and Crow Wing counties and the LCCMR 2008 Forests for the Future Revolving Account. Land sales have slowed as a result of current economic forces, hindering repayment of revolving funds. At the same time, the amount of funding available limits the ability of programs to respond to real estate

opportunities. A current legislative directive to sell state lands to address budget deficits has also limited acquisition activity.

Long-term Stewardship and Management

A long-term commitment to protect the public investment comes with land acquisition or conservation easements. Long-term costs associated with owning land or holding easements, including management, monitoring and enforcement, should always be calculated and considered in any land protection decision. As a necessary component of long-term land protection, stewardship is an appropriate use of public and private conservation funding.

Approaches to address long-term funding needs include an emphasis on acquisitions that consolidate ownerships and reduce management costs, inclusion of the level of management and potential revenue in acquisition decisions, incorporating management costs into project funding, establishing new funding sources for management (e.g. partnering with private fundraising organizations or foundations), or establishing dedicated funds for long-term stewardship and management.

In Maine, funds from the LMF program did not support long-term management. Instead, the state supported the Maine Community Foundation in development of an endowment that now provides grants to support the stewardship of their Outdoor Heritage projects[35]. Maine's Bureau of Parks and Lands requires that easements it acquires come with endowments to pay for monitoring to ensure the terms of the easement are met.

Similarly, a portion of the *Florida Forever* Conservation and Recreation Lands Trust Fund is set aside to account for increased management associated with increasing public land ownership. In Connecticut's Recreation and Natural Heritage Trust Program an amount not to exceed 20% of the appraised value of the acquired natural heritage lands may be allocated for management or deposited in a stewardship account. New Hampshire established a Land Conservation Endowment Fund in association with its *Land Conservation Investment Program* (LCIP) for the long-term management and monitoring of easements. Instead of maintaining a stewardship fund, the Vermont Housing and Conservation Board makes grants to private parties for stewardship. Here in Minnesota, we have a model stewardship fund legislated by the Minnesota Forests for the Future Fund (§84.66), which required the commissioner to

> *establish a long-term program for monitoring and enforcing Minnesota forests for the future easements. The program must require that a financial contribution be made for each easement to cover the costs of managing, monitoring, and enforcing the easement.*

To date, a stewardship program or dedicated fund has not been established. The need for long-term stewardship of acquired lands and easements has been recognized and funded in projects supported by both the Legislative Citizens Commission on Natural Resources and the Lessard-Sams Outdoor Heritage Council.

Recognizing the long-term commitment associated with Minnesota's current investments in land merits consideration and development of a comprehensive easement stewardship program and similar consideration for the long-term management of acquired natural resources lands.

5. Evaluation of Land Acquisition and Protection Tools

Effectiveness

Fee title acquisition has been described as the "surest and most effective tool in the biodiversity conservation toolbox"[36]. Protection by fee title acquisition, by exchange or through a conservation easement can be an effective means to inhibit parcelization of both an individual parcel, as well as the surrounding landscape if properly targeted and associated with a broad landscape initiative. The identification of *which lands* to protect and *in what pattern* is important.

Because acquisition requires a willing seller, strategic acquisition of the most critical parcels may be limited. Targeting of public acquisition must be iterative and consider the current configuration of protected lands, among other criteria[37]. Land exchanges are also opportunity driven and limited in strategic application by time and landowner interest. Because easements are voluntary, landowner interest depends upon the level of funding or other incentives available and the acceptability of any required easement terms.

Public ownership, via fee-title acquisition or exchange, provides a fairly permanent conservation tool to protect natural and cultural resources and provides opportunities for compatible public use. Public ownership also provides an unmatched level of control over land management by one entity. Permanent protection is, however, limited by the option for disposal by future administrations.

Conservation easements can be very effective and more efficient at limiting parcelization on working forestland. Easement terms directed at prohibiting or limiting the division of property into separate parcels are typical in most conservation easements and are quite easy to draft. Additional provisions and restrictions can be included in easements to insure that the land remains available for forestry.

Perpetual conservation easements are recognized under Minnesota law, requiring only a single transaction to achieve long-term protection. Properly drafted easements are typically upheld by the courts, assuring their long-term effectiveness. Long-term effectiveness does, however, require an easement holder with the commitment and resources to monitor, manage and enforce the easements it holds.

A Landscape Approach: Considering Land Adjacent to the Parcel

Strategic land conservation can protect adjacent land by influencing future protection; primarily due to subsequent conservation efforts to connect protected areas[38]. However, without cumulative land protection or support from other conservation tools, there is scant, if any, evidence that land acquisition protects neighboring lands from development[39].

Poorly informed land acquisition can be counter-productive, resulting in increased land conversion on adjacent parcels[40]. In fact, using geospatial modeling Robinson and Brown[41] found that forestland acquisition policies shifted developer behavior; in some cases creating an emphasis on less forest cover in developed areas and resulting in decreased forest cover overall, highlighting the importance of the relationship between planning for developments and acquisition policies. *Land protection and development planning must be coordinated.*

Studies have documented contrasting impacts of land protection on development patterns. Permanent protection is often an attractive amenity[42]. Public acquisition can also displace local development and decrease the pool of available private land on the market, affecting land prices and generating negative feedback. For example, the creation and subsequent expansion of the Northern Highland-American Legion Forest in Oneida and Vilas counties in Wisconsin resulted in substantial land value increases and development relative to those of other forested counties in Wisconsin[43]. A more recent study of land development rates from 1940 to 2000 in northern Wisconsin demonstrated concentrated housing growth rates along the boundaries of large public lands, with growth rates 1.5 times higher in areas within a 1-kilometer buffer of public land than those in more distant areas[44]. Such development results in a mosaic of ownerships and land use activities. In the latter Wisconsin study, development rates were not concentrated around cities, roads or other urban features.

In Minnesota, evidence of protected lands attracting acquisition and development is primarily anecdotal. However, over half of parcel splits in Itasca County from 1999-2006 were adjacent to public land[45]. Because over half of Itasca County is publically owned, whether parcelization near public lands occurred due to landowner interest or chance land availability could not be determined.

While the example from northern Wisconsin demonstrates the value of forestland for development, proximity to protected forestland does not always impact land value. As observed in Michigan, forestland amenity values may be related to the relative amount of forestland available in an area[46]. Research in Minnesota has primarily emphasized the relationship of land values and natural areas in suburban and urban areas, but results indicate that natural amenities are of value to Minnesotans[47]. Such increases in amenity value limit future public land acquisition opportunities[48] and suggest that, without the support of other conservation tools, land acquisition may simply shift local development.

Land exchange can be an effective alternative in cases where the land value exceeds interest in, or funding for, full fee or easement acquisition, and particularly in transactions with private landowners that would result in increased public acreage. Of the land exchange opportunities, those conducted between public and private land owners will be the most valuable in addressing the parcelization of forestland. Public-to-private land exchange can increase the size of a protected landscape complex, improve ownership recognition and direct development to areas primarily under private ownership.

Efficiency

While expensive, planning and protection are less costly than restoration. Funds for acquisition remain scarce compared with the lands identified for acquisition priorities[49] and cost varies greatly as a result of initial landscape conditions[50] and parcel size[51]. However costly acquisition may be conserved public lands provide significant environmental and social benefits[52] and protection will only become more expensive.

The direct cost of purchasing a conservation easement is almost always considerably less than the cost of purchasing land in fee title, although the specific terms of the easement and the nature and location of the land will affect any easement's value. In Minnesota, the average cost of forest conservation easements prior to the Upper Mississippi Forest easement was $318.00/acre[53]. Fee acquisition of

forestland has been about 2 to 4.5 times the cost of an easement[54]. While conservation easements usually cost less than full fee title acquisition, easements face many of the same limitations as full-fee acquisition and their complexity results in tradeoffs associated with recording, monitoring and enforcement[55].

Creating an easement program that meshes with other available incentives may keep program costs lower. Historically, many landowners have been willing to convey conservation easements at well below their fair market value. Other transaction costs associated with acquiring a conservation easement are similar to acquiring land in fee title. To be effective, all working forest conservation easements must be unique—geared to the specific parcel of land and the specific landowner. Each must be negotiated on a case-by-case basis. As a result, easements can be complicated and time-consuming to negotiate, draft and appraise, thereby increasing transaction costs. However, investing in model documents or templates and relying on existing experienced organizations and entities can enhance efficiencies. Some training may be necessary. Easements also require long-term monitoring and management with resultant additional costs. These costs, however, are typically less than the costs associated with owning and managing land in fee.

Ownership requires long-term management and stewardship of a site to protect public investments in land. Minnesota also currently pays over $5.00/acre to counties for payment in lieu of property taxes on acquired lands. In 2009, the state paid $22 million in PILT to counties, a small percentage of which supports retention of tax-forfeited lands[56]. PILT payments are not designed to replace lost taxes but are an important source of funding for county land departments. Across the nation, states have gained local support for acquisition programs by providing some sort of payment in lieu of taxes. The approach used in Florida, payment only to counties below a certain population level, could be considered for use in Minnesota. These payments keep forestland management closer to the affected communities, increase county capacity and result in local support of public ownership.

With conservation easements, targeting larger parcels in identified areas can assure the greatest impact from the fewest number of transactions, minimizing program costs. Selecting sites and designing easements that protect multiple conservation objectives can maximize the public benefits associated with each transaction, enhancing efficiency. A focus on large parcels for cost effectiveness, however, limits the ability to address fragmentation of protected lands because protection of various parcel sizes is usually needed to maximize land consolidation[57]. The need to protect various sizes of parcels to minimize fragmentation of protected areas supports application of both full-fee and partial interest acquisitions, along with other protection tools. Land should be acquired in fee where protection is justified based upon the resource values of the site, where public management will protect and improve the condition of the forest, and where the threat of parcelization warrants public intervention.

Because the cost of fee title land acquisition and protection via conservation easement limits application, land exchange can be a valuable tool to consolidate public ownership and redirect private development. However, complications associated with appraisals and review of lands to be exchanged may result in administrative expenses that far exceed those of fee acquisition transactions. If administrative costs are constrained, land exchange provides an inexpensive means to adjust land

ownership and dispose of isolated parcels that are inefficient to manage. Depending upon the involved ownerships, land exchange may take from one-to-many years. The process, necessary to ensure land exchanges are for public benefit, limits the speed with which this tool can address opportunities.

While purchasing only from willing sellers is good practice, it is not ideal for strategic land protection and may result in a mismatch between priorities and actual transactions; restricting the ability to best allocate scarce dollars. Because acquisition can be so opportunity driven, it is a challenge to balance efficient transactions with strategic planning. Often, priority parcels are adjacent to public lands, an amenity valued by many private owners. Similarly, land exchanges are limited by interested landowners and are highly opportunistic.

Palatability

In addition to cost, social and political considerations limit the amount of land protected by public ownership[58]. Minnesota ranks among the top 20 U.S. states for public land ownership[59]. With the majority of Minnesota's public lands occurring in northern forested counties, government fee-title acquisition is unlikely to be a successful broad-scale conservation strategy, especially given anticipated budget shortfalls. In counties concerned about adding to the public land base, land exchanges are often more palatable than acquisitions, but there are potential concerns about the comparability of lands traded away and acquired. Privately owned land under easement remains on local property tax rolls, providing local units of government with a continued stream of property tax income; but political palatability may also depend upon what entity holds the easements.

On a local level, removal of large areas of land from private ownership may limit economic growth for communities. Such impacts are generally greater in small, rural towns and counties–places likely targeted for conservation of forestlands. Positive consequences associated with increased land values and reduced spending on local infrastructure and services, however, may outweigh lost development opportunities[60]. Combined with lower costs, PILT and revenue sharing payments made annually by governments can help offset reduced tax revenue. Some Minnesota counties do not embrace the concept of perpetual conservation easements due to similar concerns about the impact that easements may have on property values and, as a result, on property taxes.

Private landowners are protected through a willing-seller approach and fair market value payments. As they also involve voluntary transactions, conservation easements are typically well accepted. Accountability in transaction negotiations is not always clear and privacy rules make it difficult for public oversight of investments. In addition, paying for land to avoid development or conserve forests de-emphasizes responsibility of private landowners to maintain forests and may be considered to undercut regulation efforts. There is long-term value in keeping private landowners involved in management and sustainability.

Conservation easements are privately created arrangements between the landowner and the easement holder. This requires easement holders to exercise judgment and discretion in determining which lands to protect. Many believe that this is what makes easement programs nimble and effective and avoids unnecessary bureaucratic involvement. Others are concerned about the lack of public oversight of

transactions that can permanently affect the landscape. While this may be a concern for donated easements, there is typically more public oversight or involvement when public funds are used in easement transactions. Well-drafted program criteria for publicly funded programs can go a long way in providing appropriate levels of oversight and accountability. A working forest easement program that provides appropriate accountability for use of public funds will be more likely to be accepted at the legislative level.

Equitability

Information on the social equity of conservation investments is limited and additional research is needed[61]. Protection of land may increase remaining private property tax values[62]. As a result, local governments may actually experience increased revenues associated with land value increases. At the same time, increased land values and associated increases in property taxes may be difficult for current landowners to absorb and may have negative impacts on compatible land uses and forest management.

Protection of priority resources precludes equal investment in, and access to, public lands across the state. Because forestlands are not distributed equally throughout the State, an easement program would affect some counties differently than others. Similarly, land exchanges suffer from border issues with concerns over which jurisdictions gain and lose lands. While there may be concerns about the comparability of lands traded away and acquired, opportunity for public review is provided.

Consistently applied program criteria and opportunities for public involvement are necessary for any public acquisition program. Adequate funding and a standardized approach to valuing easements can ensure that a working forest conservation easement program is equitably applied to landowners in forested areas throughout the State.

Technical Feasibility and Administrative Ease

Acquisition of fee title is not difficult, but it is time consuming. Once completed, acquisition and land exchanges may improve the administration of public lands as parcels are consolidated. Public ownership also comes with tails such as long-term management and payments in lieu of taxes. The state, as well as forested counties and federal government, has land management capabilities; however, support for long-term management is a concern.

Conservation easements are very technical and require a high degree of skill to negotiate, draft, appraise and manage. However, there are a number of nonprofit conservation organizations in the State with existing expertise. The Minnesota DNR also has existing expertise and a growing understanding of the complexities of easement programs. A conservation easement program requires ongoing attention to prevent easement violations and to enforce easement terms. In addition to ongoing monitoring, education of subsequent landowners to make sure they understand the terms of the restrictions on their property is an important component of any easement stewardship program. Many working forest easements require management plans or other approvals, again requiring ongoing attention. There are numerous models for working forest conservation easement programs around the country that can provide insight into creating an effective long-term conservation easement stewardship program in Minnesota.

Land exchanges can also be complex as a result of the time required to approve and process the disposal and acquisition of the parcels in consideration, equal valuation requirements, disagreements in appraisal valuation, difficulties associated with disposing of public land valued by citizens, finding land available to exchange and restrictions on the type of land that can be exchanged. Because township approval carries a good deal of weight in land exchange decisions, conflicts of interest may arise. The complexity of the land exchange process also increases when multiple public ownerships are involved, as each entity has different review processes and requirements.

Additional capacity in the private and/or public sectors will be necessary in Minnesota, however, as everyone with expertise already has more work than they can handle. Some training may also be necessary to ensure that necessary expertise exists for all components of a forest protection program.

6. Key Findings and Recommendations

- **Minnesota has established land protection programs and funding; however, the effectiveness of these programs could be enhanced to better address forest fragmentation with through increased coordination and directed implementation.** As established by the 2008 Minnesota legislature, the MFF program emphasized working forest conservation easements and fee title acquisition to the exclusion of other forest conservation tools. Expansion of the existing MFF program to include the suite of conservation tools as originally intended could provide a platform for a coordinated and more efficient approach to forest land conservation.

- **The recent development of several statewide conservation plans and supporting geospatial data in Minnesota has provided direction for investments; however, the volume of information has limited effective communication of priorities for comprehensive, complimentary conservation.** To effectively invest conservation dollars, any program to protect Minnesota's working forests must strategically identify and communicate priorities with public and private conservation partners.

- **Multi-party public/private partnerships can provide the strength, durability and flexibility needed to insure long-term program success.** In addition to facilitating negotiations, private, nonprofit organizations, as well as public agencies, should be funded to buy land or hold easements as appropriate.

- **Conservation easements are voluntary; generally less expensive than fee simple acquisition; can be individually crafted to the needs of each landowner, while also meeting public goals; can prevent the division and development of forest lands while maintaining private ownership and production and are well accepted in Minnesota and around the country.** As part of a comprehensive program to mitigate forest parcelization, continued use of working forest conservation easements should be supported to maintain private forest stewardship for numerous social and environmental benefits. Efficiencies and accountability can be enhanced through the use of standardized documents and protocols and sharing expertise among government agencies and nonprofit organizations.

- **Effectiveness of conservation easements as permanent land protection tools is linked to the stewardship of those easements. Lack of funding dedicated to, or specifically directed at, easement stewardship in Minnesota, has been a concern in Minnesota, particularly with respect to public agencies.** Easements should be developed and executed in a deliberate, coordinated and sustainable manner that ensures long-term management and enforcement. Funding for long-term easement management and monitoring is essential.

- **Protection by fee-title acquisition can be an effective means to inhibit parcelization of both an individual parcel, as well as the surrounding landscape if properly targeted and associated with a broad landscape initiative.** Acquisition in fee should be focused on sites adjacent to protected lands where protection is justified based upon the resource values of the site and where public management will protect and improve the condition of the forest. Recognizing the long-term commitment associated with Minnesota's current investments in land merits consideration of the long-term management of acquired natural resources lands, potentially through the establishment of a dedicated fund.

- **Of the land exchange opportunities, those conducted between public and private land owners will be the most valuable in addressing the parcelization of forestland. Public-to-private land exchange can increase the size of a protected landscape complex, improve ownership recognition and direct development to areas primarily under private ownership.** Land consolidation should be promoted through enhancement of traditional and non-traditional land exchange mechanisms. Existing revolving fund programs should be expanded.

- **Legislation to expedite public land exchange has had little impact on land consolidation.** A review of current land asset planning and regional pilot projects should be conducted to determine whether identification of priorities has resulted in improved decision making or reduced assessment period for land exchange. Development of pilot projects to test expedited exchange of school trust lands and additional regional land asset management coordination could also be considered where appropriate.

- **Payments in lieu of taxes (PILT) on tax-forfeited lands support forestland retention and forest management capabilities of county land departments.** To support continued retention and management of roughly 2.8 million acres forestland, PILT payments should continue on state-owned, county-administered land.

Posting Date: 12 May 2010

[1] Robinson and Brown. (2009). Evaluating the effects of land-use development policies on ex-urban forest cover: An integrated agent-based GIS approach. *International Journal of Geographical Information Science. 23:9.* , 1211-1232.

[2] McDonald et al. (2007). Estimating the effect of protected lands on the development and conservation of their surroundings. *Conservation Biology. 21:6.,* 1526-1536.

[3] Condemnation of land to address forest parcelization and land acquired through tax foreclosures are not considered in this review.

[4] USDA Forest Service. (2003). *FOREST SERVICE MANUAL: FSM 5400 - LANDOWNERSHIP, CHAPTER 5470 - RESERVATIONS AND OUTSTANDING RIGHTS.* Washington, DC: USDA Forest Service Washington Office.

[5] Campaign for Conservation Coalition. (2008). *A Fifty-Year Vision: Conservation for Minnesota's Future.* Afton, MN: Belwin Conservancy.

[6] MN-DNR. (2008). *Minnesota Forests for the Future.* St. Paul, MN: Minnesota Department of Natural Resources.

[7] UMN - IoE. (2008). *Minnesota Statewide Conservation and Preservation Plan.* St. Paul, MN: State of Minnesota, Legislative-Citizen Commission on Minnesota Resources.

[8] MN-MAD. (2009). *Lessard-Sams Outdoor Heritage Council: Strategic Planning and Recommendation Development Process - Summary of Input Meetings.* St. Paul, MN: State of Minnesota: Lessard-Sams Outdoor Heritage Council.

[9] DNR Division of Forestry. (2009). *Division of Forestry Land Acquisition - Biennial Plan: FY2010-2012.* St. Paul, MN: Minnesota Department of Natural Resources.

[10] MN-DNR. (2008). *Minnesota Forests for the Future.* St. Paul, MN: Minnesota Department of Natural Resources.

[11] This acreage includes the 51,163-acre forest legacy easement in Itasca and Koochiching counties.

[12] Allman, L. (2000). *Land Protection Options: A Handbook for Minnesota Landowners. Revised Second Edition.* Minneapolis, MN: The Nature Conservancy.

[13] Minnesota Office of the Legislative Auditor. (2010). Evaluation Report: Natural Resource Land. St. Paul, MN.

[14] Contacting *all* local units of government was beyond the scope of this study. Instead, counties and cities that were known to hold conservation easements or to be interested in holding easements along with other selected local units of government such as soil and water conservation districts and watershed districts were contacted. Most of these were in the greater metropolitan area.

[15] School trust lands were granted by the United States to the State to be held in trust as a long term source of funding for schools (MN § 127A.31, see also §92.121)

[16] **Class A** lands are state lands controlled or administered by the Department of Natural Resources. **Class B** lands have been acquired by the State through tax forfeiture, are administered by counties, and are held in trust in favor of taxing districts.

[17] See Section 170(f)(3) of the Internal Revenue Code.

[18] See sections 2031(c) and 2055(f) of the Internal Revenue Code.

[19] Environmental Law Institute. (2006). *The Nature of Open Space Programs: Linking Land Protection and Biodiversity Conservation.* Washington, DC: Environmental Land Institute.

[20] Richardson, B. (2008). *Regional Landscape Conservation in Maine.* Augusta, MN: Maine State Planning Office.

Sheehan, F. (2010, January 26). NY-DEC Open Space Coordinator. (L. McInenly, Interviewer).

[21] MN-DNR. (2008). *Minnesota Forests for the Future.* St. Paul, MN: Minnesota Department of Natural Resources.

[22] Richardson, B. (2008). *Regional Landscape Conservation in Maine.* Augusta, MN: Maine State Planning Office.

[23] Environmental Law Institute. (2006). *The Nature of Open Space Programs: Linking Land Protection and Biodiversity Conservation.* Washington, DC: Environmental Land Institute.

[24] ibid.

[25] Newburn et al. (2005). Economics and Land-Use Change in Prioritizing Private Land Conservation. *Conservation in Practice* , 19:1411-1420.

McDonald-Madden et al. (2008). The need for speed: informed land acquisitions for consevation in a dynamic property market. *Ecology Letters* , 11:1169-1177.

[26] WI-DNR. (2009). *Wisconsin Land Legacy Report: An inventory of places to meet Wisconsin's future conservation and recreation needs.* Madison, WI: State of Wisconsin, Department of Natural Resources.

[27] Irland, L. (1998). *Policie's for Maine's Public Lands: A long-term view. In: Maine Choices 1999-A Preview of State Budget Issues December 1998.* Augusta, ME: Maine Center for Economic Policy.

[28] Cho, S. S. (2009). Amenity values of spatial conifgurations of forest landscapes over space and time in the Southern Appalachian Highlands. *Ecol. Economics.* , 68: 2646-2657.

[29] Sheehan, F. (2010, January 26). NY-DEC Open Space Coordinator. (L. McInenly, Interviewer).

[30] Brock, G. (2009, 11 12). FL-DEP, Office of Environmental Services Bureau Chief. (L. McInenly, Interviewer).

[31] Hoctor, T., Huntley Dube, E., & Beyeler, S. (2008). *Conservation Incentives and Programs for Protecting Critical Lands and Waters.* Century Commission for a Sustainable Florida.

[32] ibid.

[33] MN-DNR. (2008). *Minnesota Forests for the Future.* St. Paul, MN: Minnesota Department of Natural Resources.

[34] Hoctor, T., Huntley Dube, E., & Beyeler, S. (2008). *Conservation Incentives and Programs for Protecting Critical Lands and Waters.* Century Commission for a Sustainable Florida.

[35] Richardson, B. (2008). *Regional Landscape Conservation in Maine.* Augusta, MN: Maine State Planning Office.

[36] Environmental Law Institute. (2006). *The Nature of Open Space Programs: Linking Land Protection and Biodiversity Conservation.* Washington, DC: Environmental Land Institute.

[37] Newburn et al. (2005). Economics and Land-Use Change in Prioritizing Private Land Conservation. *Conservation in Practice* , 19:1411-1420.

[38] McDonald et al. (2007). Estimating the effect of protected lands on the development and conservation of their surroundings. *Conservation Biology. 21:6.* , 1526-1536.

Polasky et al. (2005). Conserving Species in a Working Landscape: Land Use With Biological and Econommic Objectives. *Ecological Applications* , 15: 1387-1401.

[39] McDonald et al. (2007). Estimating the effect of protected lands on the development and conservation of their surroundings. *Conservation Biology. 21:6.* , 1526-1536.

Merenlender et al. (2004). Land Trusts and Conservation Easements: Who isConserving What for Whom? *Conservation Biology. 18:1.* , 65-75.

[40] Armsworth et al. (2006). Land market feedbacks can undermine biodiversity conservation. *Proceedings of the National Academy of Sciences* , 103: 5403-5408.

Cho, S. S. (2009). Amenity values of spatial conifgurations of forest landscapes over space and time in the Southern Appalachian Highlands. *Ecol. Economics.* , 68: 2646-2657.

[41] Robinson and Brown. (2009). Evaluating the effects of land-use development policies on ex-urban forest cover: An integrated agent-based GIS approach. *International Journal of Geographical Information Science. 23:9.* , 1211-1232.

[42] Cho, S. S. (2009). Amenity values of spatial conifgurations of forest landscapes over space and time in the Southern Appalachian Highlands. *Ecol. Economics.* , 68: 2646-2657.

Thorsnes, P. (2002). The value of a suburban forest preserve: estimates from sales of vacant residential building lots. . *Land Economics* , 78: 426-441.

Klase and Guries. (1999). *Forestland Ownership in Oneida and Vilas Counties, Wisconsin, 1975-1994.* Madison, WI: Land Tenure Center, University of Wisconsin - Madison.

[43] Klase and Guries. (1999). *Forestland Ownership in Oneida and Vilas Counties, Wisconsin, 1975-1994.* Madison, WI: Land Tenure Center, University of Wisconsin - Madison.

[44] Hammer, R. S. (2009). Housing growth, forests, and public lands in Northern Wisconsin from 1940 to 2000. *J. Env. Management* , 90: 2690-2698.

[45] Mundell et al. (2007). *Assessing Trends in Forest Parcelization and Development in Minnesota: An Itasca County Case Study.* St. Paul, MN: University of Minnesota, College of Food, Agricultural, and Natural Resource Sciences, Department of Forest Resources. Staff Paper Series 192.

[46] White, E.M. and L.A. Leefers. (2007). Influence of Natural Amenities on Residential Property Values in a Rural Setting. Society and Natural Resources. 20: 659-667.

[47] Sander and Polasky. (2009). The value of views and open space: estimates from a hedonic pricing model for Ramsey County, Minnesota, USA. *Land Use Policy* , 26: 837-845.

[48] Armsworth et al. (2006). Land market feedbacks can undermine biodiversity conservation. *Proceedings of the National Academy of Sciences* , 103: 5403-5408.

[49] Newburn et al. (2005). Economics and Land-Use Change in Prioritizing Private Land Conservation. *Conservation in Practice* , 19:1411-1420.

Merenlender et al. (2004). Land Trusts and Conservation Easements: Who isConserving What for Whom? *Conservation Biology. 18:1.* , 65-75.

Fairfax, S. L. (2005). *Buying Nature: The Limits of Land Acquisition as a Conservation Strategy, 1780-2004.* Cambridge, MA: Massachusetts Institute of Technology.

[50] Lewis, D. J. and A. J. Plantinga. (2005). Market-based policies to reduce forest fragmentation and risks to interior forest birds. 2005 Annual Workshop of the Association of Environmental and Resource Economists. Jackson Hole, WY.

[51]Shilling and Girvetz. (2007). Physical and financial barriers to implementing a nature reserve newtork in the Sierra Nevada, California, USA. *Landscape and Urban Planning* , 80: 165-172.

[52] Robinson and Brown. (2009). Evaluating the effects of land-use development policies on ex-urban forest cover: An integrated agent-based GIS approach. *International Journal of Geographical Information Science. 23:9.* , 1211-1232.

[53] Peterson, R. (2009, 1 25). *Minnesota Forests for the Future Program (Forest Legacy) Fact Sheet.* Retrieved 1 31, 2010, from Lessard-Sams Outdoor Heritage Council: Resource Plans, Documents and Other Resources: http://www.lsohc.leg.mn/materials/resource_doc_plan/MNForestsFutureProgramFactSheet.pdf

[54] Brown and Kilgore. (2008). *Evaluating the Economic Impacts of Retention and Disposal Policies for Tax-forfeited Land in Northern Minnesota.* St. Paul, MN: University of Minnesota - Staff PaperSeries No. 196.

[55] King and Fairfax. (2005). Beyond Bucks and Acres: Land Acquisition and Water. *Texas Law Review. 83.* , 1941-1984.

[56] In 2009, the state paid $1.278/acre to counties for tax-forfeited lands. This amounted to a little over $3 million to counties affiliated with the Minnesota Association of County Land Commissioners.

[57] Shilling and Girvetz. (2007). Physical and financial barriers to implementing a nature reserve newtork in the Sierra Nevada, California, USA. *Landscape and Urban Planning* , 80: 165-172.

[58] Polasky et al. (2005). Conserving Species in a Working Landscape: Land Use With Biological and Econommic Objectives. *Ecological Applications* , 15: 1387-1401.

[59] Natural Resource Council of Maine. (2009). *Public Land Ownership.* Retrieved 12 21, 2009, from Natural Resource Council of Maine: http://www.nrcm.org/documents/publiclandownership.pdf

[60] Barringer et al. (2004). *The Land for Maine's Future Program: Increasing the Return on a Sound Public Investment.* Augusta, ME: The New England Environmental Finance Center, University of Southern Maine & The Margaret Chase Smith Center for Public Policym University of Maine.

Merenlender et al. (2004). Land Trusts and Conservation Easements: Who is Conserving What for Whom? *Conservation Biology. 18:1.* , 65-75.

[61] Merenlender et al. (2004). Land Trusts and Conservation Easements: Who is Conserving What for Whom? *Conservation Biology. 18:1.* , 65-75.

[62] Standiford and Scott. (2001). Value of oak woodlands and open space on private property values in Southern California. Special issues – Investigación agrarian: sistemas y recursos forestales – Towards the new forestlands commercial and environmental benefits accounting: theories and applications 1:137-152.

Other Policy Tools in Maintaining the Forest Land Base

There are a multitude of policy tools that can be utilized to accomplish various societal goals. This report has concentrated on those determined to be most useful, effective and politically palatable in Minnesota. These tools include conservation easements, land use planning and zoning, preferential taxation, land acquisition and land exchange. This section reviews some of the other existing tools, many related to this addressed above, available to policy makers in maintaining the forestland base.

Other Incentive Programs

This report thoroughly addressed a number of tax incentive programs, but other incentive programs are available to influence landowners' decisions about retention of forestland as well. It is important to address these incentive programs, as they have been a substantial part of forest policy in the United States for a long time. At the federal level, there are a number of incentive programs that are closely related to state programs. These include the Forest Stewardship Program, the Forest Land Enhancement Program, the Conservation Reserve Program, the Wildlife Habitat Incentive Program, the Forest Legacy Program, the Environmental Quality Incentive Program, the Landowner Incentive Program and the Wetland Reserves Program. In addition to these federal incentive programs, 35 other financial incentive programs have been identified at the state level, in addition to the preferential tax program[1]. Most of these programs are cost share programs. A survey of program administrators in the same study demonstrated that financial incentive programs were more effective than preferential property tax programs at encouraging sustainable forest management, of which the maintenance of the forest land base and parcelization were a subset. The respondents also noted that these were less effective than private conservation programs in promoting sustainable forestry, with the exception being the prevention of conversion of forest land to other uses. It is important to note that a number of these programs have had inconsistent or declining funding, decreasing their effectiveness in meeting public policy goals.

Education and Technical Assistance

The need for education and technical assistance is integral in the application of all the policy tools previously examined. Further consideration of education and technical assistance as distinct policy tools is pertinent as well. Reviews of policy tool effectiveness in Minnesota and across the country, have found that education and technical assistance are the most effective policy tools in encouraging certain landowner behaviors[2]. These programs are prolific in the United States and within Minnesota, with a large infrastructure of both public and private entities delivering them, including University of Minnesota Extension, the Minnesota Department of Natural Resources, the USDA Forest Service – State and Private Forestry branch, as well as a host of others. This infrastructure is able to reach landowners regarding diverse topics, which could be used to better address the issue and impacts of forestland parcelization. Education programs are not considered in isolation in this report with the exception of this paragraph, but are extensively discussed as they relate to the other policy tools as well as the derived policy options.

Purchase or Transfer of Development Rights

Purchase or transfer of development rights (PDR)(TDR) programs use conservation easements as the fundamental vehicle through which development rights are purchased or transferred and are briefly addressed in the planning and zoning section. These are singled out here to recognize these as

pertinent tools and to address them independently from the other policy tool analyses. Basically, PDR programs purchase conservation easements, and TDR programs also involve the use of conservation easements. When development rights are transferred from one parcel to another, the fact that the development rights have been removed is recorded through a conservation easement. These programs are often centered around urban areas, yet rural programs such as the Forest Legacy Program is a PDR program as well. As an example, Washington County in Minnesota initiated a program for the purchase of development rights in 2000, with the idea of keeping targeted lands in a natural condition. The transfer of development rights programs are also related to the concept of conservation easements. They function a bit differently, however, allowing developers to buy the development rights from a low-density landowner, such as a family forestland owner, and then transfer those development rights to increase the density of development within an urban area. This is a legitimate tool used in other parts of the country, but needs to work in conjunction with land use regulations that do not exist in Minnesota at this time and that are not likely to exist in the near future.

Forest Banking

There are many different types of forest management structures. Forest banking is one example of these forest management structures which acts as a policy tool that may be utilized to at least partially mitigate some of the adverse impacts of forestland parcelization. This type of policy instrument provides forest landowners with an opportunity to enroll their land into a cooperative, where an institution, separate from the landowner, manages the land for sustainable timber and income production. The landowner forgoes making future management decisions and deposits timber assets in return for a stream of annual payments related to the original size of the deposit. Most often these arrangements have some sort of stipulation against the conversion or parcelization of the enrolled lands. A survey of Virginia forest landowners found that 77 percent were unwilling to enroll in a forest banking program, mostly due to the infringement on private property rights[3].

Public Benefits Ratings System

Public benefits ratings systems are generally used in conjunction with some sort of preferential property tax system. Mostly employed in the Pacific Northwest, these systems utilize an assessment of properties to determine the size of the reduction of taxes or taxable value. A number of counties in the State of Washington use this approach, which is integrated with local land use regulations. Some of the variables include: recreational area, groundwater protection, buffers to public land, trail linkages, forest stewardship land, historic or archaeological sites, shoreline, habitat, riparian buffers, public access and existing easements, among others.

Posting date: 12 May 2010

[1] Kilgore, M.A., J.L.Greene, M.G.Jacobson, T.J.Straka and S.E.Daniels. 2007. The influence of financial incentive programs in promoting sustainable forestry on the nation's family forests. *Journal of Forestry* 105(4): 184-191.
[2] Ellefson, P.V., A.S.Cheng and R.J.Moulton. 1995. *Regulation of private forestry practices by state governments*. University of Minnesota, Agricultural Experiment Station, Station Bulletin no. 605. St. Paul, MN.225p. and Kilgore, M.A. and C.R. Blinn. 2004. Policy tools to encourage the application of sustainable timber harvesting practices in the United States and Canada. *Forest Policy and Economics* 6(2): 111-127.
[3] Sullivan, J., G.S. Amacher and S. Chapman. 2005. Forest banking and forest landowners foregoing management rights for guaranteed financial returns. *Forest Policy and Economics* 7(3): 381-392.

Forest Land Parcelization in Northern Minnesota: A Multi-County Assessment

Kayla Block-Torgerson[1]
Michael A. Kilgore[1]
Steven J. Taff[2]
Stephanie A. Snyder[3]

A Report to the Minnesota Forest Resources Council

December 2010

[1] Graduate research assistant and professor, respectively, Department of Forest Resources, College of Food, Agricultural and Natural Resource Sciences, University of Minnesota, St. Paul, Minnesota.
[2] Associate professor, Department of Applied Economics, College of Food, Agricultural and Natural Resource Sciences, University of Minnesota, St. Paul, Minnesota.
[3] Operations research analyst, USDA-Forest Service, Northern Research Station, St. Paul, Minnesota.

This page intentionally left blank

Table of Contents

Acknowledgements

Principal funding for this study was provided by the Minnesota Forest Resources Council. Additional funding and in-kind support was provided by the MN Department of Natural Resources, Blandin Foundation, and Iron Range Resources.

Executive Summary

Parcelization, the subdivision of land into smaller ownership parcels, is a phenomenon affecting private forest land across the nation, including Minnesota. Forest land parcelization has been found to have a marked adverse effect on wildlife habitat, timber availability, water quality, and recreational access. In 2005, the Minnesota Forest Resources Council (MFRC) identified forest parcelization as the single most important policy issue affecting the economic and ecological health of the state's forests.

This report describes an assessment of forest land parcelization across a ten county region of northern Minnesota. Using ArcMap as the primary data management and analysis tool, digital files containing the boundaries of all real estate parcels in the ten county study area were analyzed to characterize parcelization activity across private forested landscapes in northern Minnesota. Regression analysis was subsequently used to identify parcel and landscape characteristics that are associated with a parcelized forest landscape. A new metric for characterizing a parcelized forest landscape is proposed to address the deficiencies associated with using average parcel size to describe forest land parcelization. This new metric uses average parcel size, but takes into account the spatial extent of the private forested landscape as well as the distribution of private forest parcel size across this landscape. The study's large spatial scale makes it unique among forest land parcelization studies.

Much of the current literature on forest land parcelization focuses on the consequences of a decrease in the average forest land parcel size. Several studies have examined policy tools and land tenure, such as tax policy and changing reasons for forest land ownership, for their contribution to this forest land parcelization. Still others have examined temporal aspects of forest land parcelization. To our knowledge, no study has attempted to characterize the extent to which a large forest landscapes have become parcelized.

The study's original objectives were to assess the extent of forest land parcelization activity in a 15 county area of northern Minnesota that has occurred since 1999 or to the extent historical records will allow, identify characteristics of parcelized forest land, isolate patterns of forest land parcelization, and assess the relationship between forest land parcelization and development. The intent was to assess the feasibility of replicating the methodology used in a previous study that examined forest land parcelization trends in Itasca County, MN (Mundell et al., 2007) such that it could be applied across a large geographic area of northern Minnesota. The Mundell et al. study used property tax records to examine changes in ownership of forested parcels from 1999-2006.

After considerable consultation with county assessors and their GIS staff, it was concluded that the methods used by individual counties to code, record, and manage parcel-level records are

so dissimilar and access (e.g., availability, format) to their parcel-level records so variable, the Itasca County study could not be replicated across the multi-county study area.

Working with MFRC staff, parcel-level GIS ownership data was obtained from the Minnesota Department of Natural Resources (MN DNR) for ten of the study's 15 counties. Data availability dictated that the following ten counties could be included in the analysis: Aitkin, Becker, Beltrami, Cass, Clearwater, Crow Wing, Cook, Koochiching, Lake, and Otter Tail. The data obtained included parcel ownership and attribute data that existed in 2008. Consequently, the study focus and methodology was modified from one that tracks parcelization activity over time to one that describes the extent to which a forested landscape is parcelized. Specifically, the study sought to:

- Identify site & proximity characteristics of private forest land in northern MN.
- Evaluate different ways to measure a parcelized forested landscape.
- Identify factors associated with a parcelized forested landscape.
- Identify forest land parcelization patterns in northern MN.

The primary data used in this study is a GIS-based dataset of parcel ownership records across a ten county region of northern Minnesota. For each parcel record, the database contained information such as the owner name, owner address, the parcel's legal description, and the parcel's physical boundaries. Additional GIS layers used were obtained from the MN DNR (http://deli.dnr.state.mn.us). Information regarding population, building and land estimated market values, net effective tax rates, and forest productivity index ratings were obtained through Minnesota Land Economics (http://www.landeconomics.umn.edu) which is a site maintained by the Department of Applied Economics, University of Minnesota.

Once the primary data set was obtained from the DNR, several steps were required to get the data into the proper format required for the analyses to be carried out. These steps were performed in ArcMap version 9.3.1. One of the main tasks was to dissolve common ownership boundaries to create parcels with contiguous owners. Numerous other steps were used to prepare the data, including adding additional information to each parcel record. Once the data was in useable format, a series of maps and histograms were generated to visually portray the state of parcelization across the ten county study area. Modeling work was done using PASW Statistics 17 software (formally SPSS). All ordinary least squares regressions, diagnostic tests, and scatter plots were run using this software.

All individual parcel-level data was aggregated to the survey township, generally consisting of 36 miles. Consequently, all analyses carried out were at the survey township level. Additionally, all survey township-level analyses were carried out at two levels: 1) one that included all private forest land parcels within the township that were at least one acre; and 2) a second that

included only those private forest land parcels within the township at least 20 acres. This two-level analysis was used to test whether there is a large effect from shoreland development, which tends to include small parcels.

A number of maps and graphs were generated for the ten county study area. They include survey township level detail of the following attributes:

- Number of forested parcels.
- Forested acres.
- Average parcel size.
- Percent of parcels adjacent to public water.
- Percent of parcels adjacent to public road.
- Percent of parcels adjacent to public land.
- Percent of parcels within 1 mile of a town.
- Percent change in population.
- Percent change in building value.
- Percent change in forest land value.
- Average net tax rate.
- Total land/bldg. market value.
- Average forest productivity.

All maps and graphs depict analyses of all private forest land within the township as well as only those private forest land parcels at least 20 acres.

The extensive series of maps and graphs created from the data provided depictions of several important physical and economic dimensions of private forest land across the ten county study area. From these maps, correlations were visually discerned between average parcel size, amount of forest land, and total parcels per township. Townships with small average parcel sizes most often have the highest number of total parcels. The maps and figures illustrate the difference between the analyses carried out using all private, forested parcels and only the private, forested parcels at least 20 acres is generally very minor for most attributes examined.

Several studies use average parcel size to characterize the extent to which a landscape is parcelized. In this study, a new metric was developed to measure the extent to which a forest landscape is parcelized, taking into consideration specific features of a forest landscape. This metric is derived from the formula:

$$\frac{\textit{percent of acres < a specified acre threshold}}{\textit{mean parcel size}} \times \textit{total private forest land acres}$$

which simplifies to:

percent of acres < a specified acre threshold x number of private forest land parcels

This new metric makes two adjustments to average parcel size to better account for the distributional and spatial variability of a parcelized forest landscape.

Ordinary least squares (OLS) regression was used to test this new proposed metric for describing a parcelized landscape. Eight regression models were developed; four using all private forest land at least one acre in a township and four using only private forest land parcels at least 20 acres within a township. For each group, four separate models were run; one using average parcel size and three using the new parcelization metric as the dependent variable. For the three models incorporating the new parcelization metric, 40, 60, and 80 acre thresholds were used.

In all eight regression models, the percent change in population, total estimated market value, and percent of forested acres adjacent to public water are significant and positive predictors of a parcelized forest landscape. Adjacency to public roads is significant in models analyzing parcels 80 acres or less in size and 60 acres or less in size, but not when a threshold level of 40 acres is used. When parcels less than 20 acres in size are removed from the analysis, adjacency to public waters is no longer a significant predictor of a parcelized landscape. This can most likely be attributed to the large amount of development along lakeshores in northern Minnesota.

Figure 1 illustrates the extent to which townships within the ten county study area are parcelized, using the proposed new parcelization metric with a 40 acre threshold value.

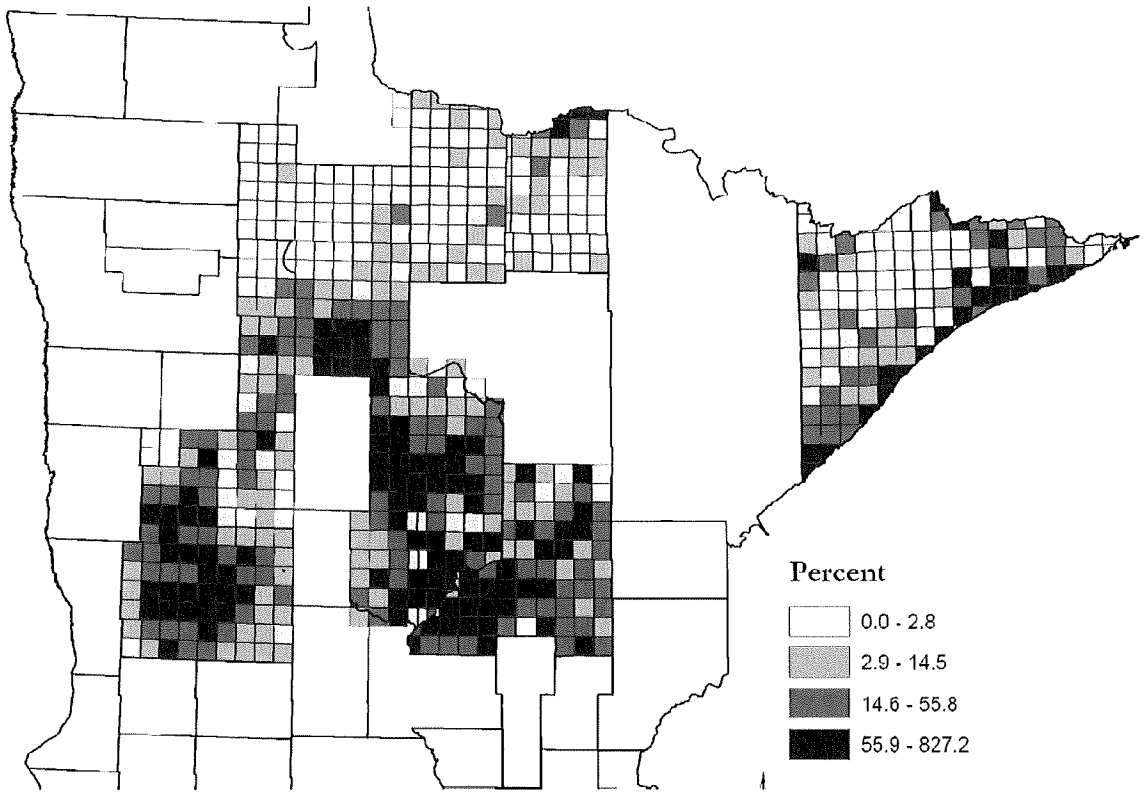


Figure 1. Parcelized forest landscapes (townships) using the new parcelization metric (all forest parcels at least one acre and a 40 acre threshold value). Darker shading indicates a more parcelized landscape.

The results from the analyses illustrate that landscapes experiencing large, positive changes in population tend to be more parcelized. For the data used in this study, this relationship holds regardless of the average parcel size, location of the parcel and amount of forest land in the landscape. Total estimated market value also has a direct and positive relationship to a parcelized landscape; the higher total EMV is for the township, the more parcelized the landscape will be.

This study illustrates the difficulties associated with modeling and assessing parcelization activity across a large forested landscape. It is one of the first to examine parcelization from this point of view; one that looks at the current state of the landscape in an attempt to discern parcelization hotspots. The associations with a parcelized forest landscape identified by this study can be used by policymakers to developing more targeted strategies for addressing parcelization and its associated impacts. Moreover, the methodology employed by this study provides a framework for evaluating drivers and conditions of a parcelized forest landscape across a large geographic area.

Introduction

Parcelization, the subdivision of land into smaller ownership parcels, is a growing concern for Minnesota's forests. Kilgore and MacKay (2007) define parcelization as the fragmentation of land ownership into smaller ownership blocks. While parcelization may appear to be a natural progression of land development to a higher valued use, it can have several adverse ecological and economic consequences. Forest land parcelization has been found to have a marked adverse effect on wildlife habitat, timber availability, water quality, and recreational access.

Of the nearly 620 million estimated acres of forest land in the United States, approximately 63%, or 393 million acres, is privately owned (Butler and Leatherberry, 2004). This means that four out of every ten acres of forest land is owned by non-industrial private forest owners (NIPF). In the east, roughly 83% of forest land is privately owned, while 67% of forest land in the west is public. This pattern resulted from the way and time each region was originally settled (Butler and Leatherberry, 2004). Based on the USDA's Forest Inventory Analysis surveys, NIPF ownership in the northeast region of the country has increased from less than 1.7 million owners in the 1970s to over 2 million owners in 1992. The majority of those NIPF owners own parcels less than 10 acres in size (Brooks, 1992).

According to the USDA, between 1982 and 1997, 10 million acres of private forest lands were developed (Germain et al., 2006). In the next few years, NIPF owners are expected to subdivide an additional 5 million acres (Germain et al., 2006). Forest product companies are increasingly divesting their lands. While most of that land will be bought by timber investment management organizations to be managed for timber production, some will be purchased by NIPF owners (Gustafson and Loehle, 2006). Across the country, the number of individuals owning forest land is increasing while the average size of NIPF parcels is decreasing.

This report describes an assessment of forest land parcelization across a ten county region of northern Minnesota. Using ArcMap as the primary data management and analysis tool, digital files containing the boundaries of all real estate parcels in the ten county study area were analyzed to characterize parcelization activity across private forested landscapes in northern Minnesota. Regression analysis was subsequently used to identify parcel and landscape characteristics that are associated with a parcelized forest landscape. A new metric is proposed to address the deficiencies associated with using average parcel size as a measure of a parcelized forest landscape. This new metric

uses average parcel size, but takes into account the spatial extent of the private forested landscape and the distribution of private forest parcel size across this landscape. The study's large spatial scale makes it unique among forest land parcelization studies.

Review of Pertinent Literature

Past studies of forest land parcelization have largely focused on four major areas of investigation: parcelization trends over time, parcelization activity across the landscape, impacts of parcelization, and measures of parcelization activity. The following summarizes forest land parcelization studies in each of these four areas.

Temporal Studies

A study of forest land parcelization was carried out using tax records of Itasca County, MN to examine changes in ownership of forested parcels from 1999-2006. The objective of the Itasca County study was to measure the level of forest parcelization within a defined area over a multi-year period and to relate this parcelization to development activity (Mundell et al., 2007). Minnesota Market Value Files (MVF), which is a database containing a complete record of all real estate in Minnesota, were the primary data used in the study. Within this database, each public and private land parcel is given a parcel identification number (PIN). To track changes in parcelization over time, PINs and deeded acreages were matched in two successive years to track all parcelization activity in the county within this period. This method allowed all parcel splits and combinations to be identified. Parcels were referred to as "parent" and "child" parcels, with the parent being the original parcel that then split into two or more child parcels. The minimum size of parent parcels that were analyzed was 38.5 acres. This allowed for errors in calculation and best fit with Itasca County's parcel identification scheme.

The Itasca County study found that average parcel size increased by 1.06 acres across the county during the seven year study period, and that an estimated 0.4% of private forestland was parcelized each year. The study found that parcelization activity was fairly constant over the 1999-2006 study period. Of the parcels that split, 11% had the same owner for both the parent and child parcels. The study concluded that forest land parcelization was occurring near water, public land, and cities. Additionally, it found that parcelization was strongly tied to development, with two of every three parcels having buildings erected within six years (Mundell et al., 2007).

A study in New York State tracked the differences in merchantable sawtimber from parcels that remained intact between 1984 and 2005 and those that became parcelized (Germain et al., 2007). The study was done using a multiple analysis of variance procedure and found the only variable with significant differences between the two categories of analysis to be mean percentage of basal area, which is the area of a given section of land that is occupied by the cross-section of tree trunks and stems at their base. The study found that subdivision of land for rural residential development leads to lower basal area

and volume of high-value tree species when compared with unorganized parcelization. Other results from the study suggest that as forest parcelization continues, fewer NIPF acres will be available as working forests.

Spatial Studies

A 2009 study by Host and Brown used two spatial analysis categories to measure parcelization: parcelization risk and critical habitat. The parcelization risk analysis used multiple factors to measure a parcels' risk of becoming parcelized—distance to water, wetland density, proportion of public land, land stewardship category, distance to municipality, and distance to major road. All variables were normalized by subtracting the minimum value of a data set from all variables in the set, then dividing the resulting values by the difference between the minimum and maximum value. Mean parcelization risk was calculated for each parcel and mapped based on its risk. The second analysis mapped areas of critical habitat statewide. This was based on positive and negative threats to biodiversity, habitat quality, outdoor recreation, and water quality. Positive features included known occurrences of rare species, biodiversity significance, or abundant game species. Negative drivers included human development, land use, and road density. The study concluded that based on distance to water, roads, and public land, certain parcels are at risk of being subdivided. It also concluded that using critical habitat data did not help identify lands that have a high risk of parcelization.

Donnelly and Evans (2008) developed a digital, spatial dataset of ownership parcels in Indiana based on historical maps from 1928 through 1997. They used a similar "parent" and "child" approach that Mundell et al. (2007) used in the Itasca County study to map changes in ownership over time. A transition matrix was used to describe the path of parcelization of parent parcels. The authors found that the most common type of parcel split was where a parent parcel split into two equally-sized child parcels. They also concluded that there was not a dominant type of parcelization among parcels that had not split in the previous time interval, the type of parcelization split was partly dependent on the size of the parcel preceding the split, and the aggregation of parcels often precedes a parcelization event.

Drivers

Parcelization studies have attempted to determine what drives parcelization. Mehmood and Zhang (2001) analyzed associations with parcelization according to supply and demand factors. Supply associations include death, taxes, and uncertainty (DeCoster, 1998). Conversely, demand associations with parcelization include lifestyle choices and urbanization. The reasons for owning forest land today include a greater interest in

aesthetic and amenity values and a decreased emphasis on timber management than in the past (Jones et al., 1995). A study of Virginia private forest landowners found the top three reasons for owning forest land were preserving nature, maintaining scenic beauty, and viewing wildlife (Hodge and Southard, 1992). Similarly, interviews with South Carolina forest land owners found that lifestyle enhancement, which includes pride of ownership, stewardship, privacy, recreation/pleasure, and family, was the main reason for forest land ownership (Haymond, 1988). Studies of northern Minnesota forest landowners further reinforces that many individuals own forest land for amenity purposes, such as recreation, aesthetics, and water access (Fleury and Blinn, 1996, Kilgore et al., 2008). The desire for more open space leads to urbanization. As metropolitan areas expand outwards, suburban fringes consume a large amount of land—much of which is often forest land (Sampson and DeCoster, 2000).

Dennis (1992) evaluated several demographic factors to see if they influenced parcelization in New England forests. He found strong negative correlations between timber harvesting and years of formal education. More highly educated forest landowners were more likely to enlist in voluntary tax programs, even if the programs were restrictive of their timber harvesting. These owners were also more likely to keep their forest land for recreation—but had a higher tendency to post that land as well. Ultimately, this study found that parcel size and owner affluence were significant factors in the behavior of NIPF owners.

A study published in 2009 focused on property taxation and land values as drivers of parcelization (Poudyal and Hodges, 2009). They used county-level panel data from counties in Texas and analyzed that data using an Instrumental Variable regression. Results from their study indicated that property tax rates and rural land values had a positive influence on increasing ownership parcelization.

Metrics

Most research on forest land parcelization has characterized "parcelization" according to average parcel size. For example, studies conducted in Wisconsin used a metric called "mean patch size," which is an area of land with similar land uses (Kennedy and MacFarlane, 2009). Mehmood and Zhang (2001) developed a regression model using average parcel size as the dependent variable to evaluate the influence several independent factors have on the average size of a parcel of forest land. The parcelization study in Itasca County, MN by Mundell et al. (2007) defined parcelization as occurring when a larger parcel split into two or more smaller parcels. A study on logging firms and stumpage prices defined parcelization as parcels becoming smaller and related that to

harvest productivity (Rickenbach and Steel, 2006). Zhang, Zhang, and Schelhas (2005) related forest utility decreases to an increasing number of NIPF owners. They equated this relationship to parcelization as average parcel size was decreasing.

Reduction in the total acreage of forest land across a landscape most often means reduced opportunities to manage forest land for economic returns (Zhang, Zhang, and Schelhas, 2005). This loss of forest land adversely affects several economic sectors that depend on this land base (Sampson and DeCoster, 2000). The traditional sources of income from forests, selling timber products, can often be supplemented by leasing hunting lands. However, as parcel size decreases, managing leased lands for recreation can be difficult (Sampson and DeCoster, 2000). Subdividing large land parcels with a single owner into smaller parcels with multiple owners significantly reduces the usefulness of management plans dealing with wildlife habitat, gainful agriculture, and timber production (Drzyzga and Brown, 1998). Increased development on parcelized forest land can also have negative effects on the surrounding ecosystem. Wildlife habitat and biodiversity are also negatively affected by forest land parcelization.

A study done in Massachusetts using data from 2005 attempted to track parcel ownership (Kittredge et al., 2007). They used parcel tax records and analyzed only undeveloped, forested land. They found that as the study area moved further away from metropolitan Boston, the median ownership size increased from 4.8 to 8.6 acres. The percentage of landowners with larger ownership acreages also increased as the study area moved away from metropolitan cities. The study found the average forest ownership parcel to be 17.9 acres; when parcels less than 10 acres were excluded the average forest ownership parcel size rose to 42.5 acres. The authors also conducted an analysis of parcelization using a proxy variable of the percent of an area's land that is in parcels smaller than 20 acres. They felt that variable was more telling of parcelization than average parcel size.

In summary, the current literature focuses on the consequences of a decrease in the average parcel size of forested land. Myriad factors, such as tax policy and changing reasons for forest land ownership, have been cited as contributing factors to this trend. Previous studies have also examined the temporal aspects of parcelization trends. However, to our knowledge no study has attempted to characterize a landscape as being parcelized based on spatial features of the landscape at a given point in time. The remainder of this report describes my attempt to characterize parcelization across a large forested landscape, as well as better understand those factors that contribute to the parcelization of a forested landscape.

Study Objectives and Approach

The study's original objectives were to:

- Assess the extent of forest land parcelization activity in a multi-county area of northern Minnesota that has occurred since 1999 or to the extent historical records will allow, through 2008.
- Identify characteristics of parcelized forest land.
- Isolate patterns of forest land parcelization.
- Assess the relationship between forest land parcelization and development.

The original intent of this study was to replicate the methodology used in a previous study that examined forest land parcelization trends in Itasca County, MN (Mundell et al., 2007) such that it could be applied across a large geographic area of northern Minnesota. To evaluate the feasibility of replicating this methodology across a multi-county study area, 15 counties in northern Minnesota were contacted to determine if they used similar methods of tax record management as is done in Itasca County. This investigation confirmed that not all counties use Itasca County's methods for recording and managing real estate data and transactions. Further, after considerable consultation with county assessors and their GIS staff, it was concluded that the methods used by individual counties to code, record, and manage parcel-level records are so dissimilar and access (e.g., availability, format) to their parcel-level records so variable, the Itasca County study could not be replicated across the 15 study counties.

Given this finding, the extent and types of spatially-explicit, parcel-level real estate data that was available for each county was explored with the intent to assess whether it would be possible to model ownership changes over time using a Geographic Information System (GIS)-based methodology. While some counties had GIS-based parcel-level data, none had these data for multiple time periods. Further, some counties had no digitized parcel data that could be used in a GIS environment.

Working with MFRC staff, we contacted the Minnesota Department of Natural Resources (MN DNR) to inquire about the availability of parcel-level data that could be used in the study. From them, we were able to obtain parcel level, GIS ownership data for ten of the study's 15 counties. While this data allowed the study to proceed, it also presented a unique challenge. Originally, we had planned to conduct a time-series study to assess changes in forest land ownership over time. However, the data we obtained was the parcel ownership data for a single period in time (2008). Consequently, the study focus and methodology was modified from one that tracks parcelization activity over time to one that describes the extent to which a forested landscape is parcelized. Additionally, it was determined the data could be linked to other data (e.g., census data) to identify

proximity characteristics (e.g., a parcel's distance to a town) that may be associated with a parcelized forest landscape and forest land parcel size. Given these data limitations, the study objectives were modified to be as follows:

- Identify site & proximity characteristics of private forest land in northern MN.
- Evaluate different ways to measure a parcelized forested landscape.
- Identify factors associated with a parcelized forested landscape.
- Identify forest land parcelization patterns in northern MN.

The nature of this study makes it unique among forest land parcelization research in several important respects. First, nearly all of the previous research has been time-series studies to determine whether or to what extent a landscape becomes parcelized. Our approach involves examining the condition of a private forested landscape at a single point in time. Second, the large spatial scale of my study sets it apart from most previous forest land parcelization studies. We analyzed data across ten counties comprising more than 10,000,000 acres of land using a dataset of over 100,000 parcel ownership records. Another distinction between this and most other parcelization studies is that we attempted to measure and describe a parcelized forest landscape, rather than look at the process of parcelization. Parcelization as a process occurs when a parcel is subdivided into smaller parcels and sold to multiple owners. We were unable to examine the parcel-level data in this manner as it reflects conditions at a single point in time (2008). Rather, our study attempted to identify specific factors that are associated with a parcelized forest landscape.

Study Area

The MFRC identified 15 counties to be examined in the study. These counties were grouped into two tiers; Tier I counties include Aitkin, Cook, Koochiching, Lake and St. Louis. Tier II counties include Pine, Cass, Crow Wing, Carlton, Beltrami, Hubbard, Clearwater, Becker, and Otter Tail. Per guidance from the MFRC, Tier I counties were to be the primary focus of the study. If a usable study protocol could be developed, then Tier II counties were to be analyzed. Data availability dictated that the following ten counties could be included in the analysis: Aitkin, Becker, Beltrami, Cass, Clearwater, Crow Wing, Cook, Koochiching, Lake, and Otter Tail (see Figure 2). Additional information about the rationale for their selection is outlined in the Data section of this report.

The ten counties included in this study vary in land area, physical characteristics, population, and land use. Agriculture is a common land use in the southern and western portion of the study area such as Becker and Otter Tail counties, whereas forest is the

predominant land cover in the northern region of the study area. In the northeastern counties such as Lake and Cook, a high percent of the forest land is publicly owned. Koochiching is the most sparsely-populated county and its land cover is predominately forested.

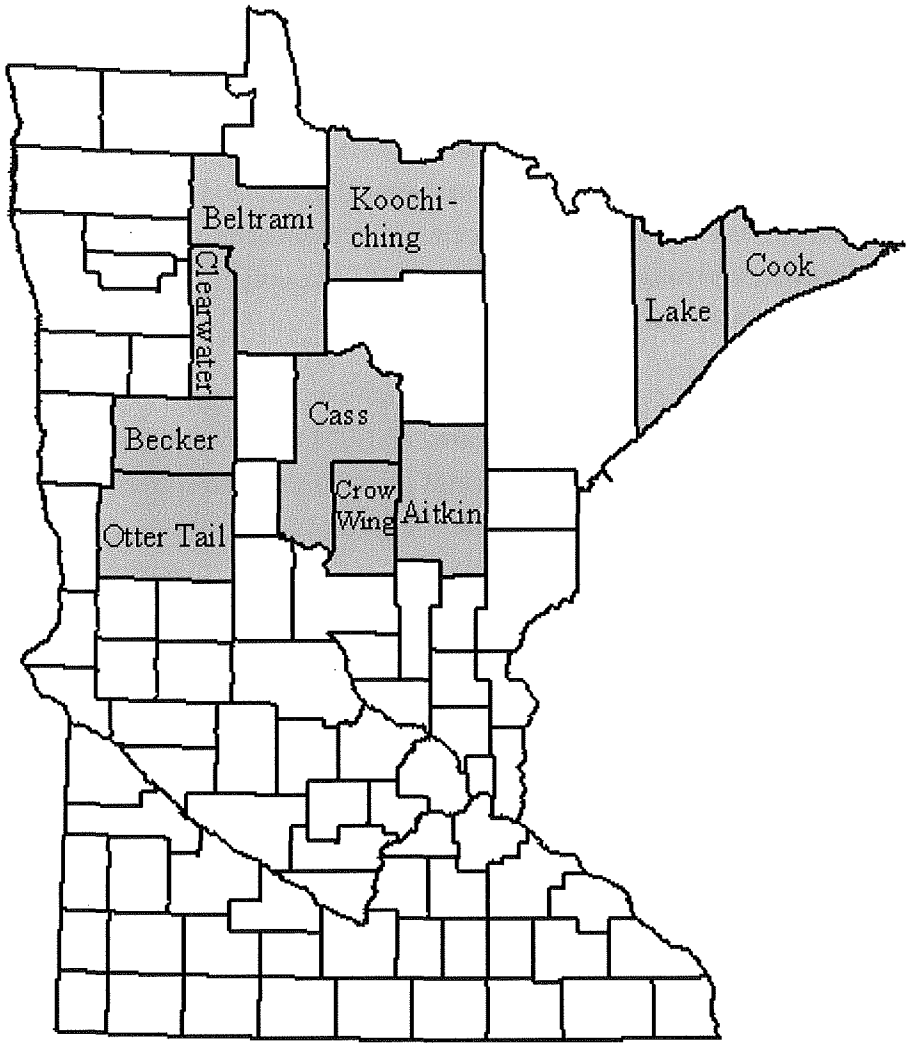


Figure 2. Ten county study area

Aitkin County

Aitkin County is located in north central Minnesota. Its population was 15,301 at the 2000 Census and the county spans 1,215,669 acres. Home to over 300 lakes and 95 miles of the Mississippi River, recreation and tourism are important components of the region's economy. Agriculture and forestry are major economic sectors in the county. There are six incorporated cities in the county ("Aitkin County home," 2009) ("Minnesota quickfacts from," 2010).

Becker County

Becker County is located in west central Minnesota and had an estimated 2006 population of approximately 32,000. Total land area is approximately 838,669 acres and contains over 400 lakes. The county has eight incorporated cities. The main economic sectors in the county include forestry, agriculture, and tourism ("Becker county, Minnesota," 2008) ("Minnesota quickfacts from," 2010).

Beltrami County

Beltrami County, located in northern Minnesota, has a total area of 1,604,695 acres with 16,887 acres of lakes and 459,851 acres of public lands. Six cities are incorporated within the county. The 2008 estimated county population was 43,835 ("Beltrami County Minnesota," 2008) ("Minnesota quickfacts from," 2010).

Cass County

Cass County is located in central Minnesota and has a land area of 1,291,520 acres. Its 2000 population was 27, 150. Twelve cities are incorporated in the county ("Cass County, Minnesota," 2010) ("Minnesota quickfacts from," 2010).

Clearwater County

Clearwater County is one of the smaller counties in Minnesota; its total area is 636,800 acres. With an estimated 2008 population of only 8,249 it is also one of the least populous counties in the state. There are six incorporated cities in the county ("Clearwater County, Minnesota," 2007) ("Minnesota quickfacts from," 2010).

Cook County

Cook County is located in northeast Minnesota, with its southern border along the north shore of Lake Superior. It is bordered to the north by Canada and to the west by Lake County. The county seat is located in Grand Marais, which is also the county's only incorporated city. The county population is approximately 5,000. Of its roughly 1,000,000 acres of land, 89% is publicly owned ("Cook County, Minnesota," 2009) ("Minnesota quickfacts from," 2010).

Crow Wing County

Crow Wing County is located in central Minnesota containing 639,360 acres. Its estimated 2007 county population was 61,390. There are a total of 21 incorporated cities within the county. Crow Wing County is also home to numerous lakes that provide many recreational opportunities ("Crow Wing County," 2008) ("Minnesota quickfacts from," 2010).

Koochiching County

Koochiching County is in northern Minnesota, bordering Canada. Most of its 1,985,510 acres is sparsely populated – there were only 13,281 inhabitants as of 2008. International Falls is the only major city, although there are four other incorporated cities in the county. ("Koochiching County, Minnesota," 2010) ("Minnesota quickfacts from," 2010).

Lake County

Lake County is located along the North Shore of Lake Superior. As of 2009, an estimated 10, 610 people lived in its 2,099 square mile land area. There are three incorporated cities within the county ("Lake County, Minnesota," 2010) ("Minnesota quickfacts from," 2010).

Otter Tail County

Otter Tail County is located in west central Minnesota, directly south of Becker County. Its county seat is Fergus Falls and has 19 additional incorporated cities. The estimated 2008 population was 56,786. Of its 1,428,480 acres of area, 173,851 acres are occupied by lakes. There are over 1,000 lakes in the county, including the large Otter Tail Lake ("Otter Tail County," 2010) ("Minnesota quickfacts from," 2010).

Data

The primary data used in this study is a GIS-based dataset of parcel ownership records across a ten county region of northern Minnesota. This dataset contained parcel data for ten of the 15 counties originally identified by the MFRC for this study. After consultation with MFRC staff, it was decided to limit the analysis to the ten counties for which GIS-based parcel records were available. The parcel data for the ten counties reflect 2008 ownership conditions. For each parcel record, the database contained information such as the owner name, owner address, the parcel's legal description, and the parcel's physical boundaries. Additional GIS layers used were obtained from the MN DNR (http://deli.dnr.state.mn.us). Information regarding population, building and land estimated market values, net effective tax rates, and forest productivity index ratings were obtained through Minnesota Land Economics (http://www.landeconomics.umn.edu) which is a site maintained by the Department of Applied Economics, University of Minnesota.

Methods

Once the primary data set containing individual parcel attributes was obtained from the DNR, several steps were required to get the data into the proper format required for the analyses to be carried out. These steps were performed in ArcMap version 9.3.1. The initial task was to properly identify the size and boundaries of individual land holdings. Initial inspection of the data indicated that some counties record contiguous parcels owned by the same individual as separate parcel records. For example, an individual owning 200 contiguous acres of forest land would have five individual 40-acre parcel records. Consequently, prior to conducting any analysis, parcel boundaries between contiguous parcels with the same owner needed to be eliminated. This was achieved through the use of the dissolve function in ArcView, dissolving on owner names. This process erased adjacent property lines between parcels that have the same owner and produced a dataset with a smaller number of parcels. Once this step was complete, the file then had to be changed from a single part file to a multipart file so that parcels owned by the same person could be recorded as separate parcel records.

Public lands were then removed from the data set. This was done using the select by attribute function in ArcView. Once identified, all public lands were manually removed from the dataset and saved as their own shapefile for later use. Public lands were removed from our parcel database, as this study focused on the fragmentation of private forest land ownership.

The Department of Revenue Identification Number (DORID) file was then added and used to crop the boundaries of the parcel shapefile into individual counties. This step was done in order to identify each city or town by code. That code consists of a unique county code, followed by a unique city code. For example, the DORID number 2030 refers to one city (coded 30) in Aitkin County (coded 20), while the number 2050 refers to another city (coded 50) in Aitkin County. The DORID file was also used to remove all parcels located within city boundaries. Parcels within cities were removed because of the uncertainty whether these parcels were truly "forested," meaning they were over one acre in size and contained at least 50% forest cover. To remove these parcels, the attribute "cities" was selected in the DORID file and exported as a new shapefile. This newly-created cities shapefile was then spatially joined to the parcel file. The "select by attributes" function was then used to select all parcels within a city boundary, which were subsequently deleted from the dataset.

Next, shapefiles from the DNR Data Deli website were then loaded into the ArcView file. These layers include Public Land Survey System (PLSS) township boundaries, Minnesota lakes, ponds, and rivers, and the DOT master road map. The PLSS township file was for the

whole state; consequently it was clipped using the previously created county DORID outline. During the clipping process, negligent "slivers" of townships are created and must be removed in order for the file to function properly. These "slivers" are created because of the syntax used by ArcView when clipping one shapefile based on another shapefile. If they are left in the shapefile, they cause functions to not work properly and to give false results. In the PLSS township file, total acreage was calculated for each township in the attribute table. Any "township" with negligible area (under one acre) was then deleted from the township shapefile. The PLSS township file was added because individual parcel attributes were aggregated to the township level to facilitate analysis and characterization across a large forested landscape.

A "forested" parcel consisted of all parcels containing at least 50% forest land cover. Using data from the National Land Cover Database, a raster file was created which converted over 100 different land use categories into five at the 30 x 30 meter raster scale. The National Land Cover Database is a GIS created by the US Geological Survey that classifies the land cover of the United States. Other federal agencies also collaborate to maintain and update the GIS database, including the US Environmental Protection Agency, the National Oceanic and Atmospheric Association, and the USDA-Forest Service. A raster file stores information in a rectangular grid. Each cell has information that is used to make up the whole file or image. For example, a raster file may simply be a 4 x 4 grid, with each cell either being designated as "on" or "off." The five land use categories into which each private land parcel was reclassified were: 1) annual crops/orchard; 2) grass; 3) trees; 4) water/wetlands; and 5) urban/other. Once this classification was complete, a separate binary indicator was used to classify the land into forest or non-forest using the Spatial Analyst tool, which totals the associated values within each raster cell. In order to interpret this data, all assigned values needed to be reclassified as either zero or one.

The spatial analyst tool within ArcView was utilized to calculate a zonal statistics table. The zonal statistics table creates a data table with a variety of useful metrics regarding the raster data it is analyzing, including mean, median, mode, and count. The zonal statistics table was subsequently joined to the file containing all of the individual parcel records. Two metrics in the zonal statistics table were used to determine if a parcel was "forested." The first, the sum statistic, sums all the "1" values in the forest/non-forest column for each parcel. The second statistic, count, sums all raster squares for the same parcel. By dividing the sum statistic by the count statistic, a percentage of forested land for each parcel is created. All parcels whose sum/count value was under 0.51 were deleted from the data set. The resulting data set was a file containing all private forest land parcels.

Certain counties' designate "undivided ownership interests" when classifying taxable property. Undivided ownership interest occurs when two or more individuals each have equal ownership in a single parcel. In several counties, each owner of an undivided interest in land is recorded as a separate parcel record. This resulted in a situation in which the same parcel is listed multiple times in the data set – one for each owner of the undivided interest. The zonal statistics function does not work properly when undivided interests exist. To remove the multiple listings, a manual inspection of acreages of the parcels was done. When a specific acreage was repeated multiple times, the parcel records were checked to see if the same parcel was listed for each undivided interest. When this situation was encountered, all but one of the entries was deleted. Zonal statistics were subsequently run on the resulting file to identify the private forested parcels in each county.

The new parcel file was then spatially joined with the PLSS township file (a file containing the boundaries of each township) to facilitate analysis at the township level. The resulting parcel/PLSS township file was spatially joined with the DORID file to associate each PLSS township with a civil township. This was done because much of the data used was based on civil townships, which are different than PLSS townships in that civil townships are jurisdictional boundaries and PLSS townships were established through the National Land Survey. The final joined file was exported as a new file.

The National Land Cover Database data was also used to calculate the percent of private forest land as compared to all land for each township. To do so, the National Land Cover Database file was reclassified into "land" and "water" categories. Much like the determination of forested land, the zonal statistics function was used to determine the percent area of each township that was land. This percent was then multiplied by the total township acreage (land and water) to determine the township's total land acres. That figure was then used to calculate the percent of private forest land per township. This calculation was important, as we wanted to limit our analysis only to land cover.

Based on their prevalence in the literature, a number of proximity variables thought to be helpful in explaining a parcelized landscape were identified. The variables that were most often mentioned in the literature, however, were not all replicable given the data or the method of analysis employed. Variables that could not be represented spatially, for example a landowner's need to sell their land to pay medical bills, were not included in this analysis. The proximity variables selected as having possible associations of parcelization included adjacency to: water[4], public land, roads, and cities. Estimating these attributes for each private forest land parcel was accomplished using a binary

[4] As defined by Minnesota Statutes section 103G.005, subdivision 15

indicator column in the attribute table. The "select by location" function in ArcView was used to determine each adjacency feature. For example, if a parcel was adjacent to public waters, it received a "1" value in the corresponding column.

Identifying how population and development affected the parcelized condition of a forested landscape was also of interest. While a variable depicting population change within the township already existed, estimated building market value within the township was used as a proxy variable to represent development. This value is further discussed in the Maps and Descriptions section.

The preceding file was then joined to a five other data tables: population data, timber value data, property tax data, crop and forest productivity data, and agricultural production data. The population data was obtained from the Minnesota Department of Revenue's (DOR) annual Abstract of Tax Lists. This is a database compiled by the DOR from tax data each county is required to submit, including population information and how much was paid in taxes for various categories of taxation. This large database was then aggregated using Pivot Tables in Microsoft Excel and brought back into ArcMap. Maps and histograms were then created from this database in ArcMap and Excel. The database was also used for modeling the associations of parcelization.

Modeling work was done using PASW Statistics 17 software (formally SPSS). All ordinary least squares regressions, diagnostic tests, and scatter plots were run using this software. Data to be used in the modeling work was selected by choosing only those records with at least 10% forest cover and less than 100% forest cover. It was felt that a parcel with less than 10% forest cover could not be managed as forest land and therefore should not be included in the "forested" category. Because of calculating errors when using ArcMap, a few townships were recorded as having more than 100% forest cover; these were not included in the modeling to maintain accuracy.

Each township's private forest land data was defined in two ways. The first included all private, forested parcels with no minimum individual parcel acreage limit. The second definition included only those private, forested parcels that were greater than 20 acres in size. The parcels less than 20 acres in size were eliminated from the second screen to account for the pattern of development around lakeshore, where parcels tend to be very small. By removing only parcels less than 20 acres in size instead of parcels touching the boundary of a lake, large parcels that may have minimal shoreline were retained in both screens. Those larger parcels play an important role in telling the story of parcelization. Forest management plans are more feasible on larger forest parcels. Larger forest parcels also provide more area for recreation and wildlife habitat.

Maps and Descriptions

This study was conducted over a ten county region in northern Minnesota. Any township depicted on a map that is clear is a township for which data was not available for the variable being analyzed. The shading for all townships for which data existed is broken into quartiles. For each variable that is mapped, the two definitions of private forest land were analyzed. The first includes all private, forested parcels regardless of acreage. The second includes only private, forested parcels greater than 20 acres in size.

A standard PLSS township is made up of 36 sections and covers thirty-six square miles of area, or approximately 23,040 acres. Individual townships in the study region range from roughly 400 acres to 25,000 acres. The variability in township area is due to the way the original public land survey was carried out. Townships would often end at major terrain events, such as a river or bluff. Townships are also truncated at county boundary lines. In this study, 555 townships are contained within the ten county study area. Figure 3 illustrates a group of standard townships whose sizes are approximately six square miles. Figure 4 shows smaller townships along the border between counties. Figure 5 illustrates irregular townships bordering a river.

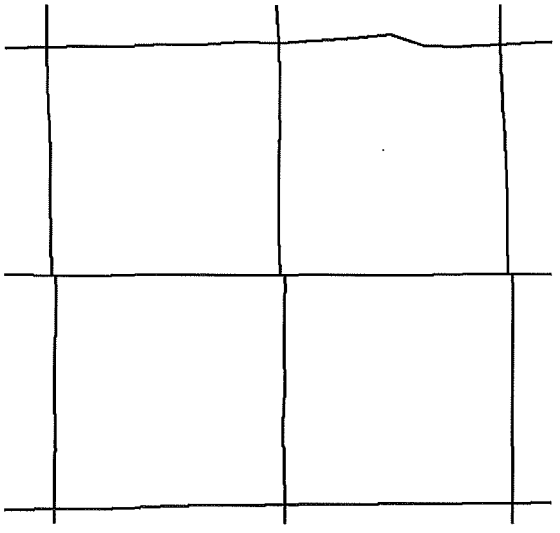


Figure 3. Standard township boundaries. boundaries.

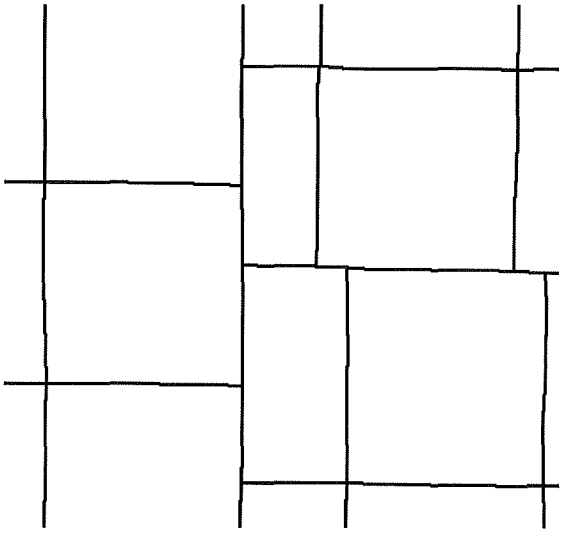


Figure 4. Irregular township

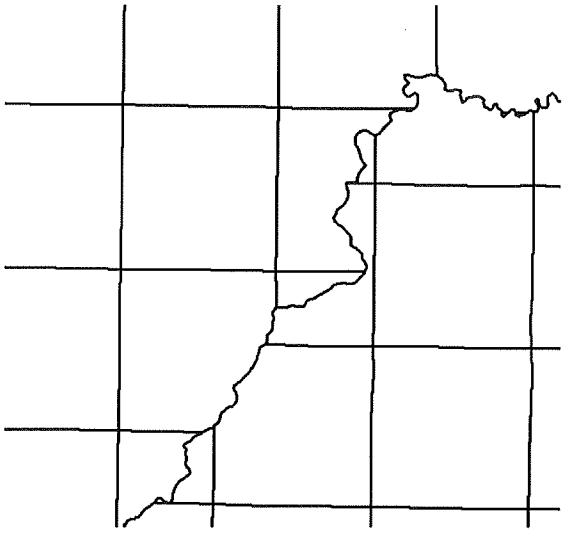


Figure 5. Boundaries between adjacent townships.

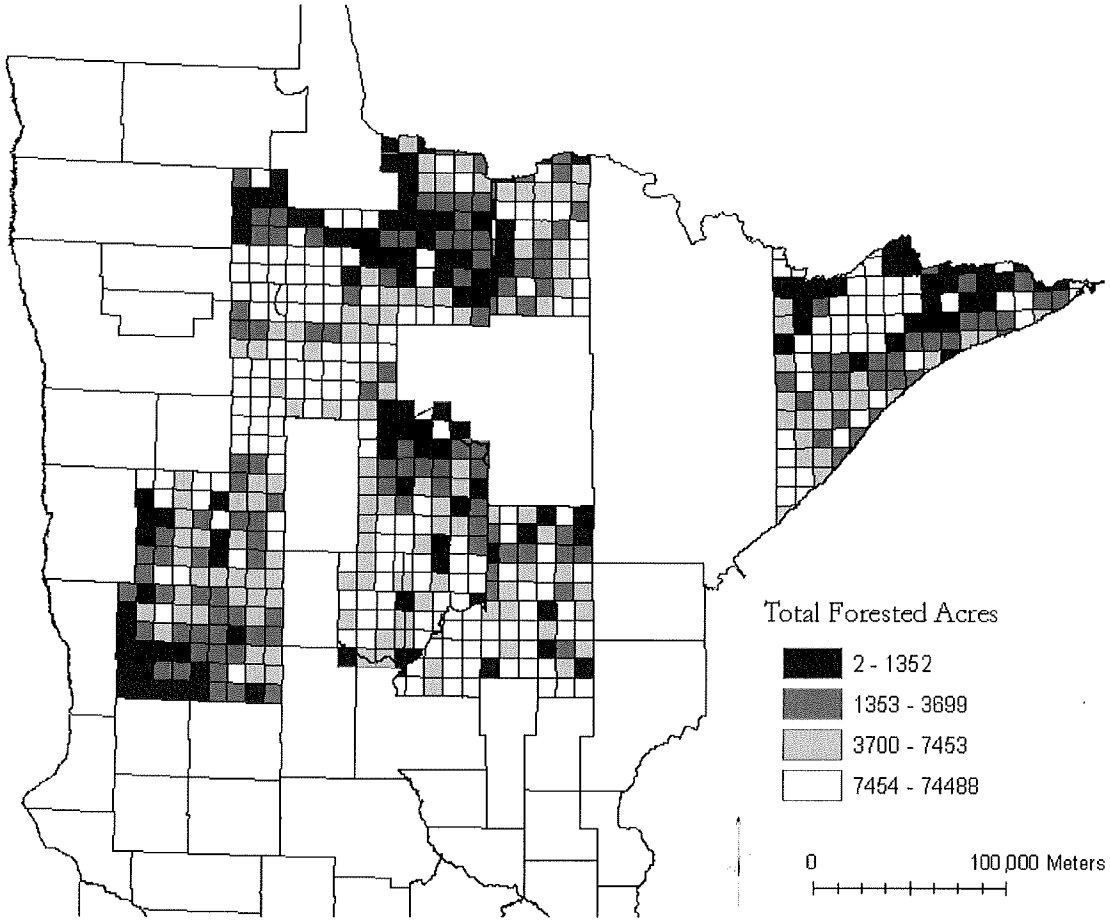


Figure 6. Total forested acres per township.

Figure 6 illustrates the total forested acres per township across the ten county study region. A majority of townships contain between 3,700-24,000 forested acres. Southern counties tend to have smaller amounts of private forest land due to the large amount of land that is agricultural. Cook and Lake Counties also have several townships containing only a small amount of private forest land, but for a different reason. In these counties, while forest is the predominant land use, most of the forest land is publicly-owned.

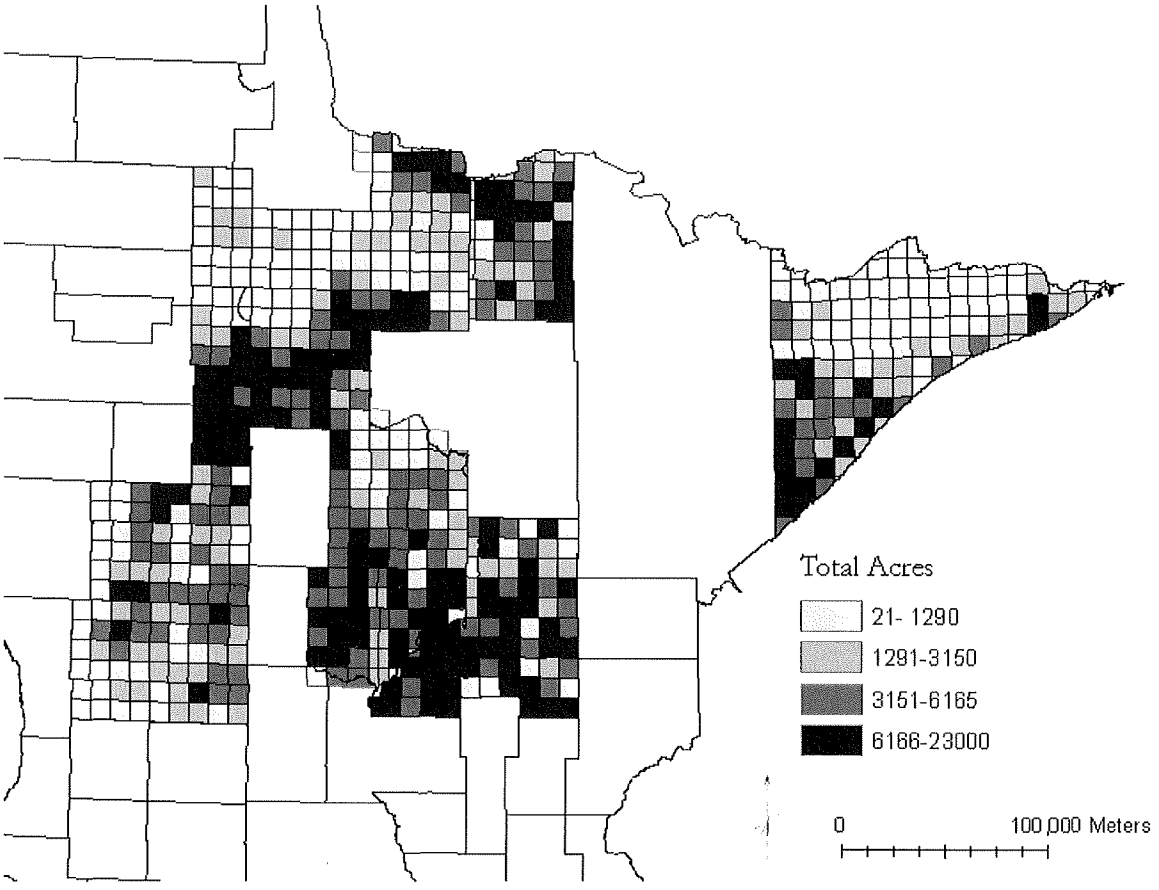


Figure 7. Total forested acres in parcels over 20 acres per township.

Figure 7 shows the total forested acres per township for all forested parcels greater than 20 acres in size. As expected, there is a noticeable decrease in total forested acres per township across the entire study area as compared to Figure 6 which includes all forested parcels. This finding indicates a large amount of forest land is in parcels less than 20 acres.

The average amount of forested land remains high in Becker, Clearwater and southern Lake Counties, as well as in parts of Koochiching County.

Correlations can be seen between average parcel size and the total forested acres in a township. If a township has a large amount of forested acres available for private ownership, there is greater opportunity for larger parcels to exist. Alternatively, when a township has few forested acres, parcel size tends to be smaller.

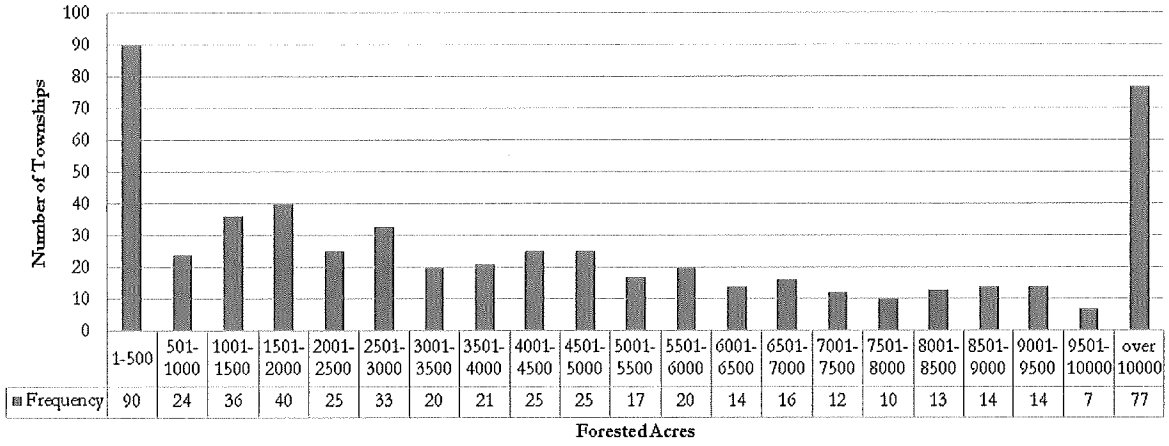


Figure 8. Frequency distribution of total forested acres per township for forested parcels.

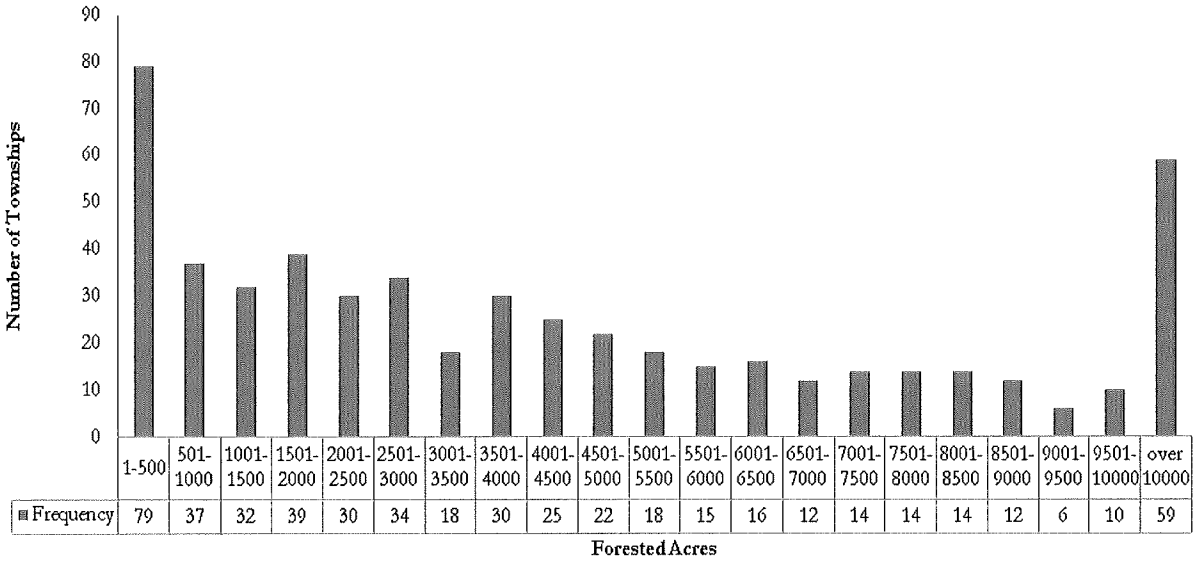


Figure 9. Frequency distribution of total forested acres per township for forested parcels over 20 acres.

Figures 8 and 9 correspond to the maps depicting total forested acres per township (Figures 6 and 7). These graphs are fairly similar in that the largest frequency of townships contain between one and 500 acres of forestland. The number of townships in each frequency bin following the 1-500 acres category gradually decreases.

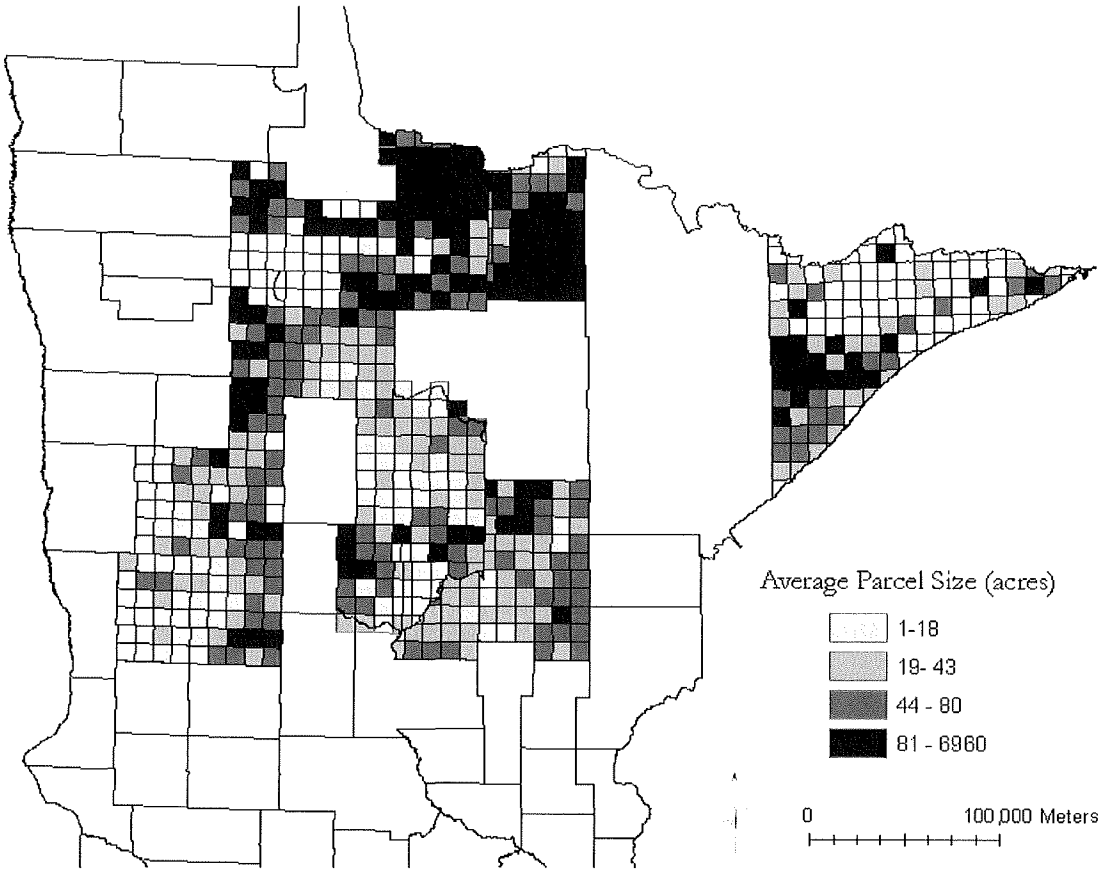


Figure 10. Average forested parcel size per township.

Figure 10 depicts the average parcel size of all forested parcels per township across the ten county study region. A forested parcel is defined as a parcel that has at least 50% of its land classified as forest, based on the study's reclassification of the National Land Cover Database. By looking at the map, one can see that average parcel size is generally higher in the northern part of the study area. The southern counties, such as Otter Tail and Becker, have more agricultural land rather than forest land, which could contribute to the smaller average parcel size. The southern areas also tend to have more population and development, leading to smaller parcel sizes. The average parcel size in Cook County

is smaller than might be expected, given the county's extensive area of forest cover. This can be attributed to the fact that a majority of the forest land in Cook County is public land.

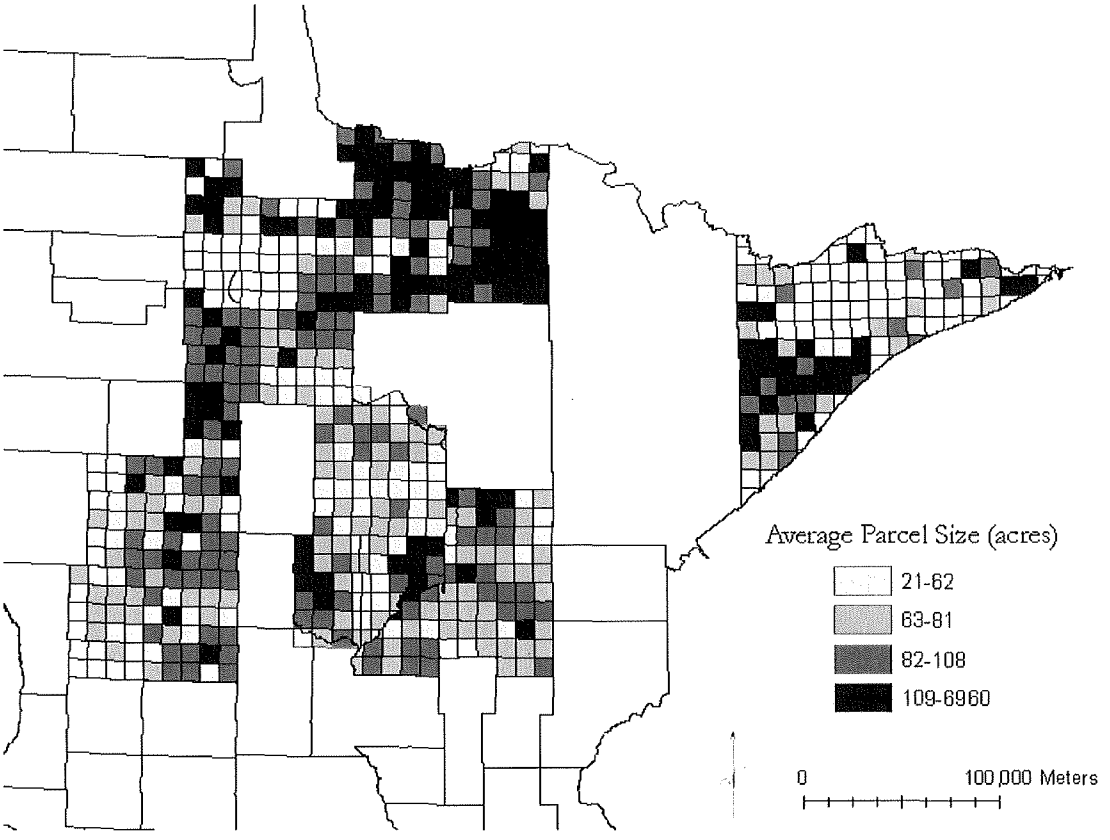


Figure 11. Average parcel size per township in parcels over 20 acres.

Figure 11 depicts the average parcel size for all forested parcels greater than 20 acres per township. The patterns between this and Figure 8 are essentially identical; parcel size tends to be the largest in the northern portion of the study area. The southern counties have a slightly higher average parcel size with the parcels less than 20 acres removed. This was expected; when calculating average parcel size the average will increase when the smallest parcels are removed.

Figure 12 illustrates the frequency of townships' average parcel size. It shows that the majority of townships have an average parcel size between 1 to 40 acres. Out of 554 townships included in this category, only 92 have an average parcel size greater than 100 acres, which represents only 16% of the study area's 555 townships.

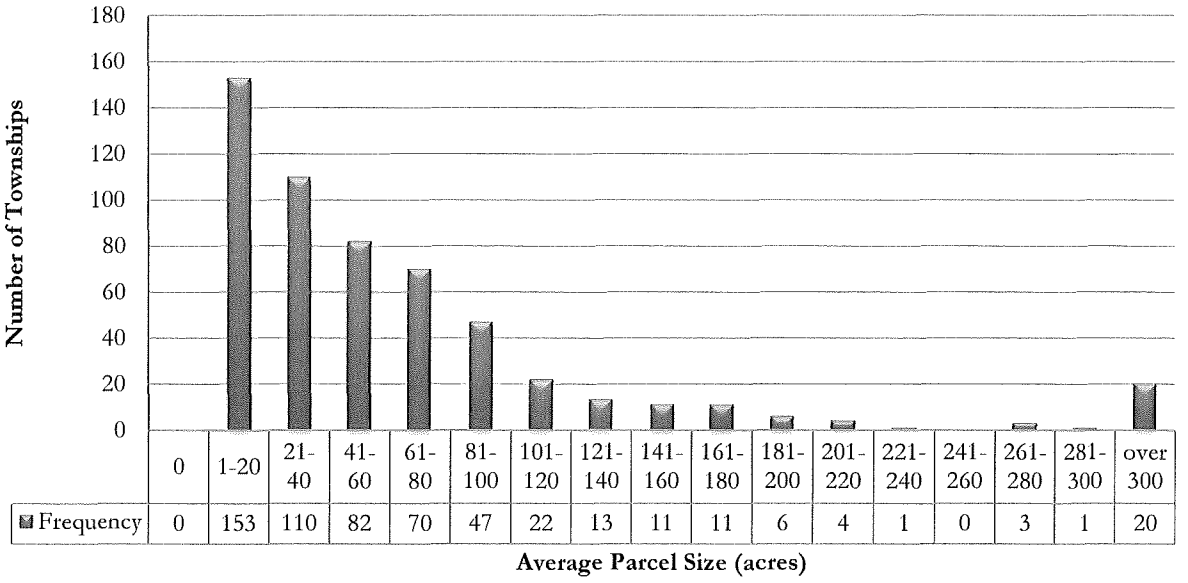


Figure 12. Frequency distribution of average forest parcel size per township.

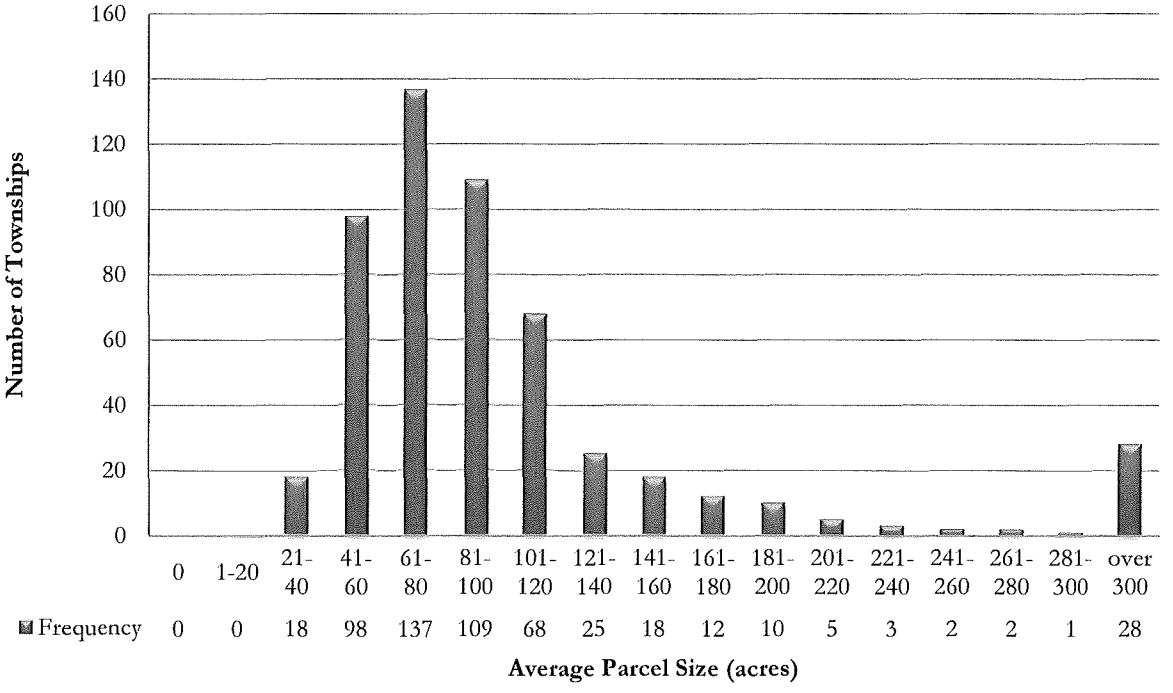


Figure 13. Frequency distribution of average parcel size per township for forested parcels over 20 acres.

Figure 13 illustrates the frequency distribution of the average parcel size for forested parcels greater than 20 acres per township. Again, the majority of townships have an average parcel size less than 100 acres; more specifically 362 out of 536 townships or approximately 68%. The total townships in this screen is not 555, as some townships do not have an average parcel size of 20 or more acres; consequently those townships are not included in this analysis. By comparing the preceding two histograms, one can see the resemblance in their shapes.

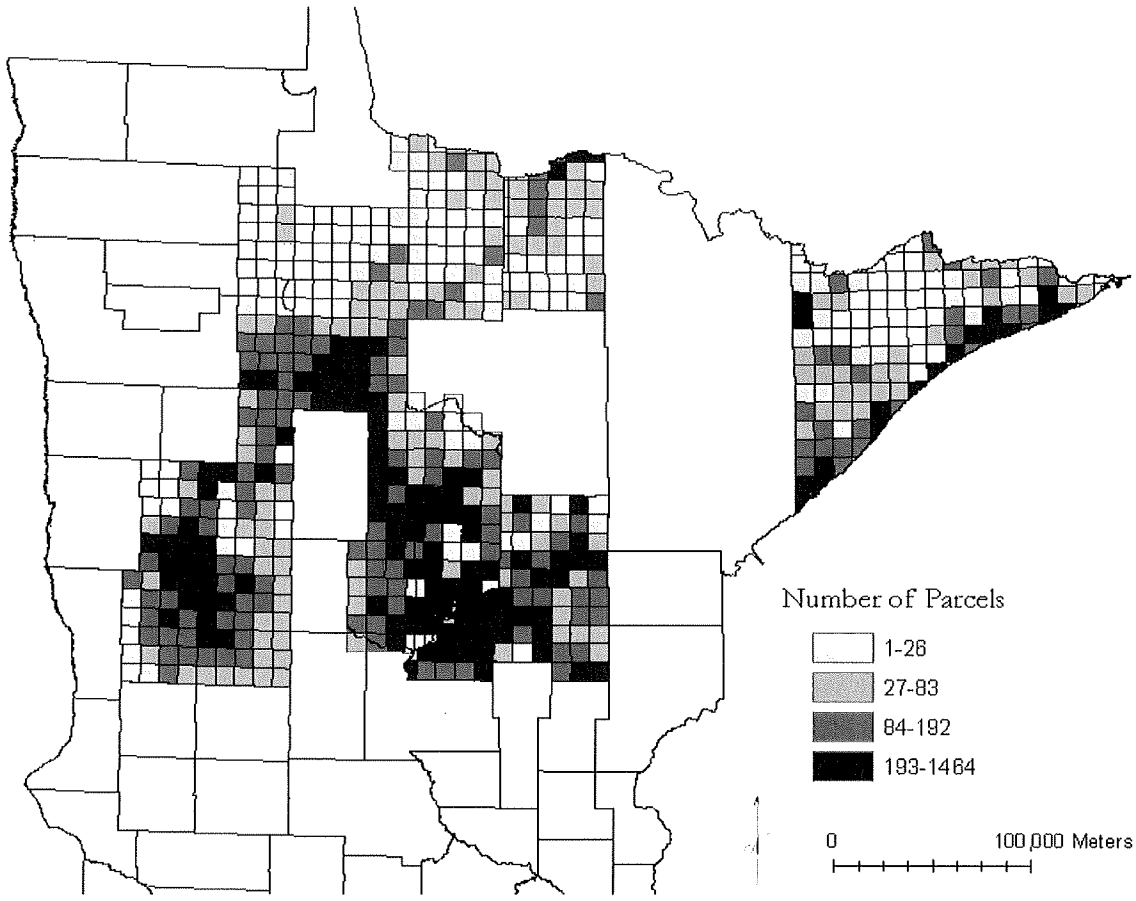


Figure 14. Number of forested parcels per township.

Figure 14 shows the number of forested parcels per township for the ten county study region. The total number of parcels is highest in the southern counties and lowest in the northern part of the study area. Crow Wing County has a very high number of forested parcels per township. This may be due, in part, to the large number of water front lots and their associated small acreage per parcel. Total parcel numbers are also high in Cook and Lake Counties, especially along the boundary of Lake Superior, but then the number of forested parcels quickly decreases as the distance from lakeshore increases.

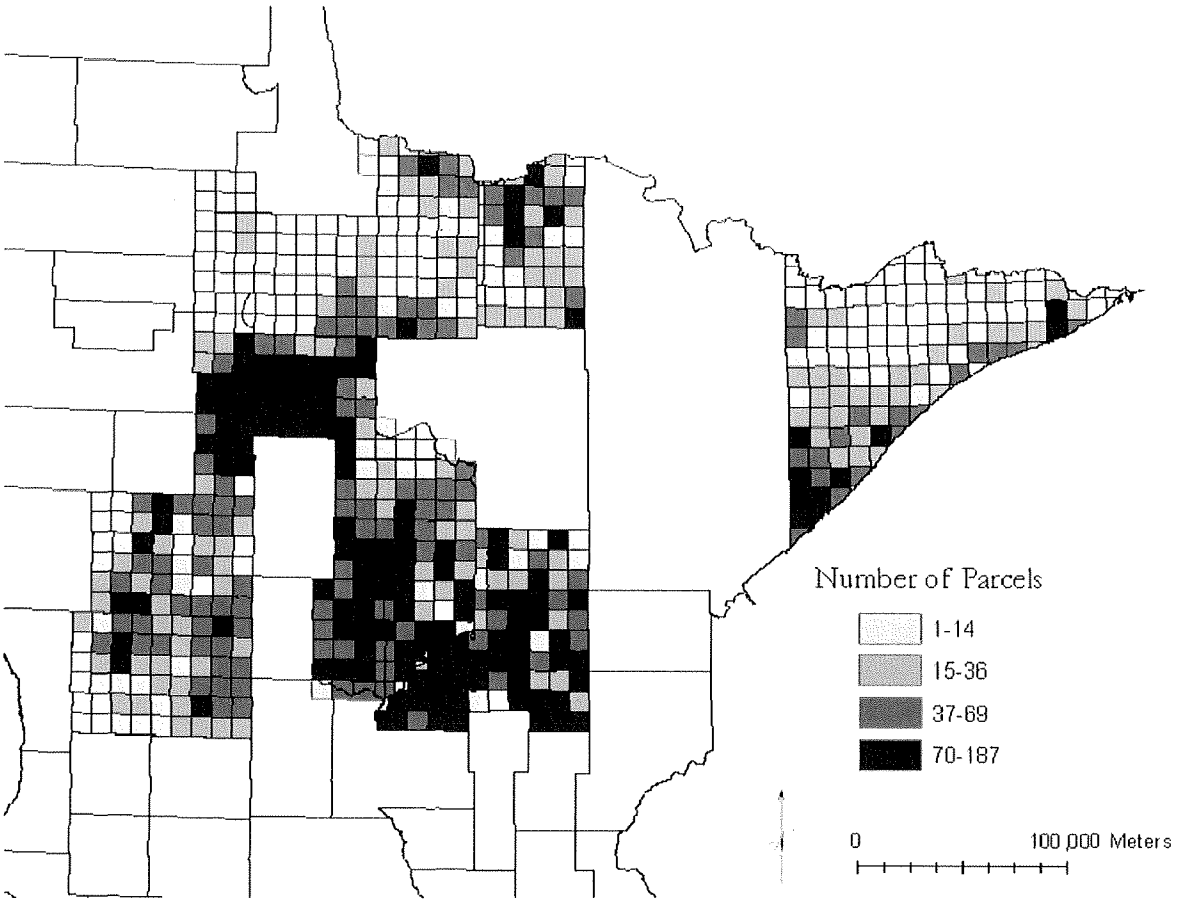


Figure 15. Number of forested parcels over 20 acres per township.

Figure 15 illustrates the number of forested parcels of 20 or more acres in size in each township. The pattern of southern counties having a larger total number of parcels per township than northern counties is similar to the patterns seen in Figure 14 (where all forest land parcels greater than one acre are included). Similarly, the number of forest land parcels is still high in those Cook and Lake County townships that border Lake Superior.

Across the study area, the total number of parcels per township is inversely correlated to average parcel size. When a township has a large number of parcels, the average parcel size tends to be small. This suggests a township containing small amount of private forest land and a large number of parcels tends to have the smallest average forested parcel size. Areas of the maps showing total forested acres and total number of forested parcels to pay particular attention to are those that are the darkest. If a township has a large

amount of forest land and a large number of forest parcels this may indicate the presence of a parcelized landscape.

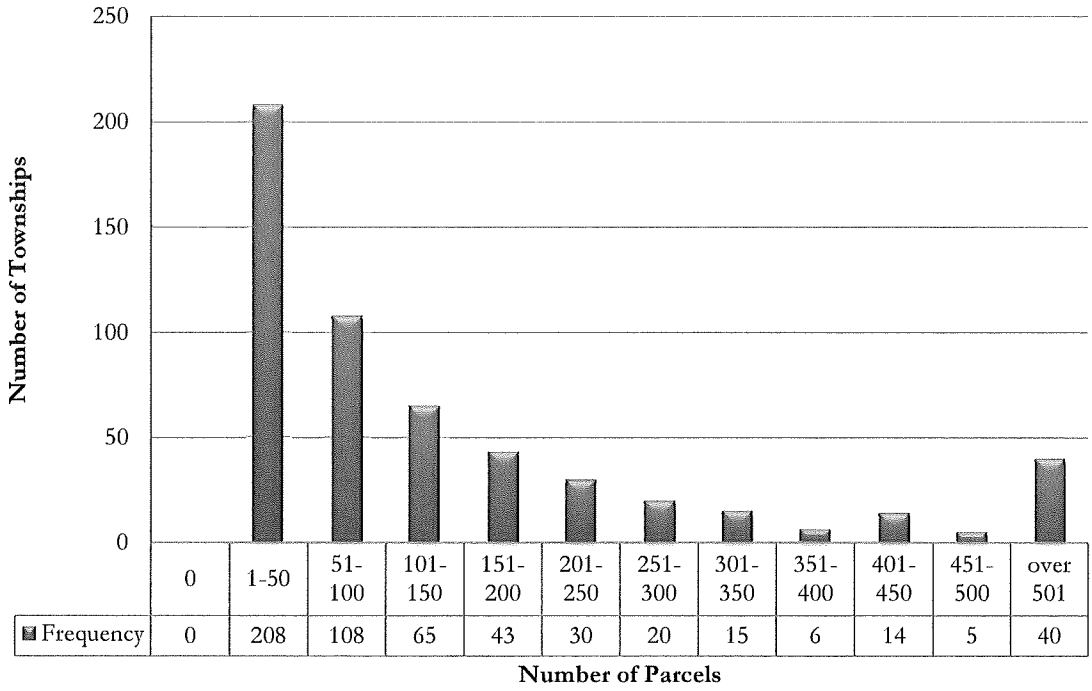
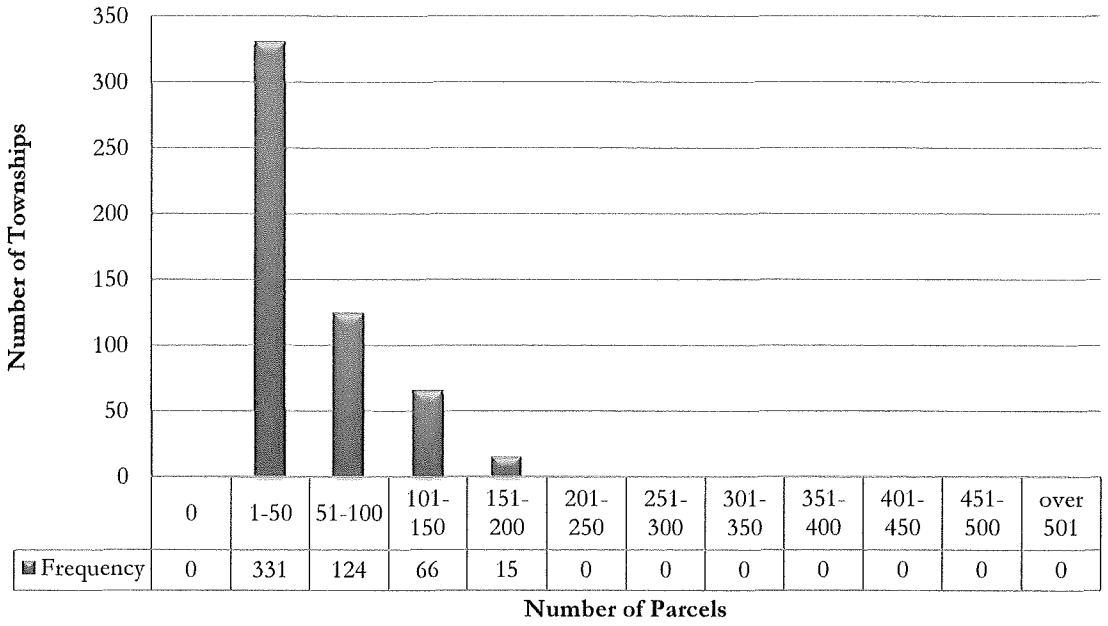


Figure 16. Frequency distribution of number of forested parcels per township.

Figure 16 shows the number of forested parcels per township in a histogram format. The majority of townships have between one to 100 forested parcels.



	0	1-50	51-100	101-150	151-200	201-250	251-300	301-350	351-400	401-450	451-500	over 501
Frequency	0	331	124	66	15	0	0	0	0	0	0	0

Figure 17. Frequency distribution of number of forested parcels over 20 acres per township.

Figure 17 illustrates the distribution of the forest parcel numbers of 20 acres or more in size per township. As with the previous histogram, the majority of townships have between 1-100 forested parcels. Note that in contrast to Figure 16 (no minimum parcel size), no townships have more than 200 forested parcels. This comparison illustrates the large number of forested parcels that are less than 20 acres in size.

The next series of maps portrays information on proximity of forested parcels to features that may have an effect on parcelization. They include adjacency to water, public land, and roads and the parcel's proximity to an incorporated municipality. Maps illustrating the percent of forested parcels containing these adjacency or proximity characteristics were included to illustrate possible associations with average parcel size or number of parcels per township.

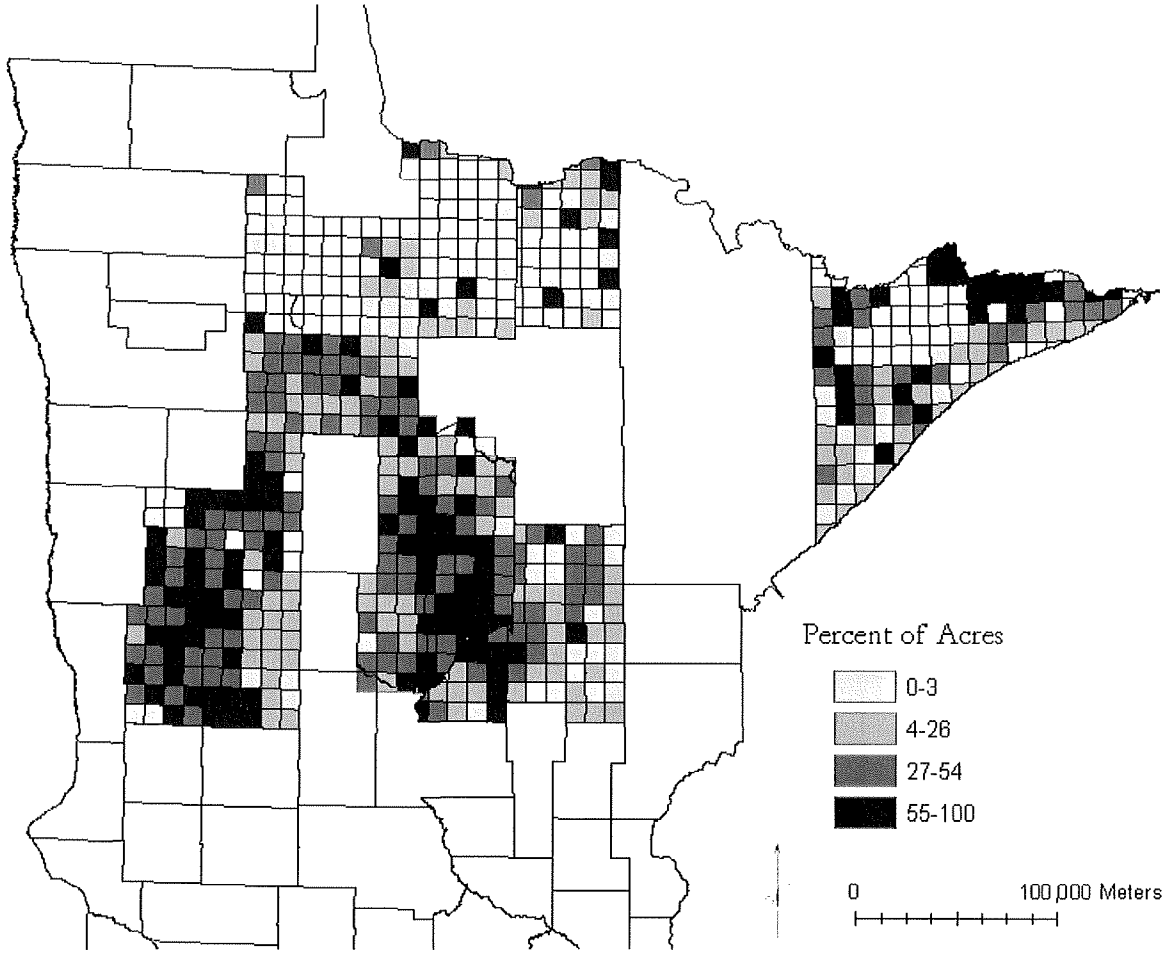


Figure 18. Percent of forested acres per township adjacent to public water.

Figure 18 shows the percent of forested acres per township that are adjacent to public waters. This statistic was calculated by dividing the total forested acreage that is adjacent to water by the entire sum of forested acres per township. As with other descriptions of the study area, the number of forest parcels adjacent to water are generally highest in southern counties and lowest in the north. There are also high portions of Otter Tail County where the percent of forest land adjacent to water is high due to the large number of lakes. Nearly all of the townships in Koochiching County contain little to no forest land that is adjacent to water. Across the study area, half of the townships in the study area have between 27-100% of their private forest land adjacent to water.

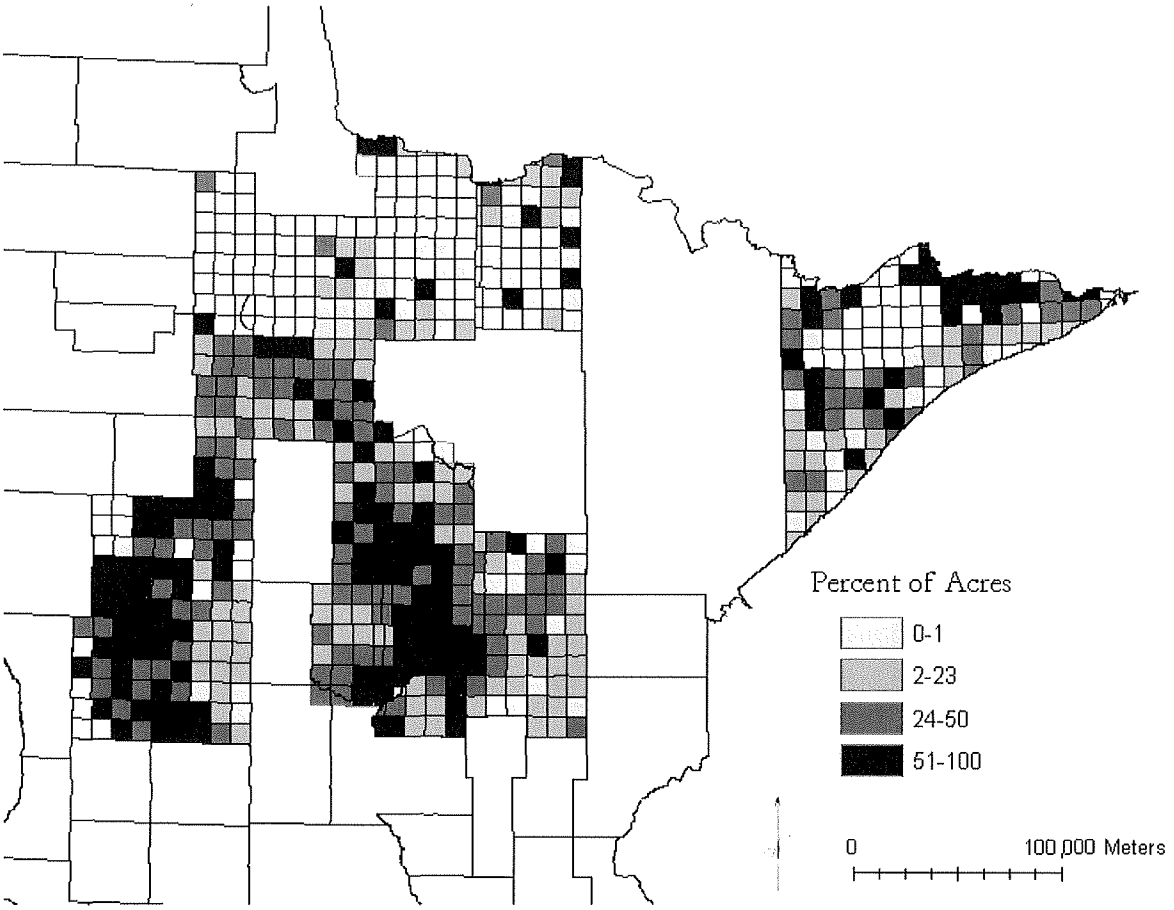


Figure 19. Percent of forested acres in parcels over 20 acres per township adjacent to public water.

Figure 19 illustrates the percent of forested acres of parcels 20 acres or more in size that are adjacent to public waters. Basically the same patterns are evident in this map as in the map that includes all forested parcels. When compared to the analysis that includes all forest land (Figure 18), Otter Tail County has more townships with the majority of its private forest land adjacent to water, while Koochiching County has an even lower percent of its forest land containing water frontage.

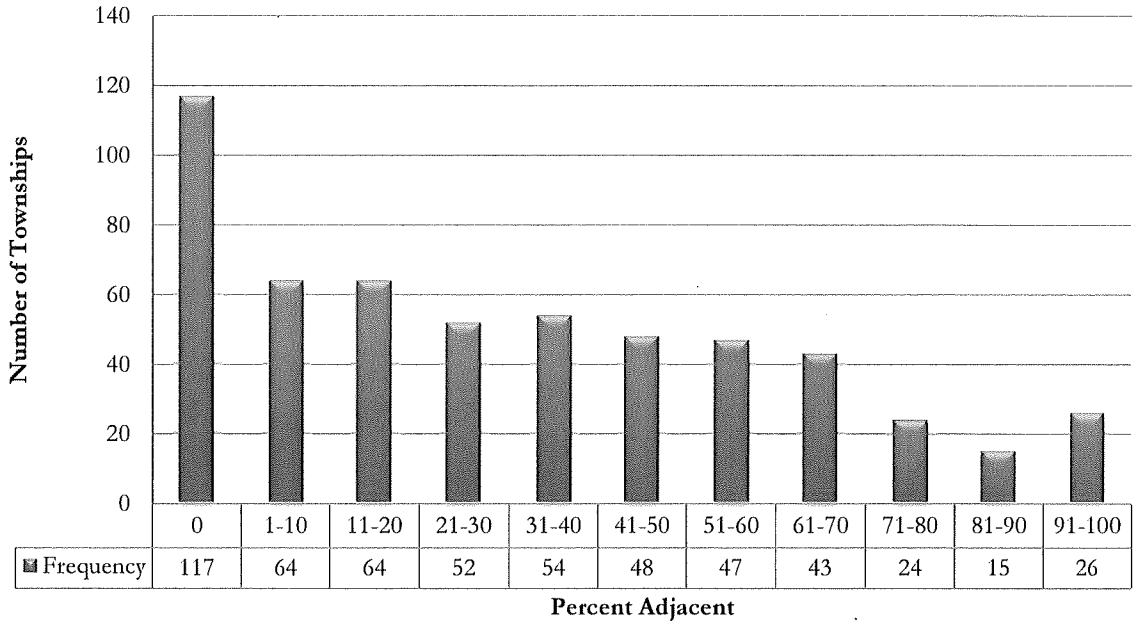


Figure 20. Frequency distribution of percent of forested acres per township adjacent to public water.

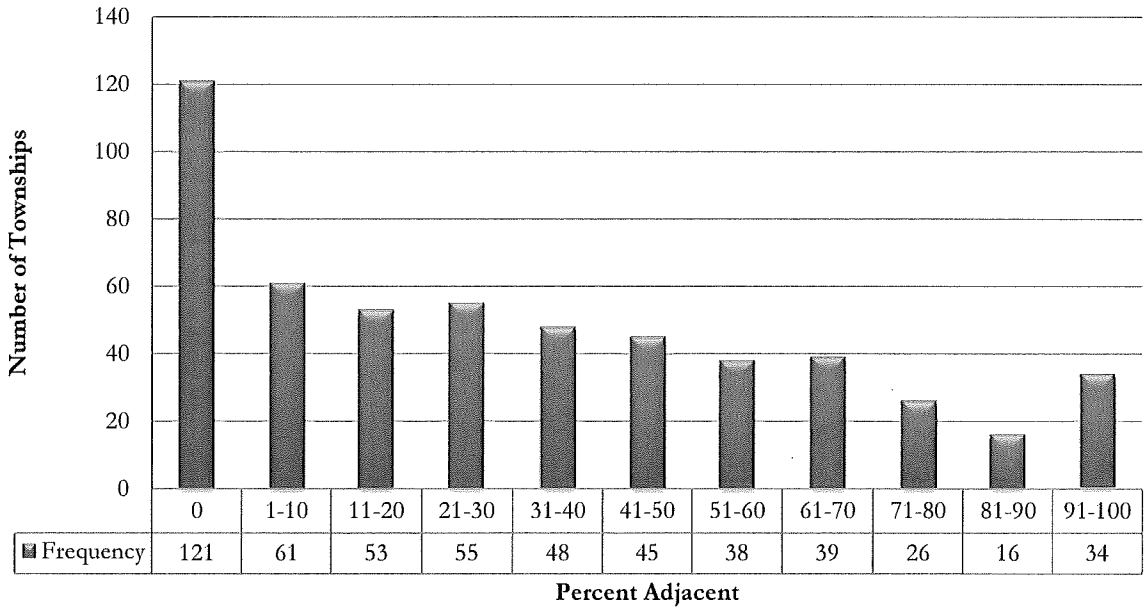


Figure 21. Frequency distribution of percent of acres in forested parcels over 20 acres per township adjacent to public water.

Figures 20 and 21 correspond to the maps showing forest acres per township adjacent to public waters. The number of townships in each bin is fairly evenly distributed, with an

increase in townships having no forest land adjacent to public waters. These two figures are nearly identical, with Figure 21 illustrating a smaller number of forest land adjacent to public waters, which was expected given that all parcels less than 20 acres are not included.

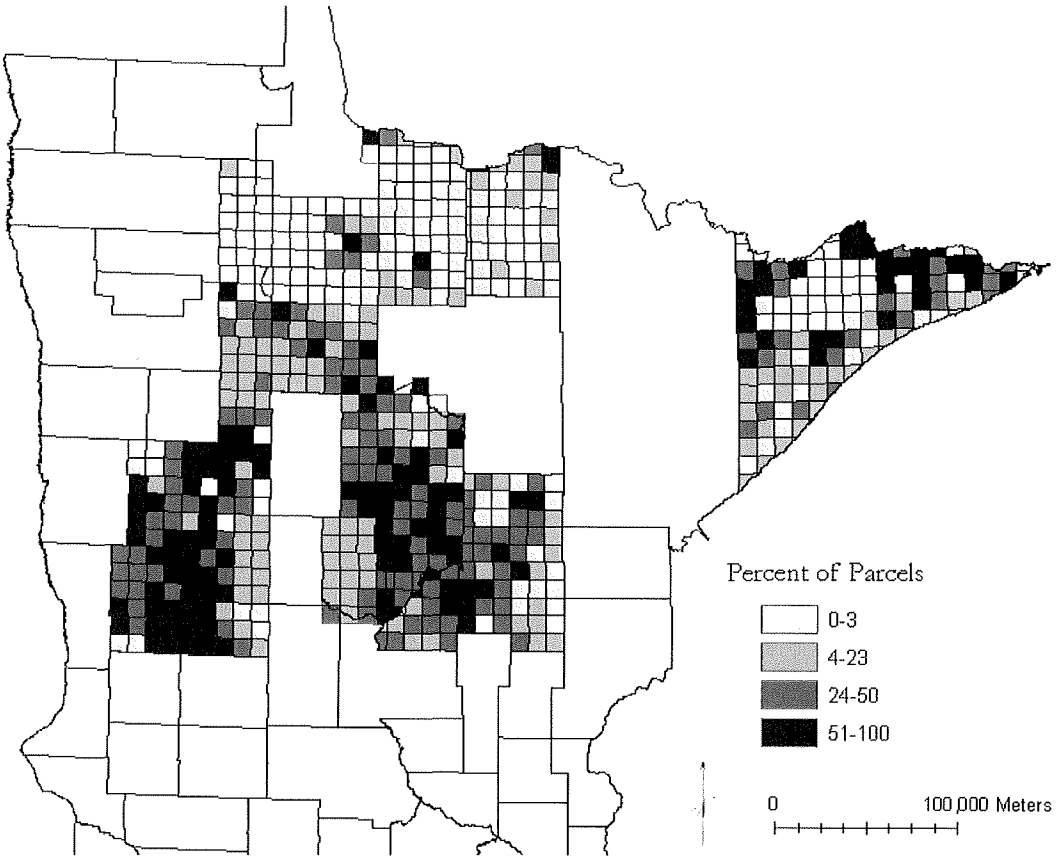
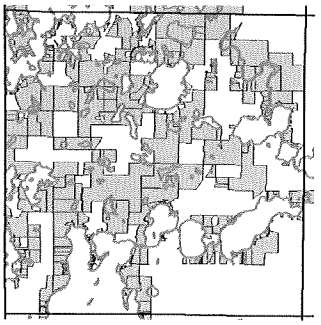


Figure 22. Percent of forested parcels per township adjacent to public water.

At the right, a township from Aitkin County showing all private, forested parcels adjacent to public waters.



Figures 22 and 23 illustrate the same proximity variable, adjacency to public waters, as is presented in Figures 18-21. In these figures, adjacency to public waters is presented as a percent of the number of forested parcels rather than number of forested acres in a

township. The patterns that emerged are strikingly similar to the maps based on acreage, suggesting there may be a correlation between average parcel size and number of parcels.

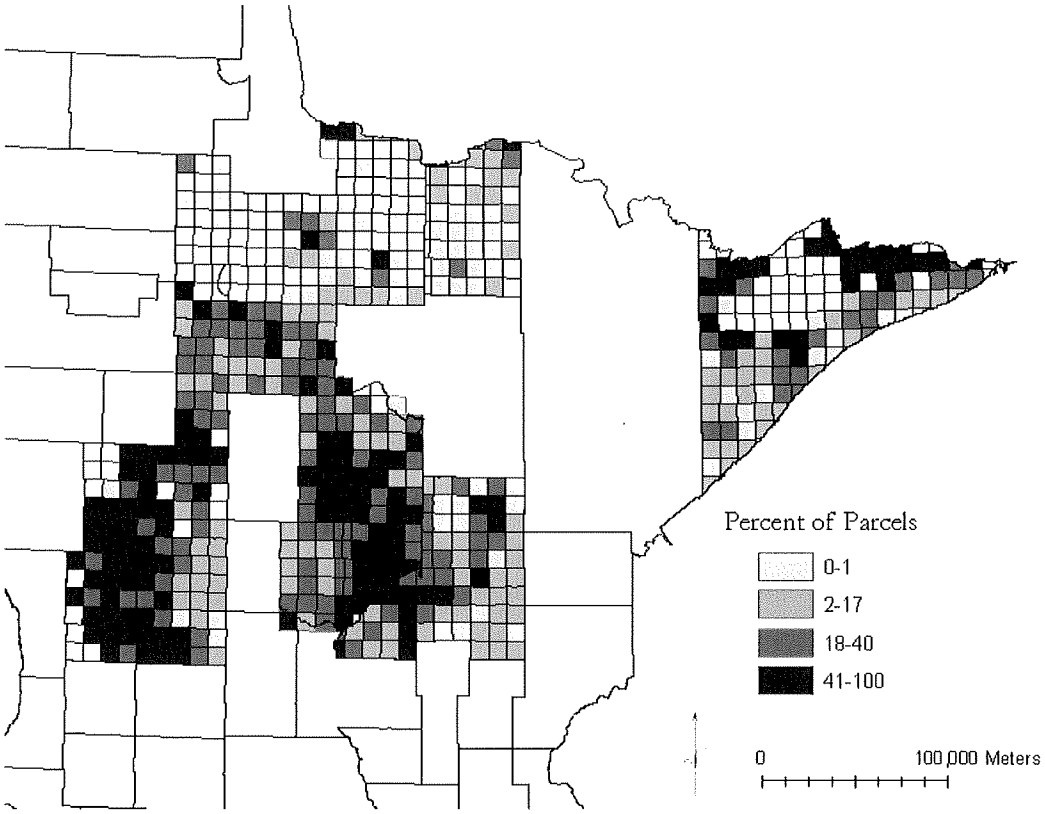


Figure 23. Percent of forested parcels over 20 acres per township adjacent to public water.

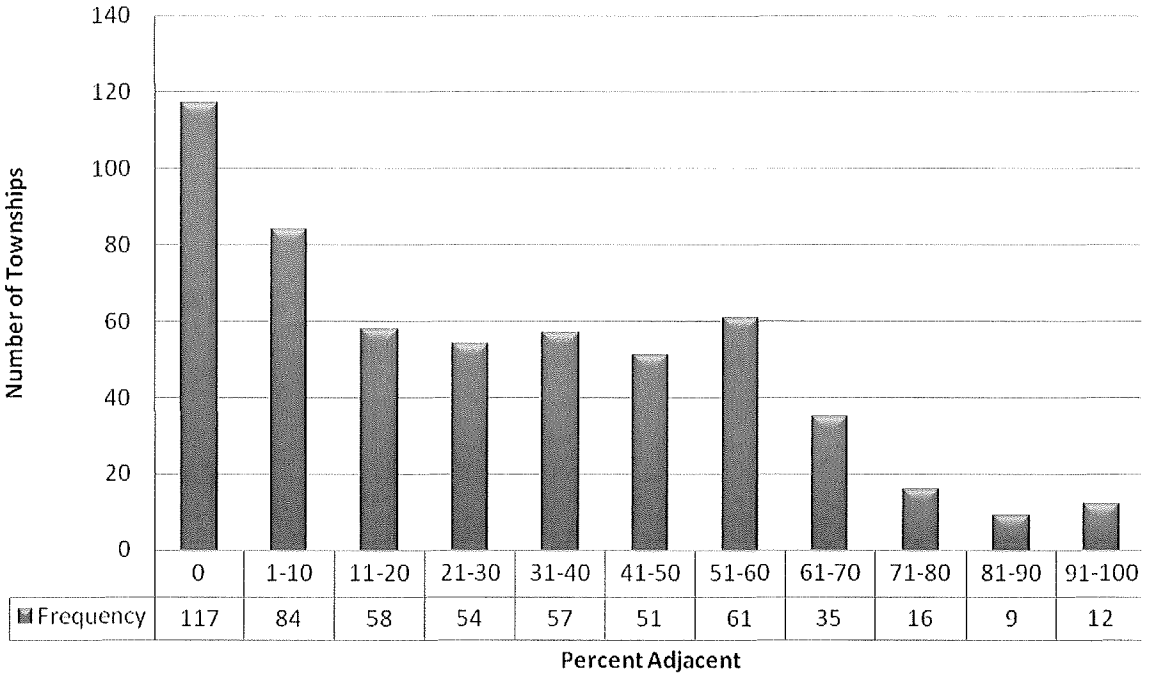


Figure 24. Frequency distribution of percent of forested parcels per township adjacent to public waters.

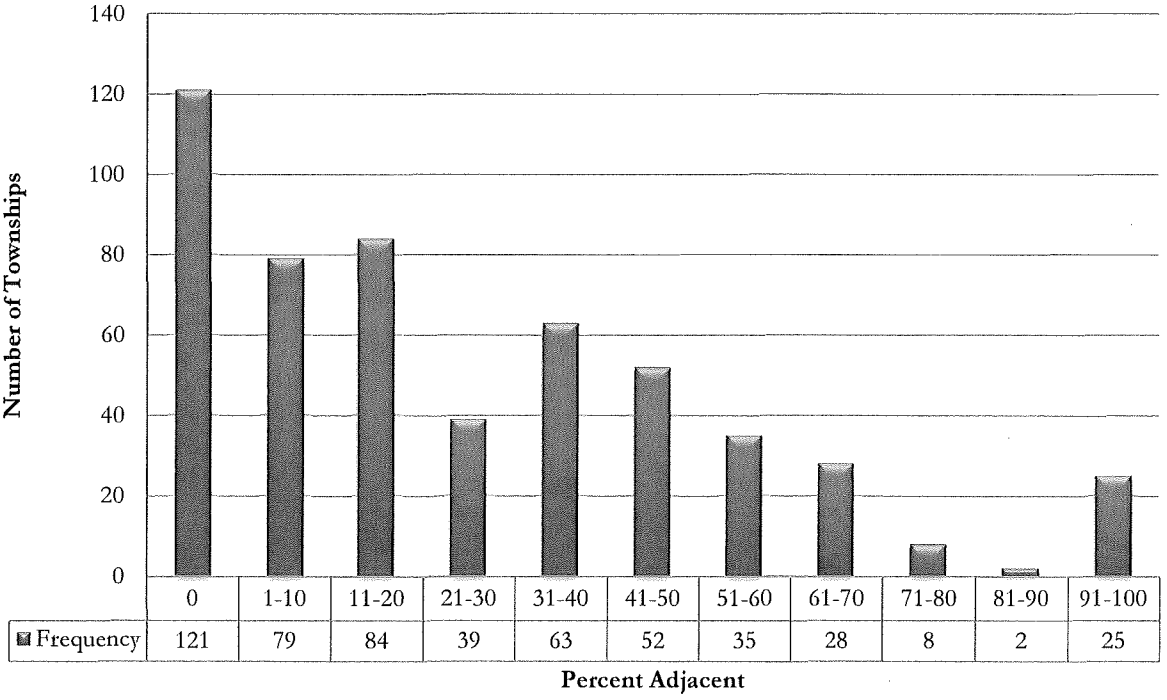


Figure 25. Frequency distribution of percent of forested parcels over 20 acres per township adjacent to public water.

Figures 24 and 25 correspond to the previous set of maps(Figures 22 and 23)showing the

percent of forested parcels per township that are adjacent to public waters. Note the similarity between the two graphs. For both all private forest land in a township as well as only those parcels 20 acres or more in size, the majority of townships did not have any forest land adjacent to public waters. However, unlike the graphs showing percent of forest acres adjacent to public waters, these graphs have a slightly wider distribution with less concentration in the low percentage categories and more townships falling into some of the middle categories.

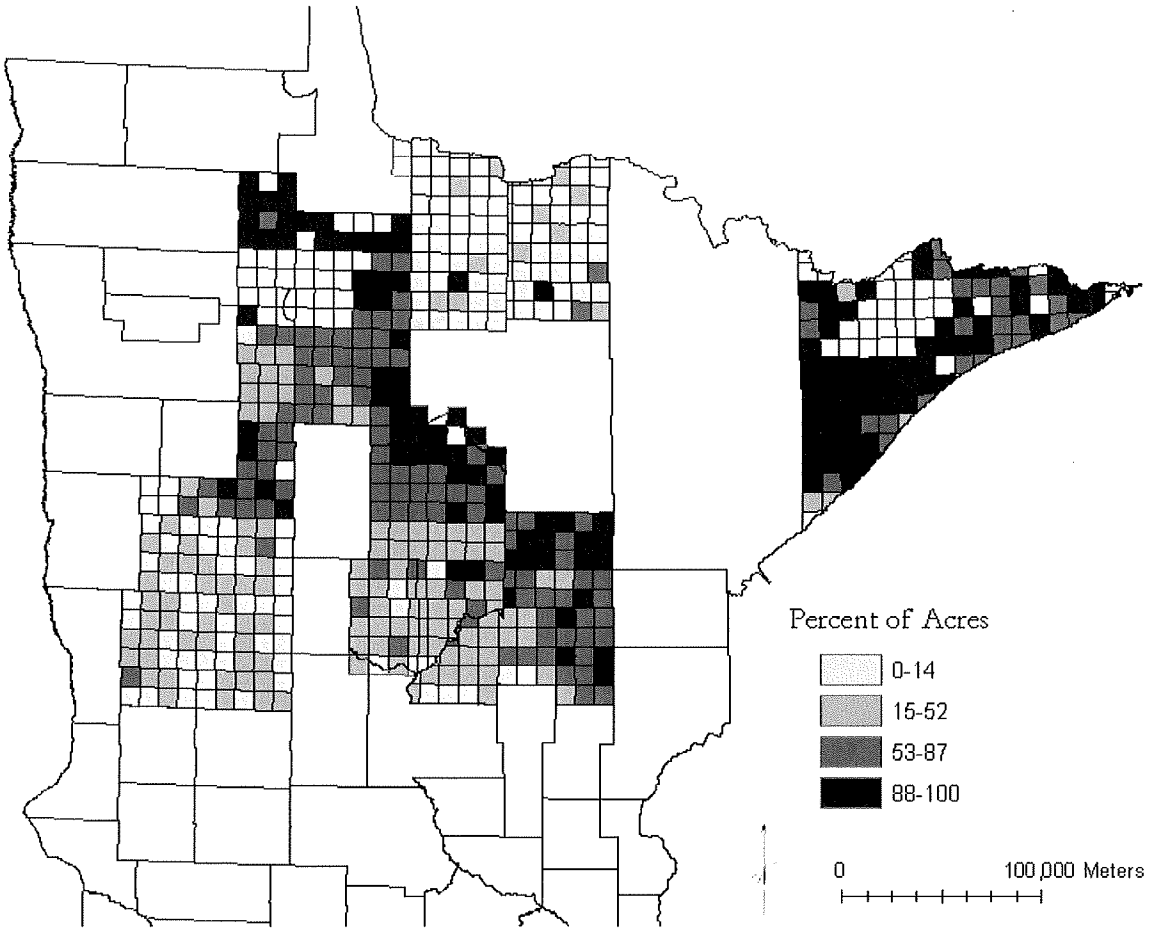


Figure 26. Percent of forested acres per township adjacent to public land.

Figure 26 depicts the percent of forested acres per township that are adjacent to public land. Public land is defined as forest land owned and/or managed by federal, state, or local units of government. This statistic was calculated by dividing the total forested acreage that is adjacent to public land by the sum of forested acres per township. Cook and Lake Counties have the highest overall percentages throughout the county -- almost all townships have between 87%-100% of their forest land adjacent to public land. In

contrast, Koochiching County has low percentages in all townships, in the 0%-14% range, likely due to the large blocks of contiguous private forest land that exist in the county. The large blocks of private forest land exist because of the high amount of public forest land in Koochiching County, indicating that private forest land is concentrated into those large blocks. Several townships in Otter Tail County also contain a relatively low portion of their forest land that is adjacent to public lands. The central region of the study area has most of its townships containing 15%-52% of its private forest land adjacent to public forest land.

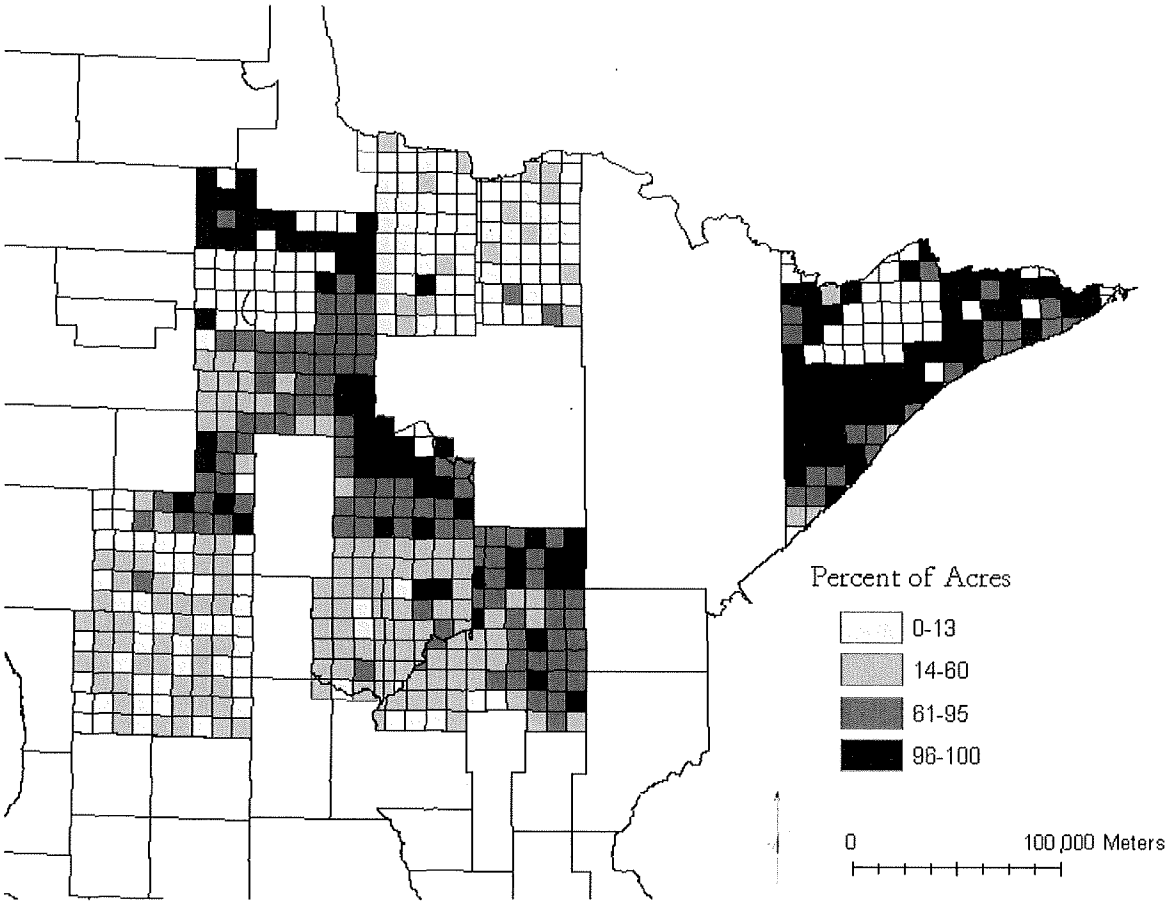


Figure 27. Percent of forested acres in parcels over 20 acres in size per township adjacent to public land.

Figure 27 depicts the percent of forested acres of parcels 20 acres or more in size that are adjacent to public forest land. Patterns between this and the previous figure are nearly identical. One difference can be seen in Cook and Lake Counties where the percent of private forest land parcels adjacent to public land is higher when only larger forest parcels

(> 20 acres) are considered, compared to the percent of all forest land parcels that are adjacent to public forest land.

Interestingly, in the southern part of the study area where many townships had high number of forested acres and total parcels, there seems to be low adjacency to public land rates. This may indicate that adjacency to public land is not a significant driver of parcelization.

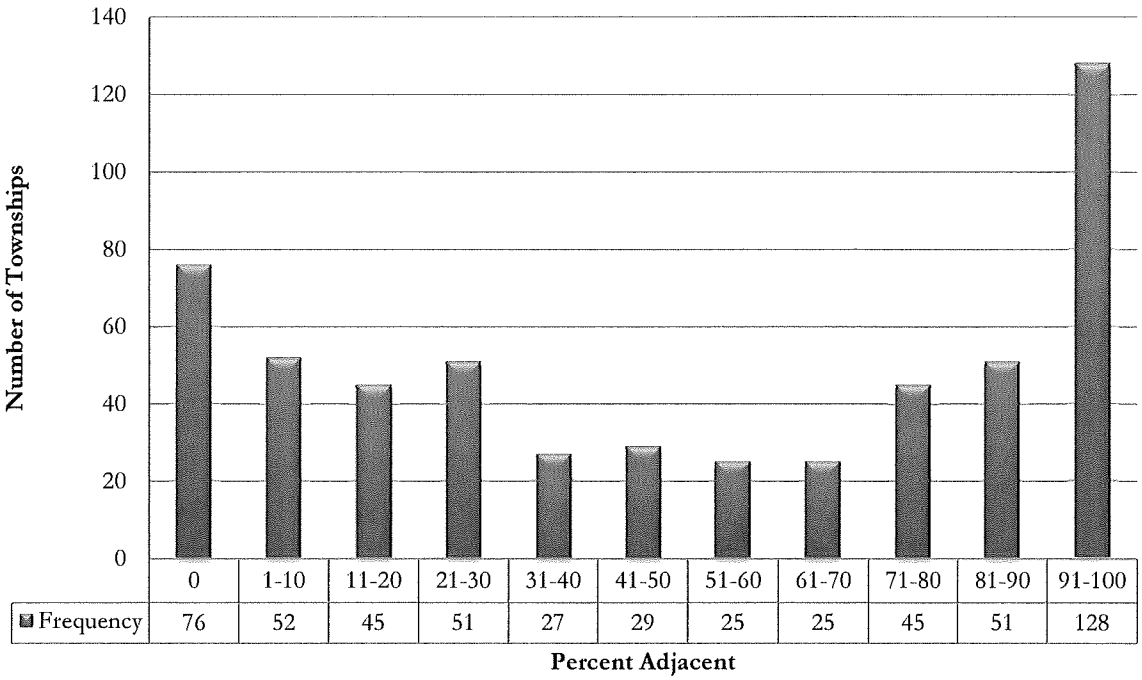


Figure 28. Frequency distribution of percent of forested acres per township adjacent to public land.

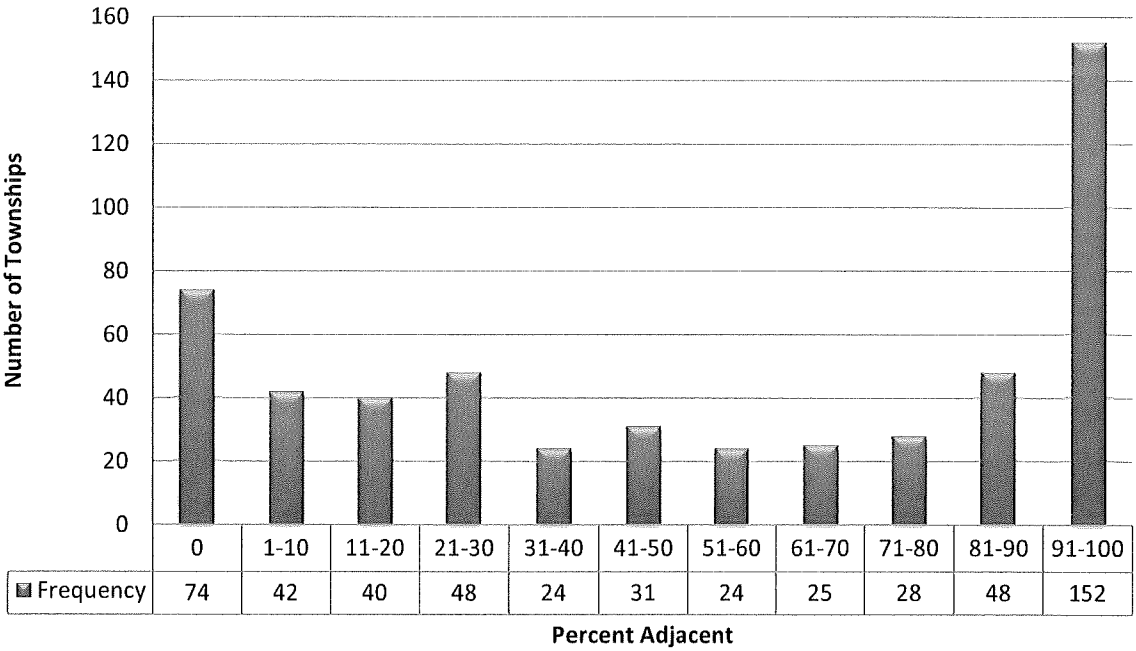


Figure 29. Frequency distribution of percent of acres in forested parcels over 20 acres per township adjacent to public land.

Figures 28 and 29 illustrate the frequency distribution of the percent of private forest acres per township that are adjacent to public land. These two figures have roughly the same frequency distribution, indicating that, on a percentage basis, only a small portion of forest parcels under 20 acres are adjacent to public land. Interestingly, there is a large spike in the number of townships having 91-100% of their forested acres adjacent to public land when only parcels that are 20 acres or more in size are considered. This may be due to landowners with property adjacent to public land that value the recreational value of public land and keep their land forested to increase this recreational value. Note that a considerable number of townships (i.e., nearly 80) have no forest land adjacent to public land.

Figures 30 and 31 depict private forest land adjacency to public forests, expressed as a percent of private forest land parcels, rather than a percent of all private forest land acres, that are adjacent. The similarities between the maps featuring percent of acres adjacent and maps featuring percent of parcels adjacent are evident, reaffirming the likely correlation between parcel size and number of parcels. The distribution of percent adjacent townships only slightly changes between the analysis of acres adjacent and parcels adjacent, it shows that the number of parcels and parcel size are correlated.

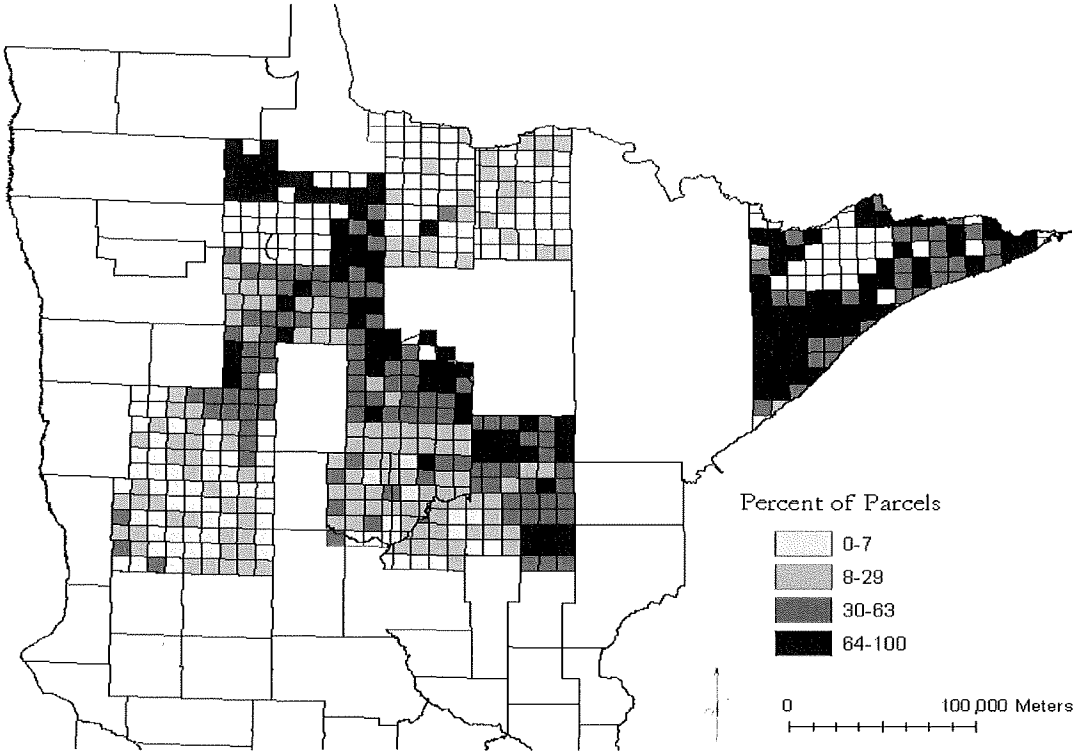
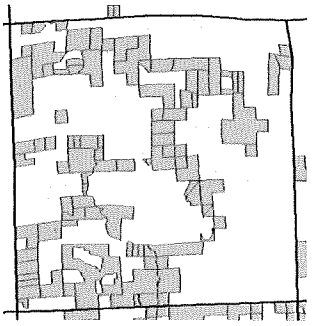


Figure 30. Percent of forested parcels per township adjacent to public land.

At the right, a township from Cook County illustrating parcels adjacent to public lands. Public lands are designated by the dotted pattern.



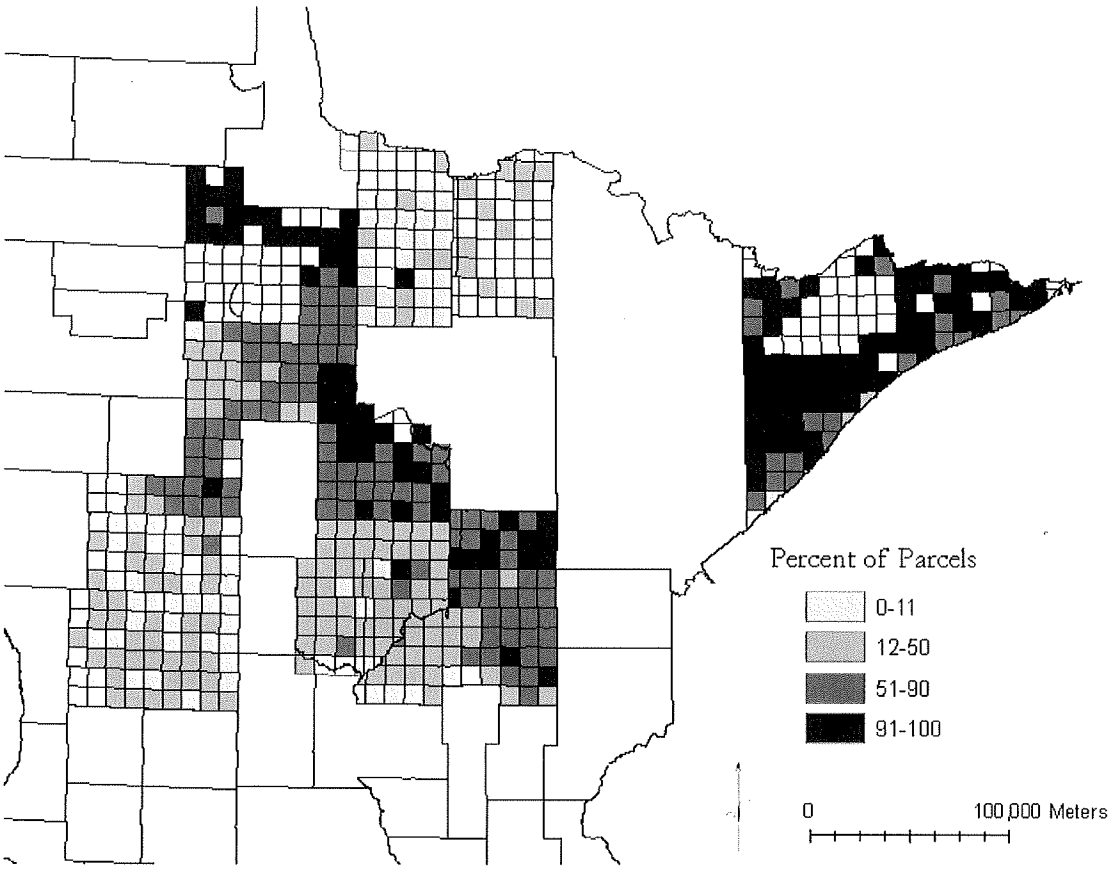


Figure 31. Percent of forested parcels over 20 acres in size per township adjacent to public land.

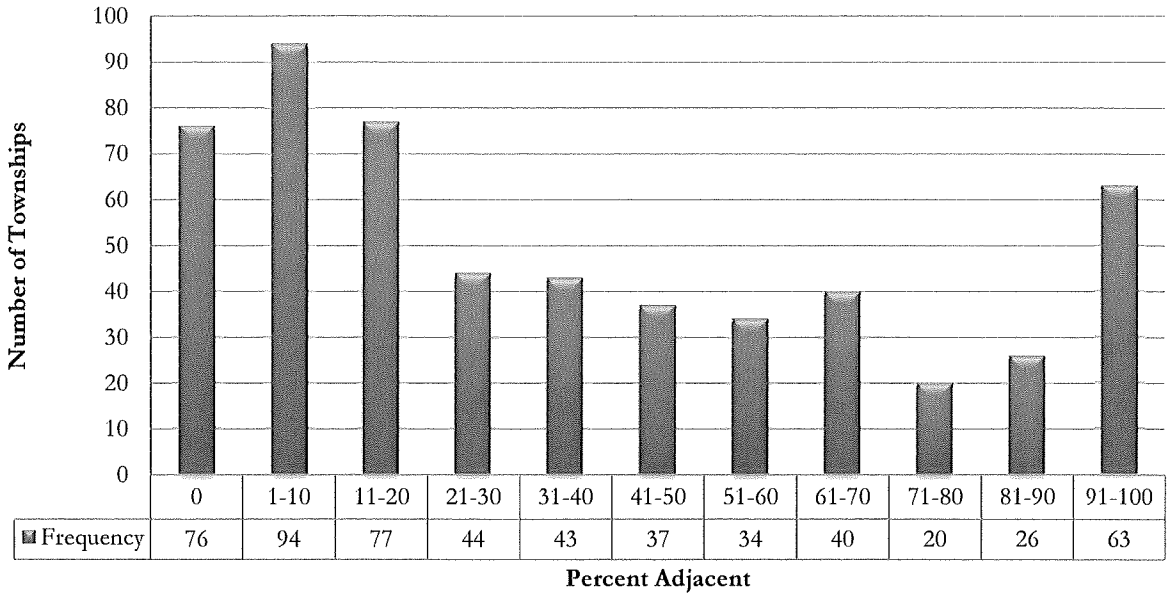


Figure 32. Frequency distribution of percent of forested parcels per township adjacent to public land.

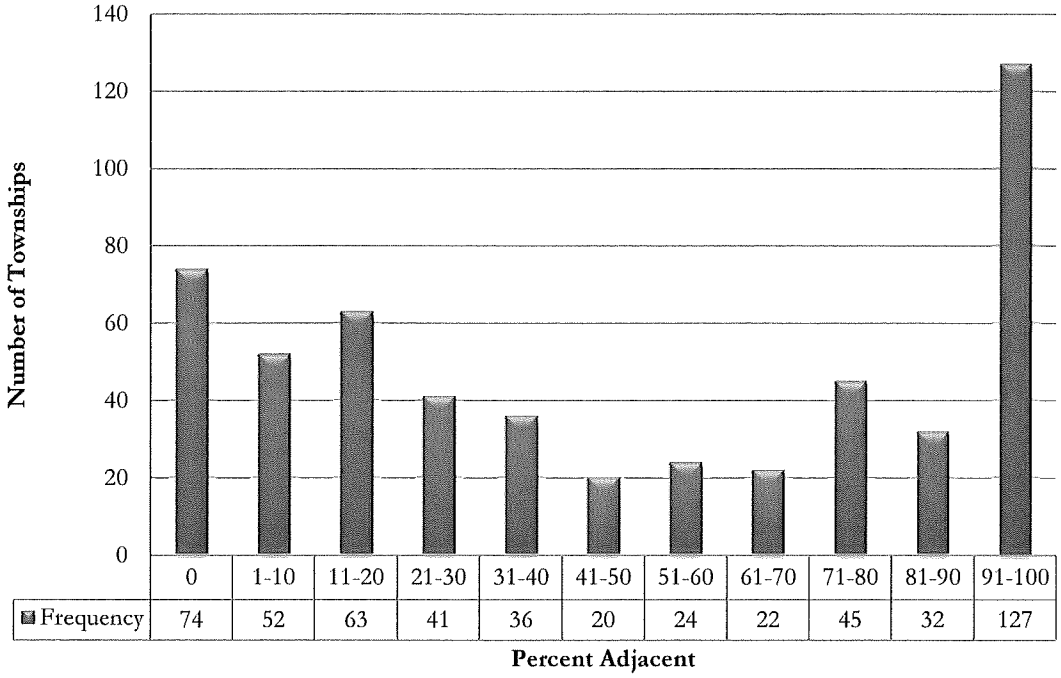


Figure 33. Frequency distribution of percent of forested parcels over 20 acres per township adjacent to public land.

Figures 32 and 33 graphically illustrate the distribution of the percent of forested parcels per township that are adjacent to public land with and without the 20-acre cutoff value.

Townships having up to 20% of their private forest land parcels adjacent to public land or having 91-100% of the parcels adjacent to public land are the most common categories. The differences when all versus only parcels 20 acres or more in size are considered appears to indicate there are many smaller acreage parcels adjacent to public land that collectively do not amount to a large number of forested acres.

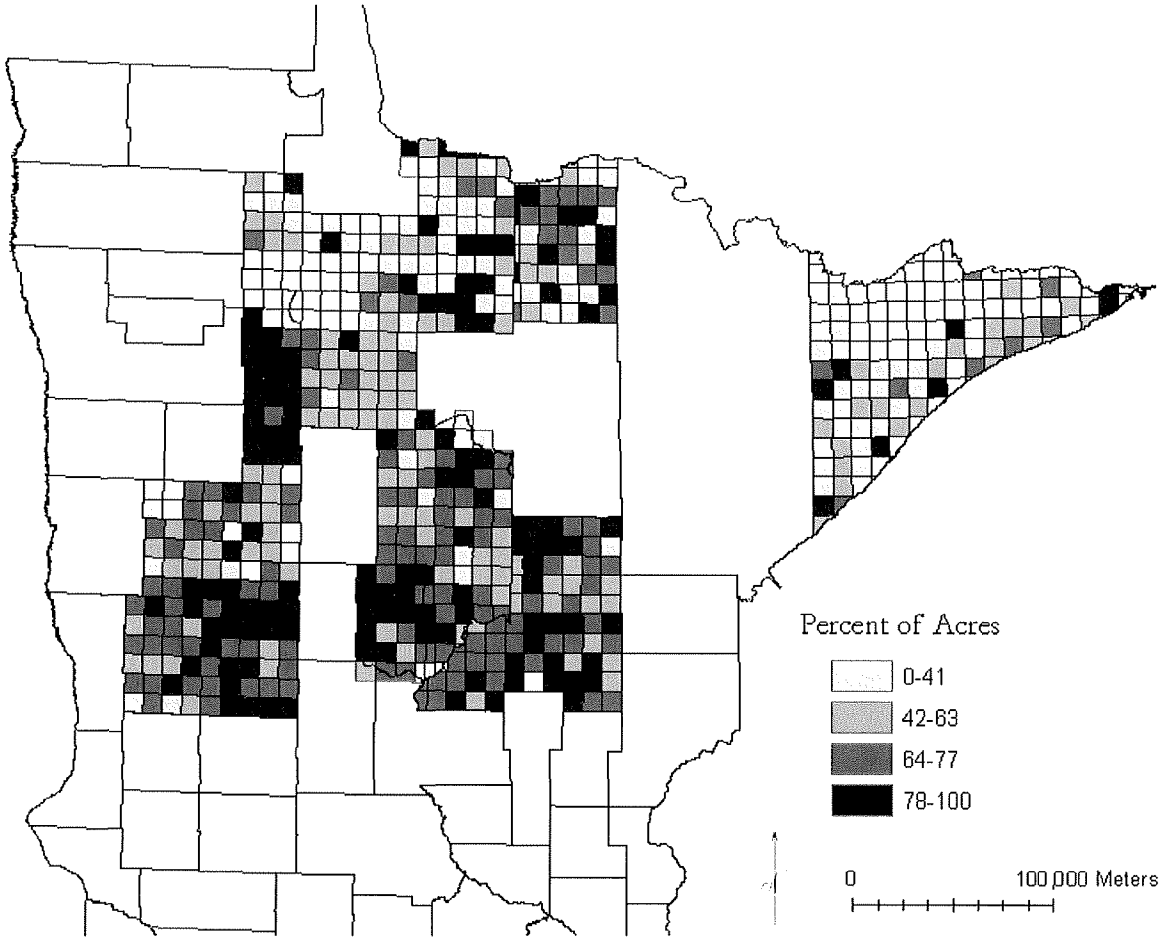


Figure 34. Percent of forested acres per township adjacent to public roads.

Figure 34 illustrates the percent of forested acres per township that is adjacent to public roads. This statistic was calculated by dividing the total forested acreage adjacent to public roads by the total forested acres per township. Southern counties have higher adjacency rates to public roads than northern counties. This can be attributed to the fact that southern counties are more populated and consequently, have more development including all-weather roads. Adjacency rates are lowest in Cook and Lake counties, where

a large amount of the land base is public and few roads exist. Clearwater County has very high overall adjacency rates; 77%-100%. Some townships in Otter Tail County also have high adjacency rates.

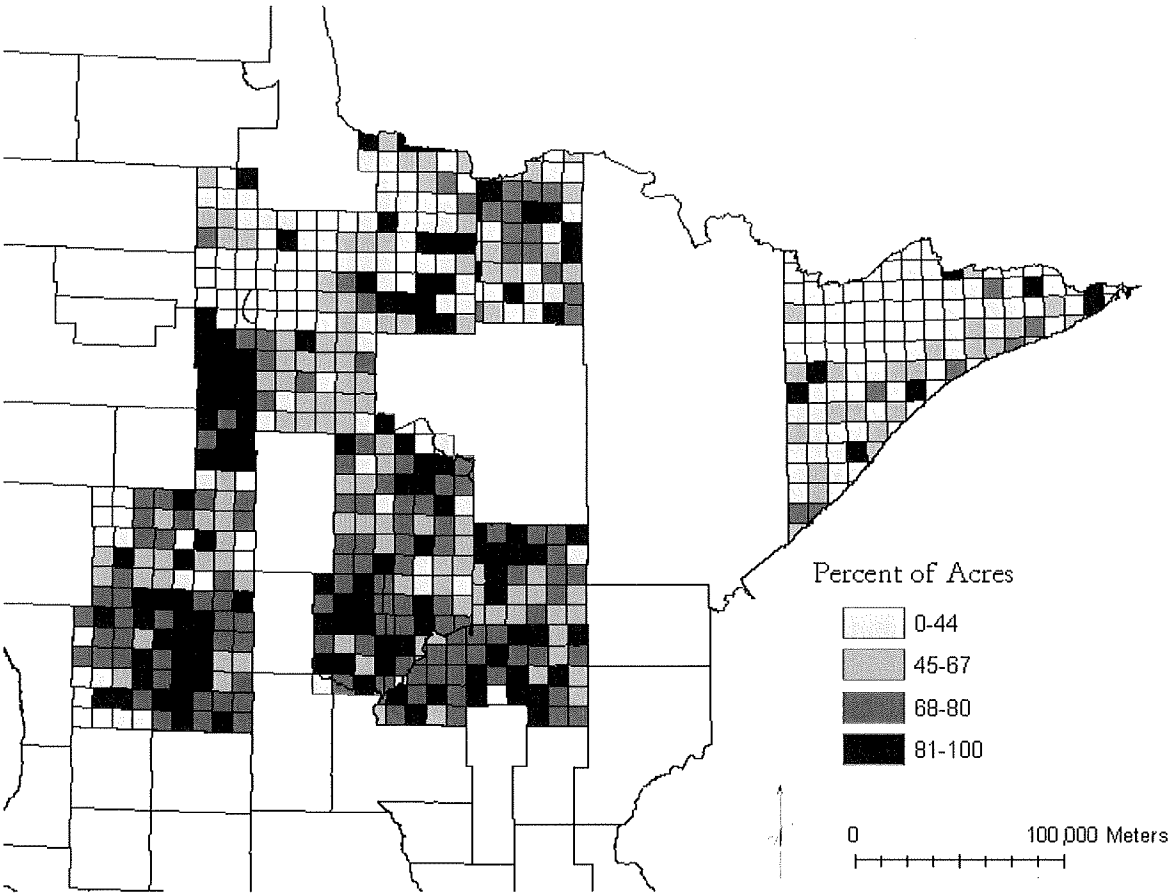


Figure 35. Percent of forested acres in parcels over 20 acres in size per township adjacent to public roads.

Figure 35 depicts the percent of forested acres for parcels 20 acres or more in size per township that is adjacent to public roads. As expected, there is an overall decrease in the percent of larger private forest land parcels that are adjacent to public roads, with more townships falling under the 67% adjacency rate. Cook and Lake counties have the lowest overall adjacency rates of the study's ten counties.

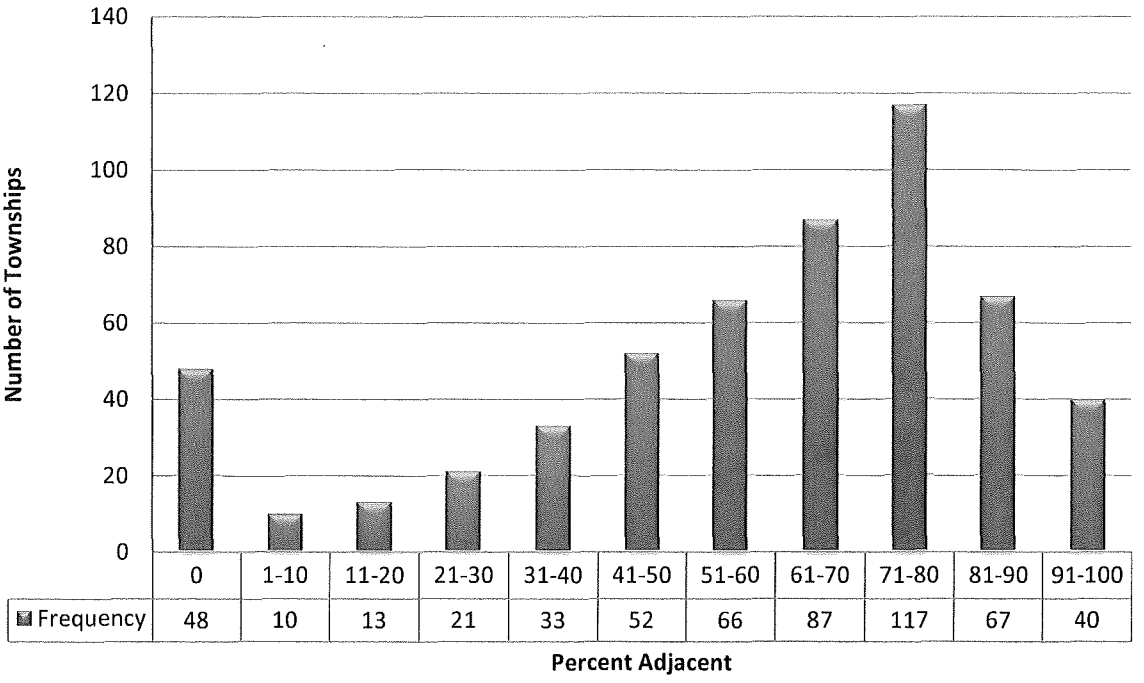


Figure 36. Frequency distribution of percent of forested acres per township adjacent to public roads.

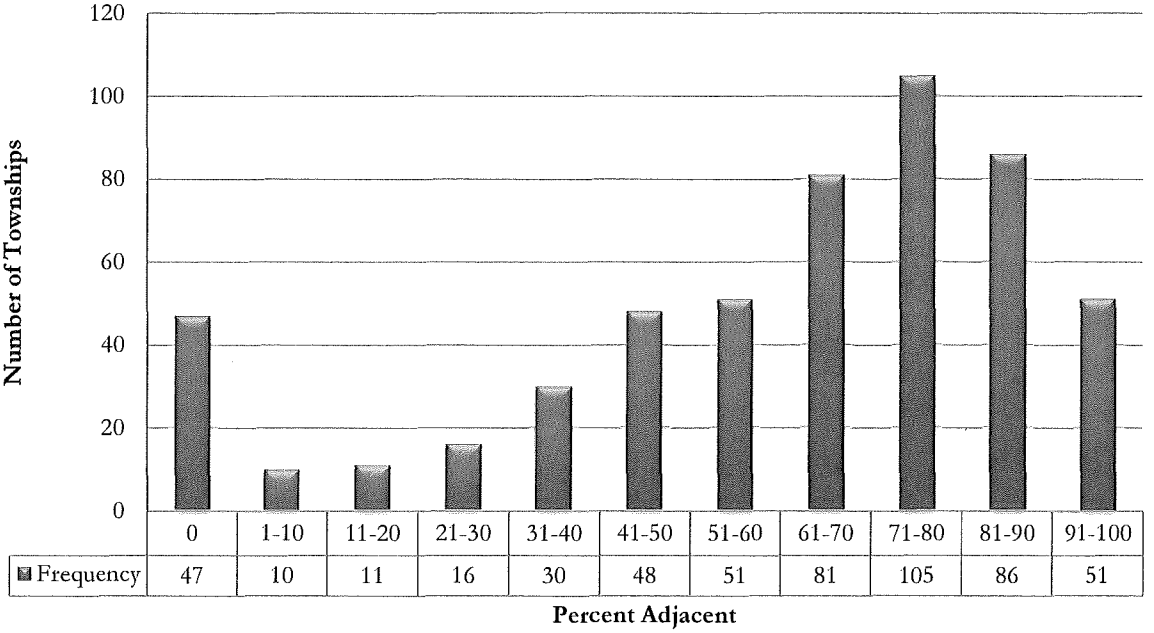


Figure 37. Frequency distribution of percent of acres in forested parcels over 20 acres in size per township adjacent to public roads.

Figures 36 and 37, depicting the percent of all private forest land and only forested parcels 20 acres or more in size per township that are adjacent to public roads, respectively, are very similar. This similarity illustrates that smaller parcels (under 20 acres) do not have much of an effect on overall percent of forested acres adjacent to public roads. Interestingly, the curve is skewed towards the right, with more townships having higher adjacency rates; the most in the 71-80% category. This is likely due to the fact that as our landscape in general becomes more developed, more roads are built. There are also more than 40 townships with less than 1% of its private forest land (both all and only 20+ acre parcels) adjacent to public roads.

Figures 38 and 39 are similar to Figures 34 and 35, with the difference being the former are the percent of forest land parcels adjacent to public roads instead of percent of forest acres.

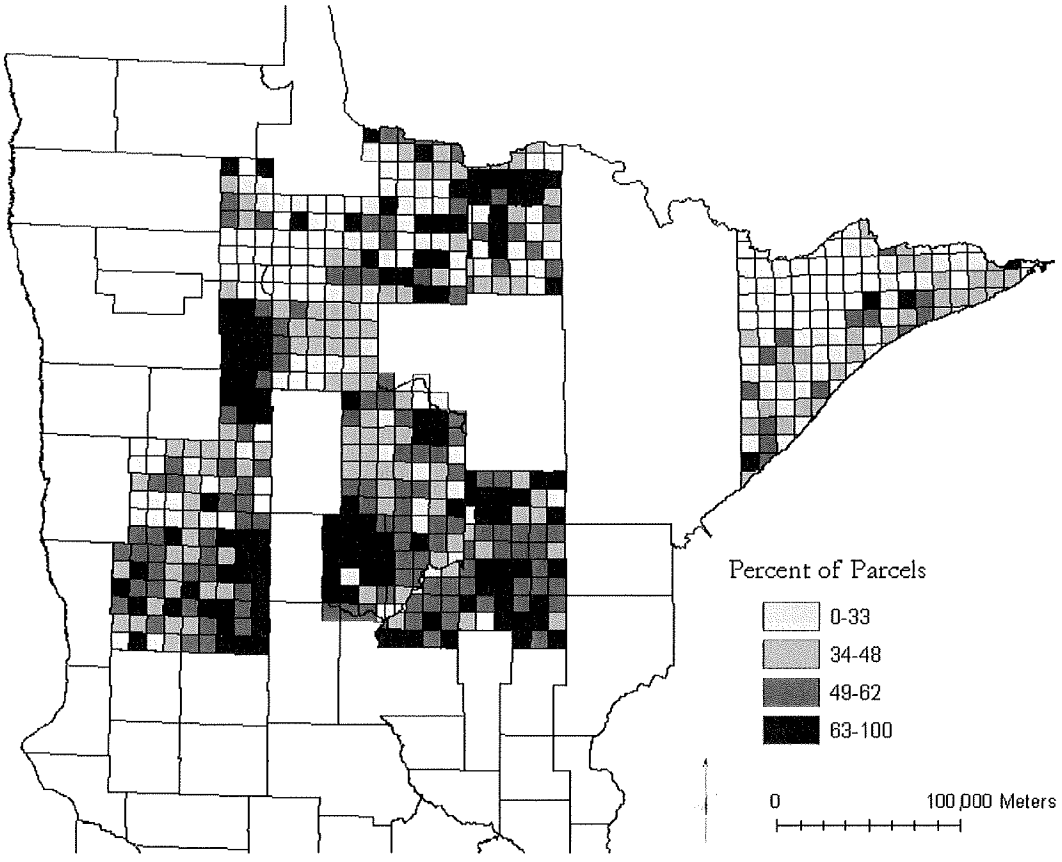
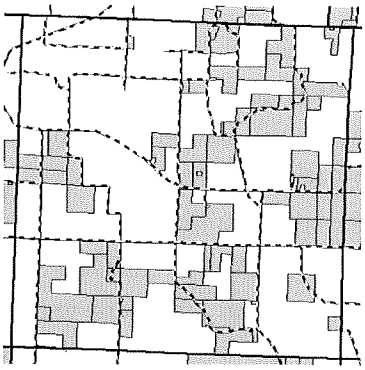


Figure 38. Percent of forested parcels per township adjacent to public roads.

At the right, a township from Ottertail County illustrating private, forested parcels adjacent to public roads.



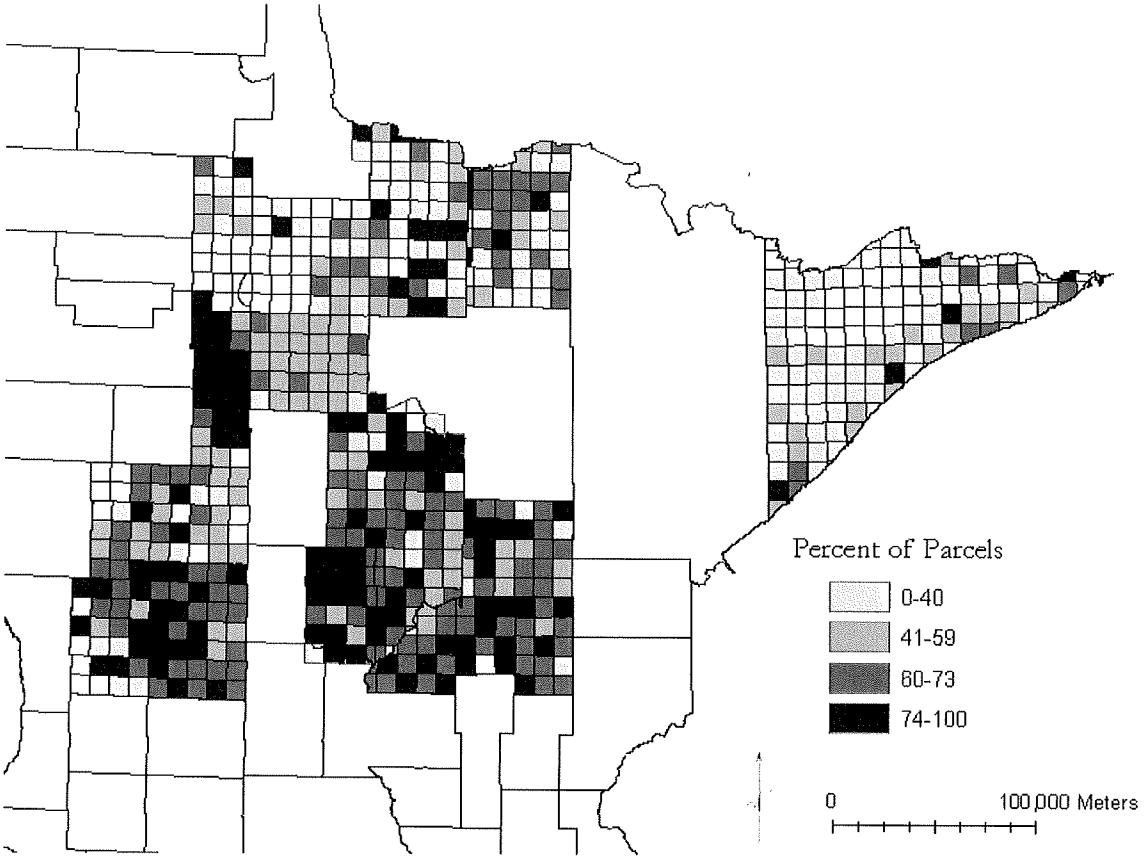


Figure 39. Percent of forested parcels over 20 acres per township adjacent to public roads.

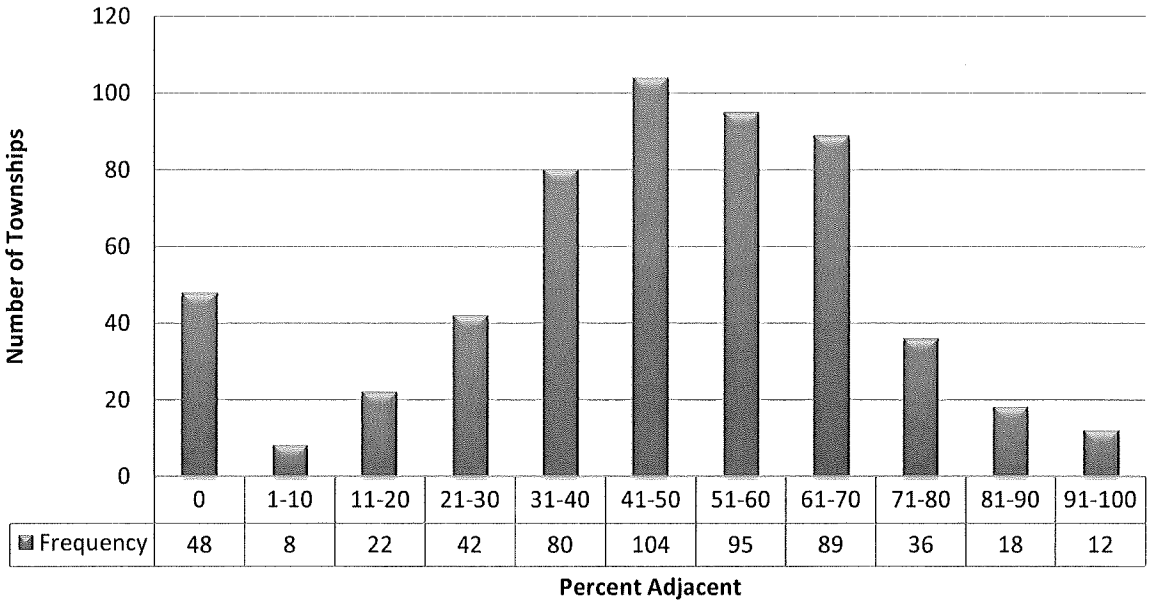


Figure 40. Frequency distribution of percent of forested parcels per township adjacent to public roads.

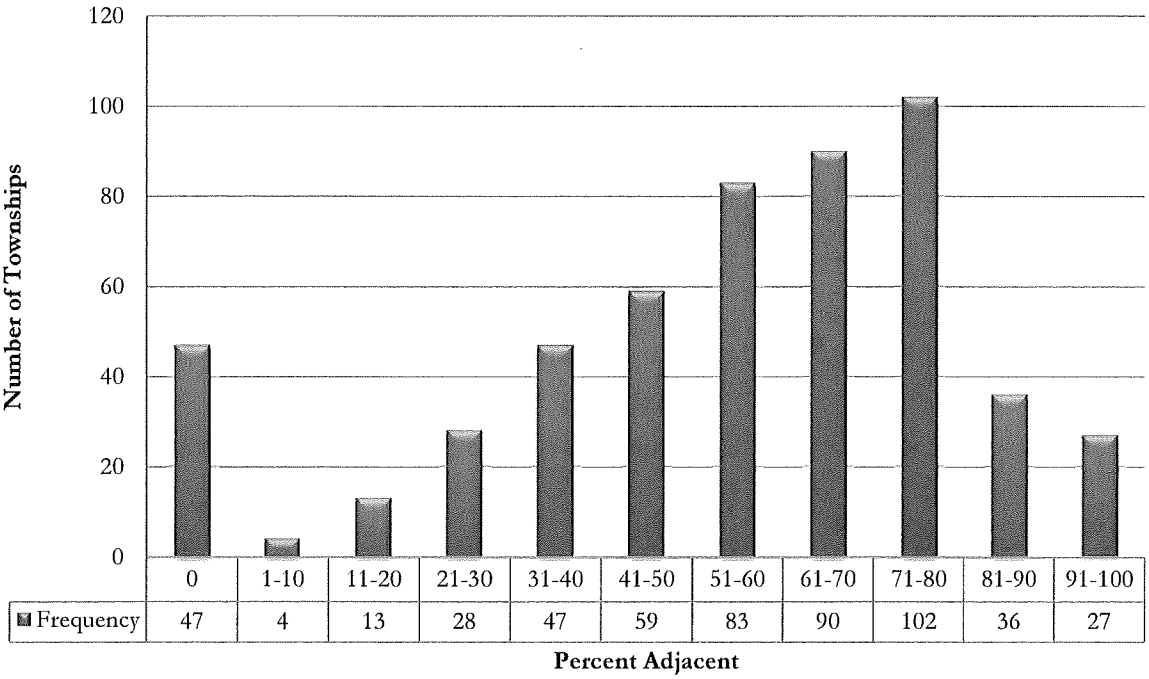


Figure 41. Frequency distribution of percent of forested parcels over 20 acres per township adjacent to public roads.

Figures 40 and 41 are also quite similar to the histograms depicting percent of forested acres adjacent to public roads (Figures 36 and 37). However, there is a slight shift in distribution with more being distributed in the middle categories. This could indicate that

some of the large-acreage parcels are adjacent to public roads. Again, a considerable number of townships have less than 1% of their private forest land adjacent to roads; most likely due to the remoteness of these townships.

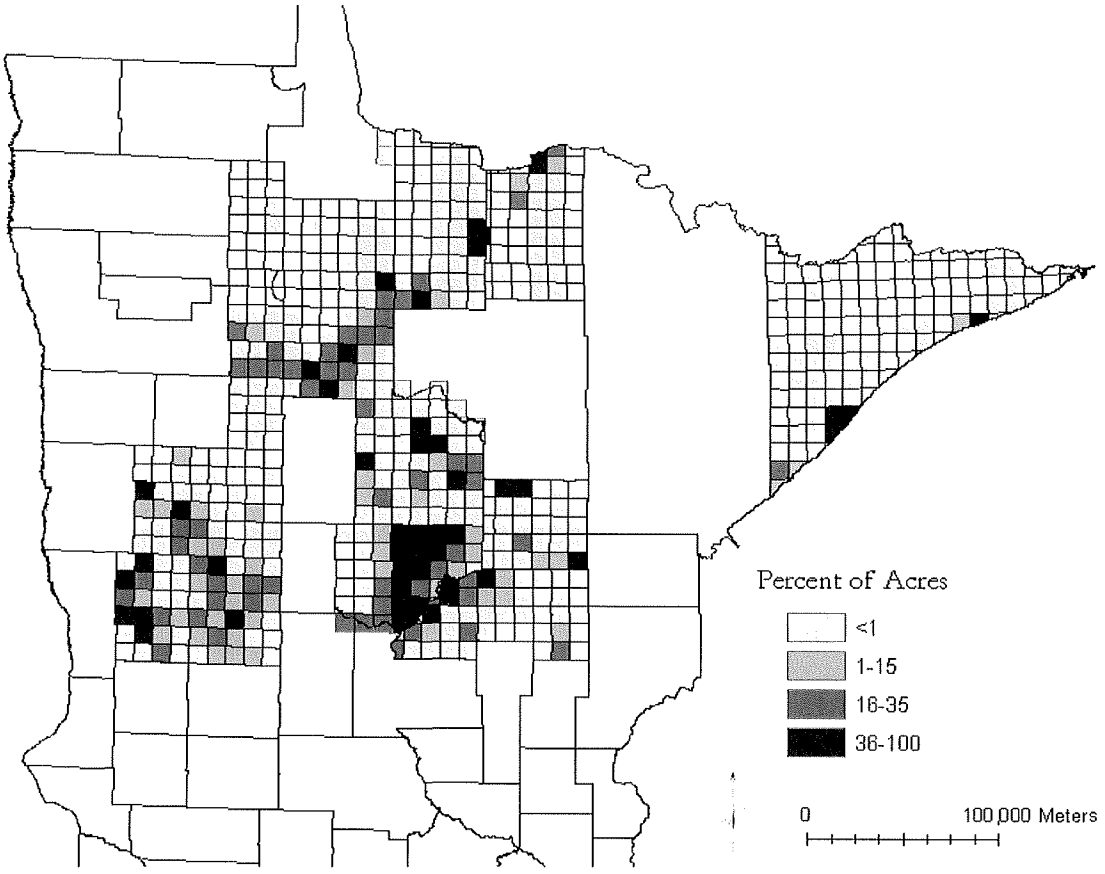


Figure 42. Percent of forested acres per township within 1600 meters of a city.

Figure 42 depicts the percent of forested acres per township that is within 1,600 meters of a city, which is roughly equal to one mile. A city was defined as an incorporated municipality based on the DORID files. The percent of forested acres per township within 1,600 meters of a city was calculated by dividing the total forested acreage that is within 1,600 meters of a city by the entire sum of forested acres per township. As shown in Figure 42, the majority of townships have less than 1% of parcels within 1,600 meters of a city. Crow Wing County has the largest percentage of its townships in close proximity to an incorporated municipality, with a number of its townships falling in the 36%-100% range. Some townships in southern Otter Tail County also fall into that higher range of 36%-100%. The overall low percentages are most likely due to the paucity of incorporated municipalities in the study counties.

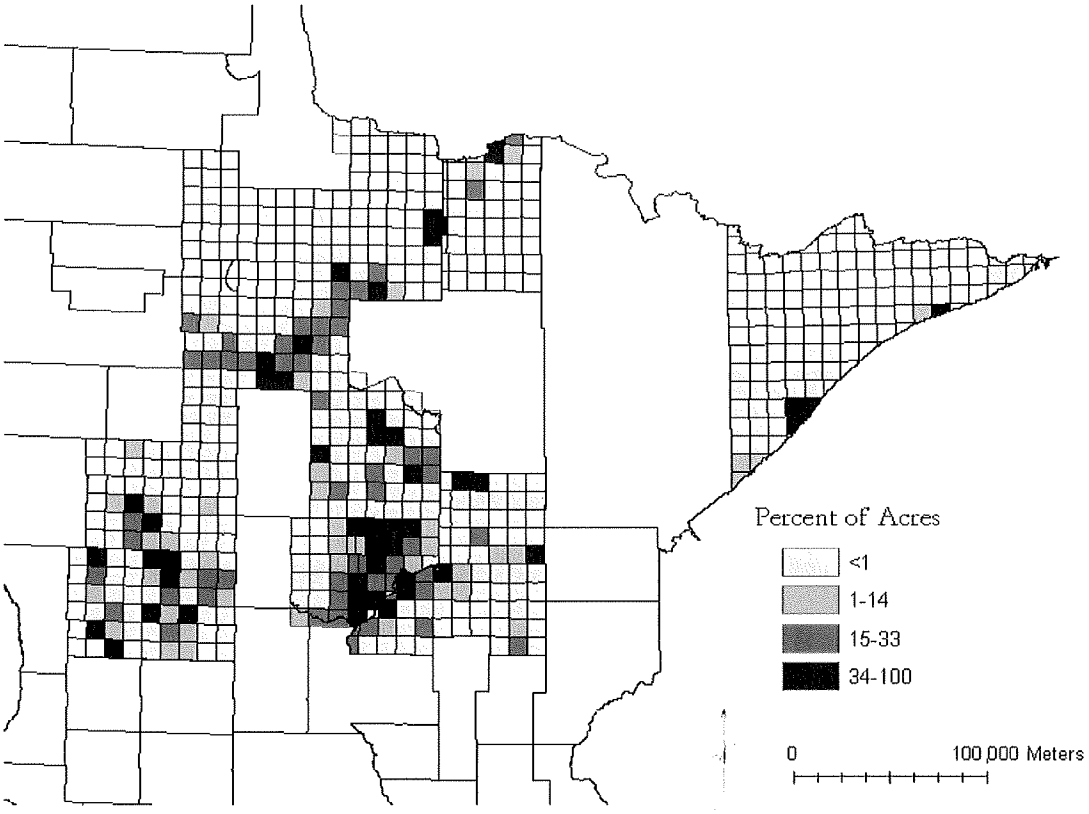


Figure 43. Percent of forested acres in parcels over 20 acres per township within 1600 meters of a city.

Figure 43 illustrates the percent of forested acres for parcels 20 acres or more per township that is within 1,600 meters of a city. As with Figure 42 that included all private forest land, the majority of townships do not contain 20+ acreage forest land within the specified distance of a city. Exceptions include southern Beltrami and Otter Tail Counties. In general, the northern counties of the study area tend to be very rural, resulting in very few townships having any significant amount of private forest land within 1,600 meters of a city.

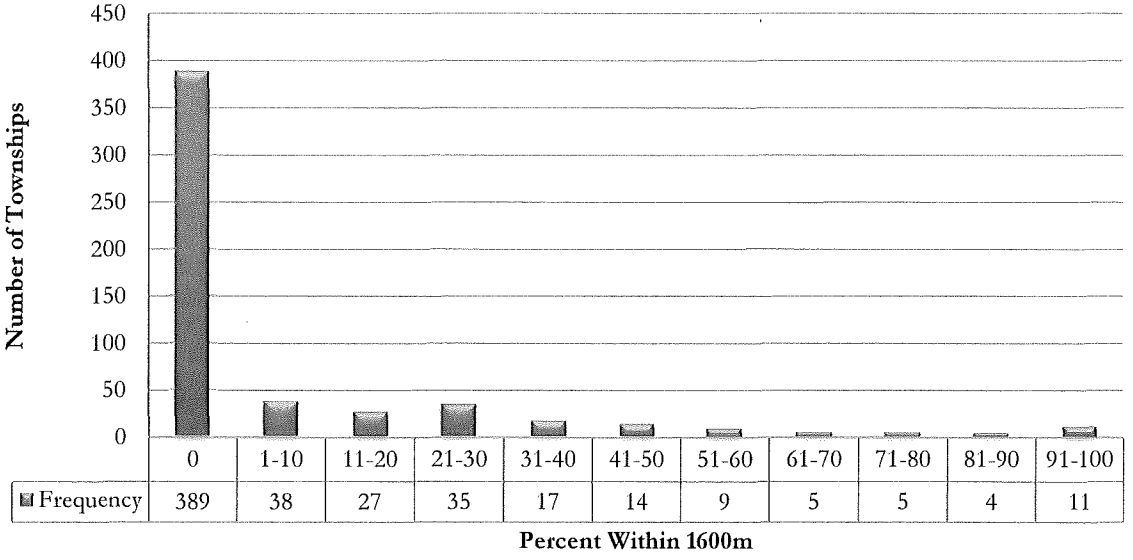


Figure 44. Frequency distribution of percent of forested acres per township within 1600 meters of a city.

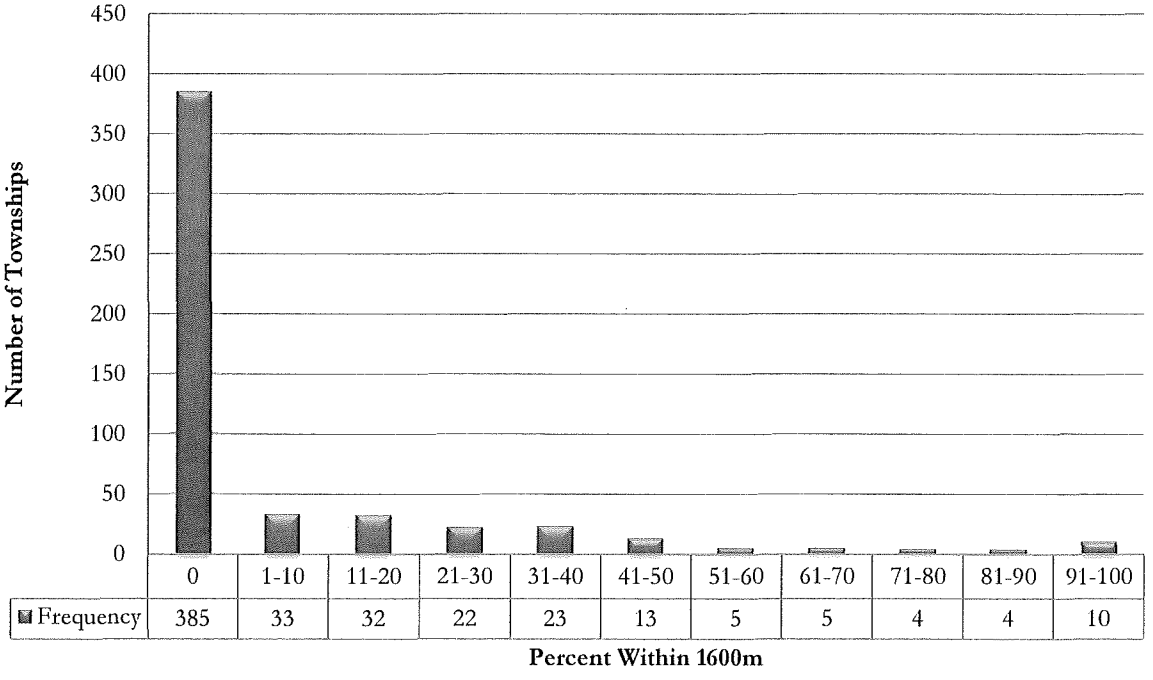


Figure 45. Frequency distribution of percent of acres in forested parcels over 20 acres per township within 1600 meters of a city.

Figures 44 and 45 show the percent of acres in forested parcels, and forested parcels 20 acres or more in size per township, respectively, that are within 1,600 meters of an

incorporated municipality. These graphs reiterate what the maps (Figures 42 and 43) depicted—that in most townships the forested parcels are not within 1,600 meters of a city. There is not a large difference between the two histograms, indicating that parcels under 20 acres in size are not any more likely to be within 1,600 meters of a city than larger forested parcels.

Figures 46 and 47 illustrate the percent of forested parcels that are within 1600 meters of a city rather than the percent of forested acres.

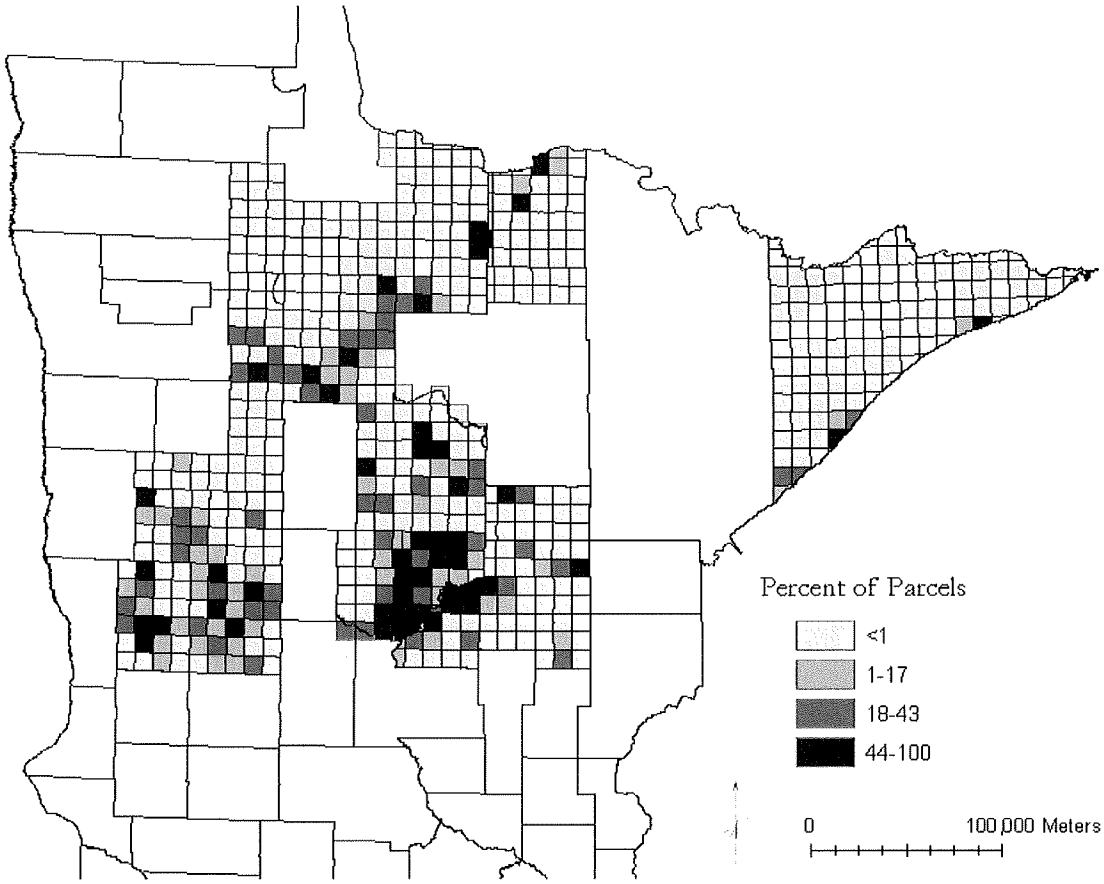
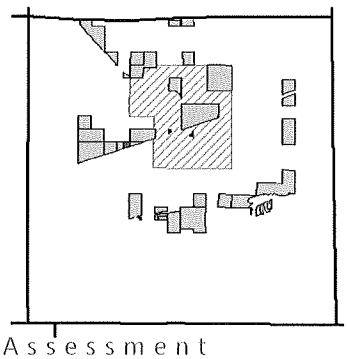


Figure 46. Percent of forested parcels per township within 1600 meters of a city.

At the right, a township in Aitkin County illustrating parcels within 1,600 meters of a city. The city boundaries are shown with a diagonal hatch.



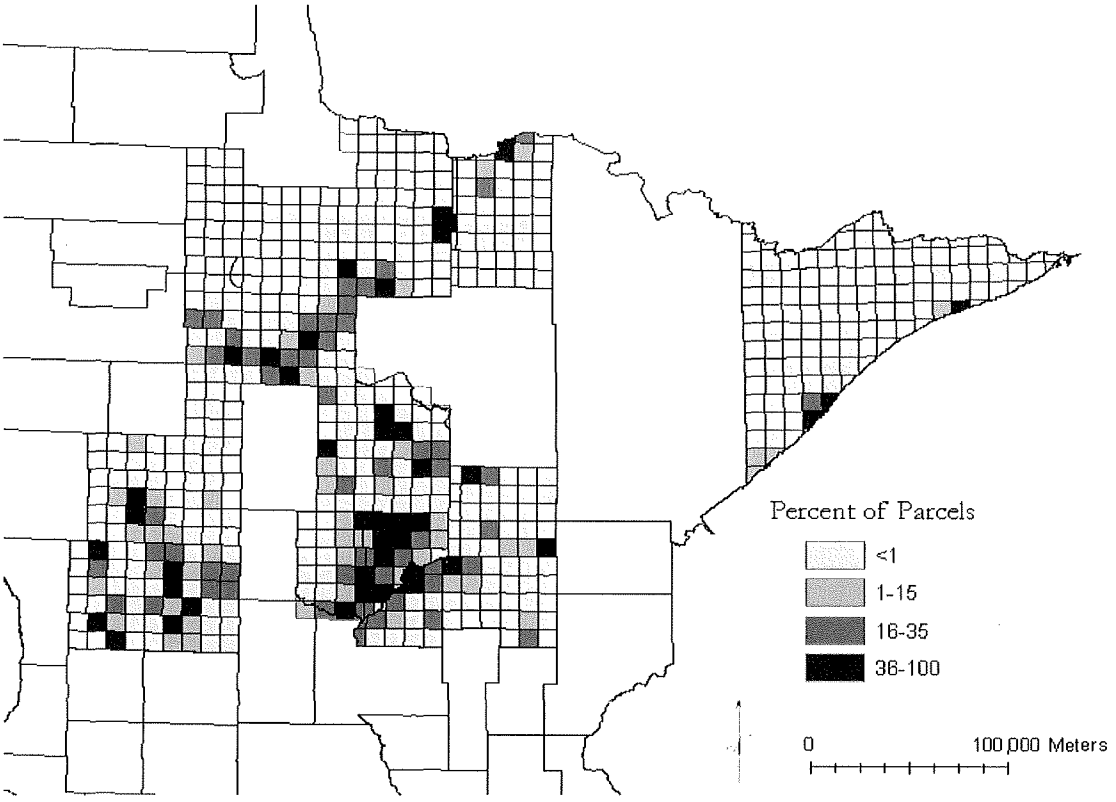


Figure 47. Percent of forested acres in parcels over 20 acres per township within 1600 meters of a city.

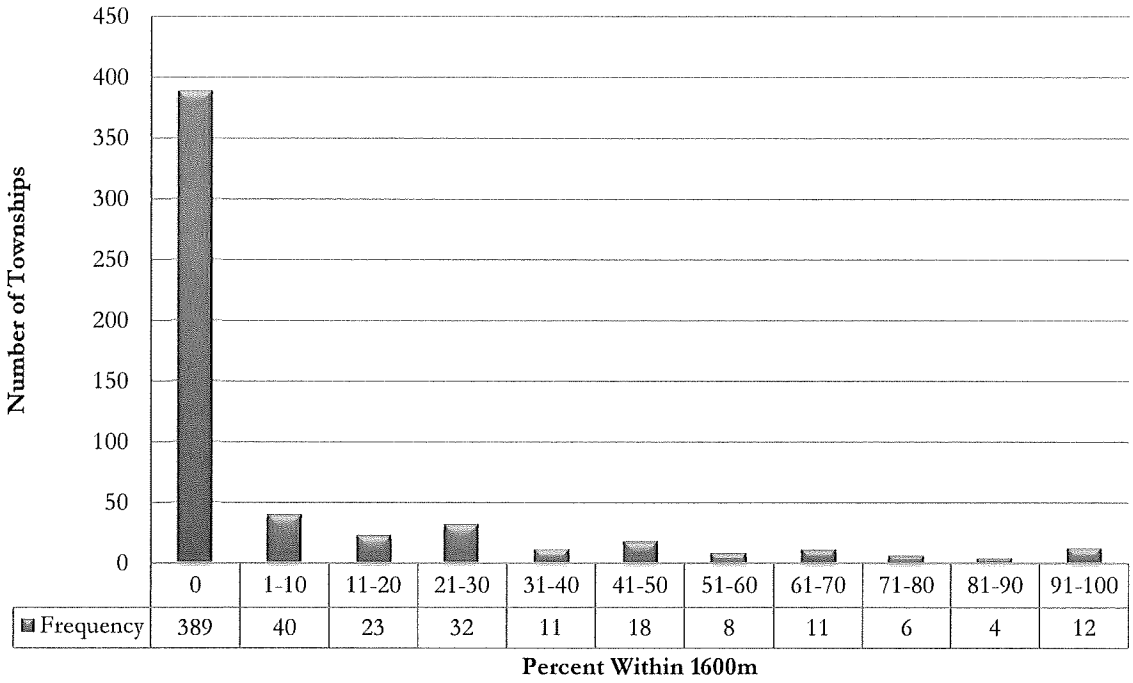


Figure 48. Frequency distribution of percent of forested parcels per township within 1600 meters of a city.

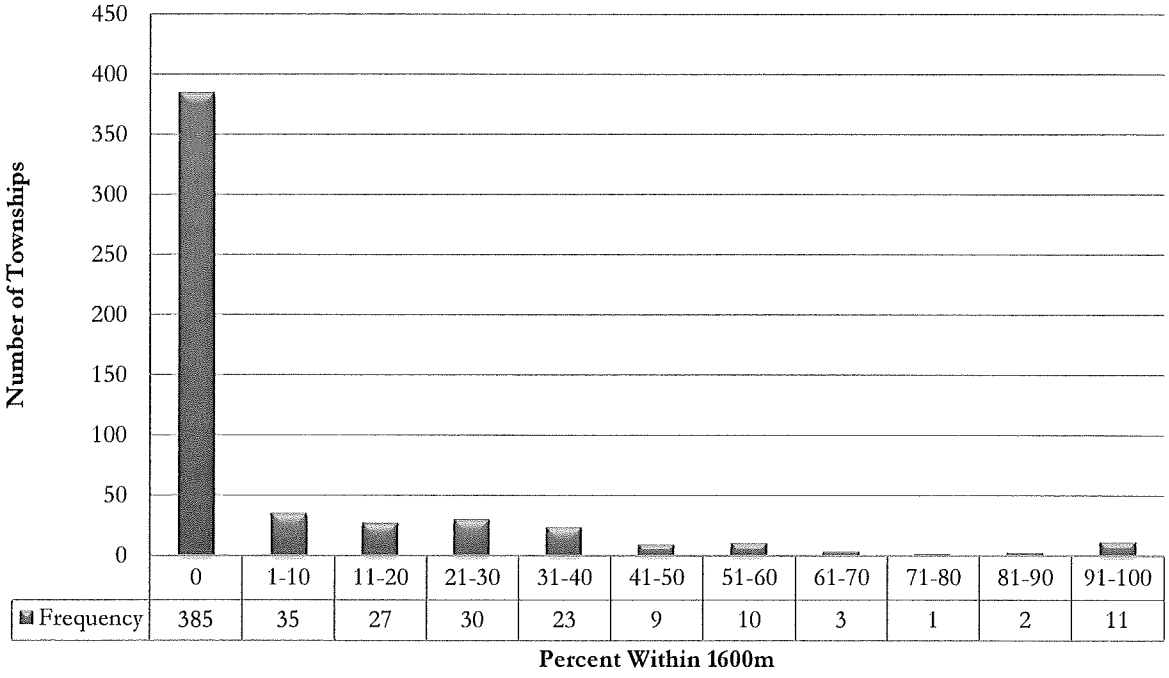


Figure 49. Frequency distribution of percent of forested parcels over 20 acres per township within 1600 meters of a city.

Figures 48 and 49, depicting the frequency distribution of percent of forested parcels within 1,600 meters of a city, do not show much of a difference from their counterparts depicting percent of forested acres within 1,600 meters of a city (Figures 44 and 45). The fact that Figures 48 and 49 are very similar indicates that forested parcels under 20 acres in size are no more likely to be within 1,600 meters of an incorporated municipality than larger forested parcels. Overall, the majority of townships have less than 1% of their forested parcels within 1,600 meters of a municipality.

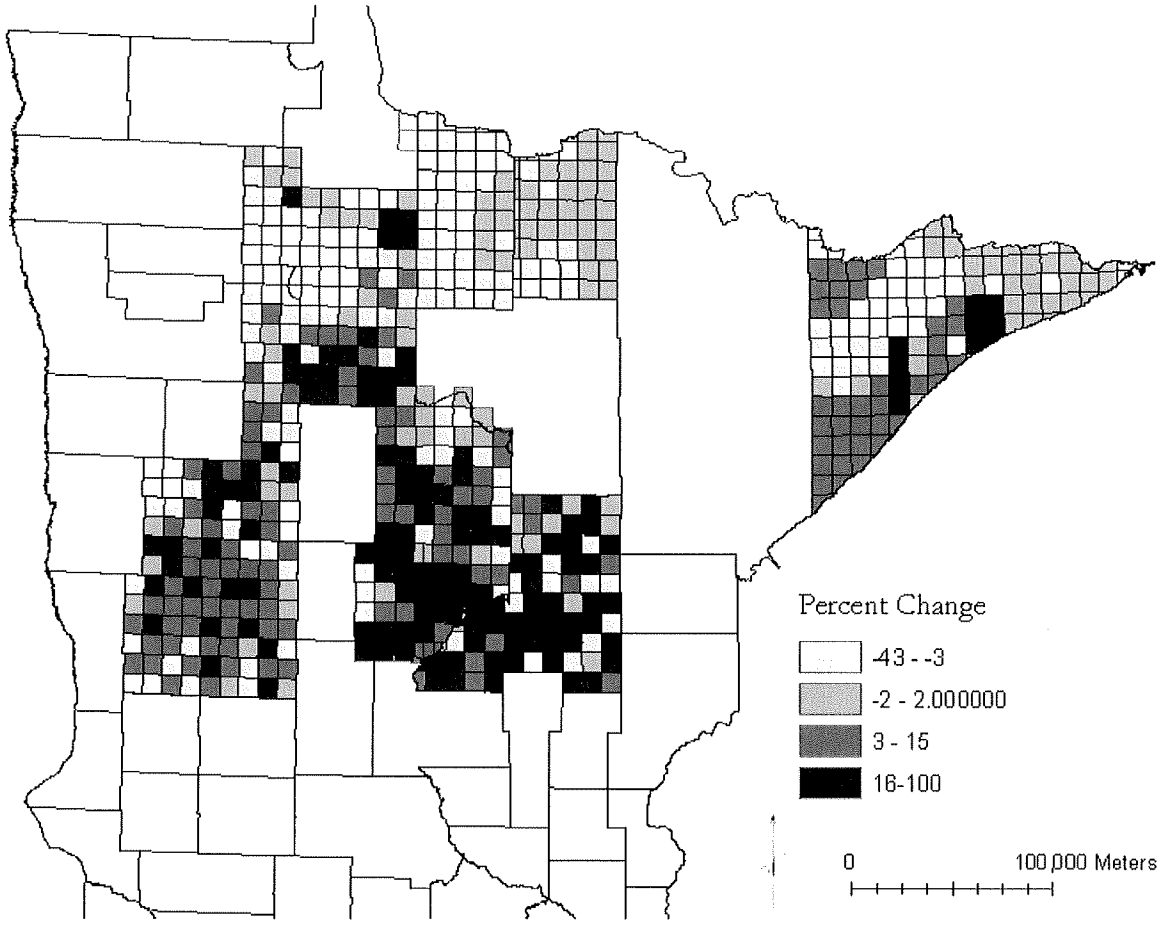


Figure 50. Percent change in population in forested parcels per township from 1996-2006.

Figure 50 indicates the percent change in population from 1996-2006 per township. Population figures came from data collected by the Minnesota Land Economics. Larger increases in population are seen in the townships located in the southern counties than in northern ones. Some townships experienced decreases in population over this period, such as Koochiching and Lake Counties. Overall, the highest population increases occurred in the central area of the study region. Large population increases were also evident in certain parts of southern Cook and Lake Counties, likely illustrating the demand for

amenities such as Lake Superior. The large increases in the southern/central counties, however, are more likely attributable to an increase in employment opportunities and the rural character of that area when compared the area surrounding the Twin Cities Metropolitan Area.

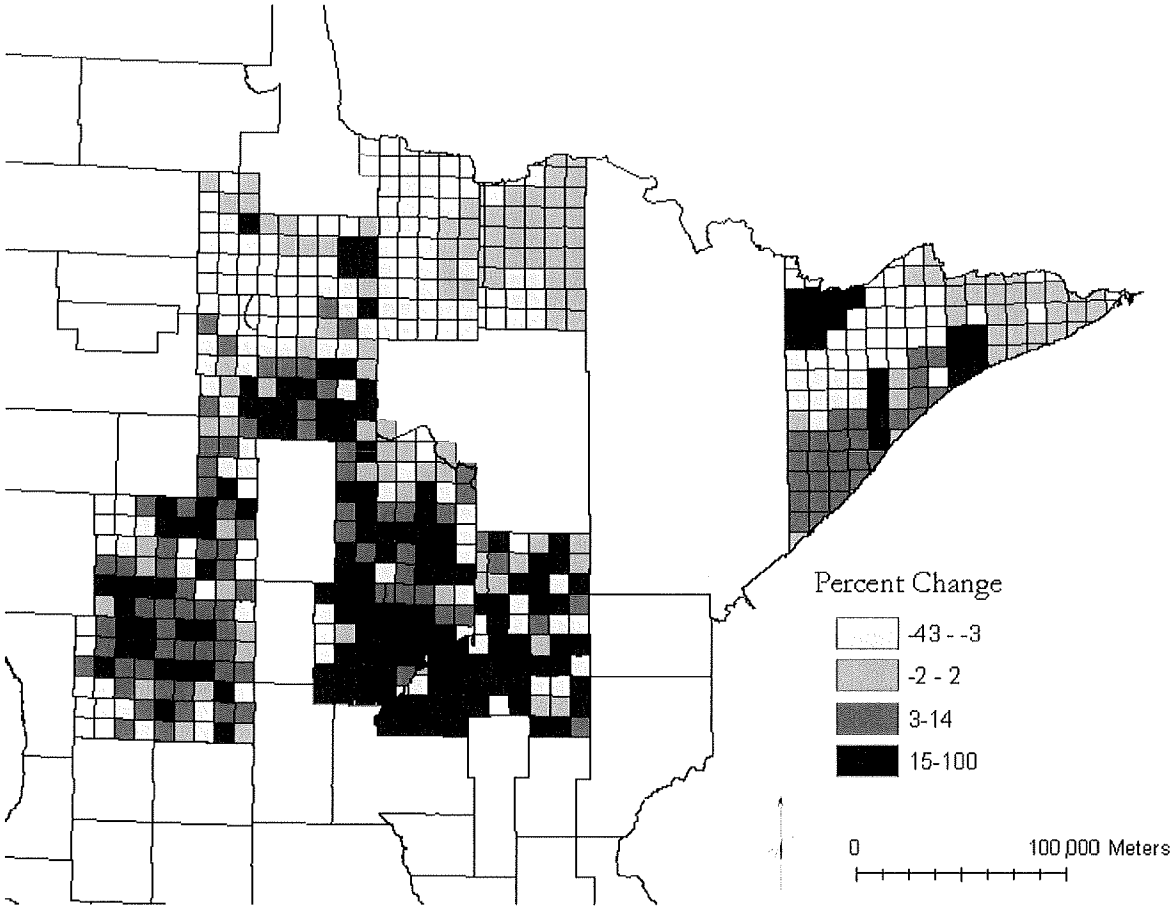


Figure 51. Percent change in population in forested parcels over 20 acres per township from 1996-2006.

Figure 51 illustrates the percent change in population from 1996-2006 per township for all forested parcels over 20 acres. The patterns in this map are basically the same as those shown in Figure 50, which includes all private forest land. Otter Tail County shows fewer townships with decreases in population during this period, while southern Cass County shows the area with the largest increase in population.

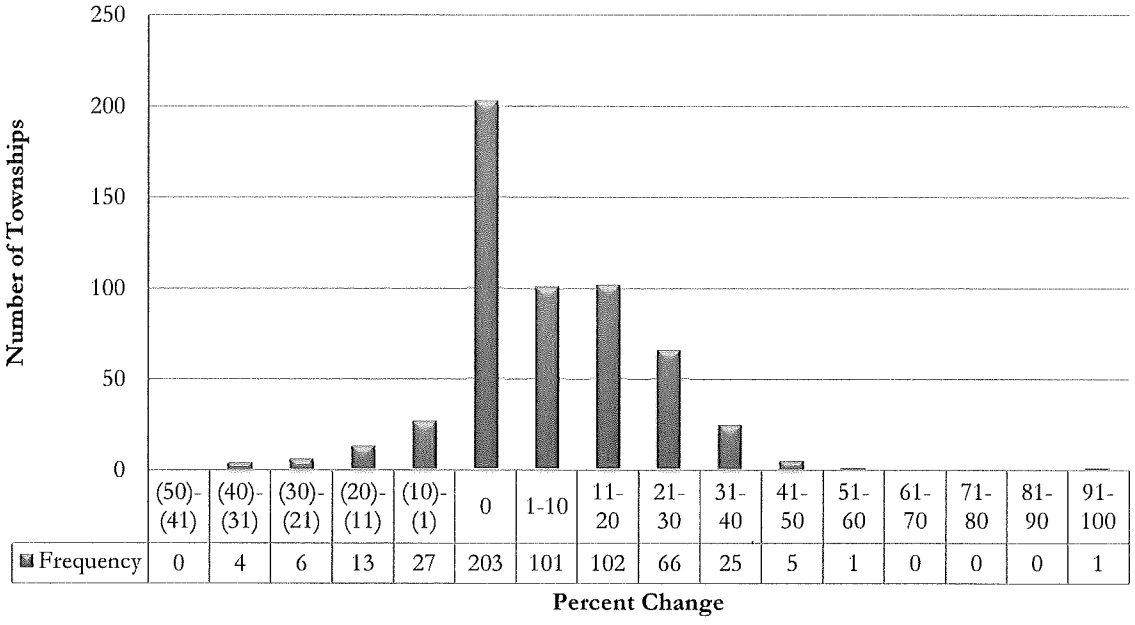


Figure 52. Frequency distribution of percent change in population for forested parcels per township from 1996-2006.

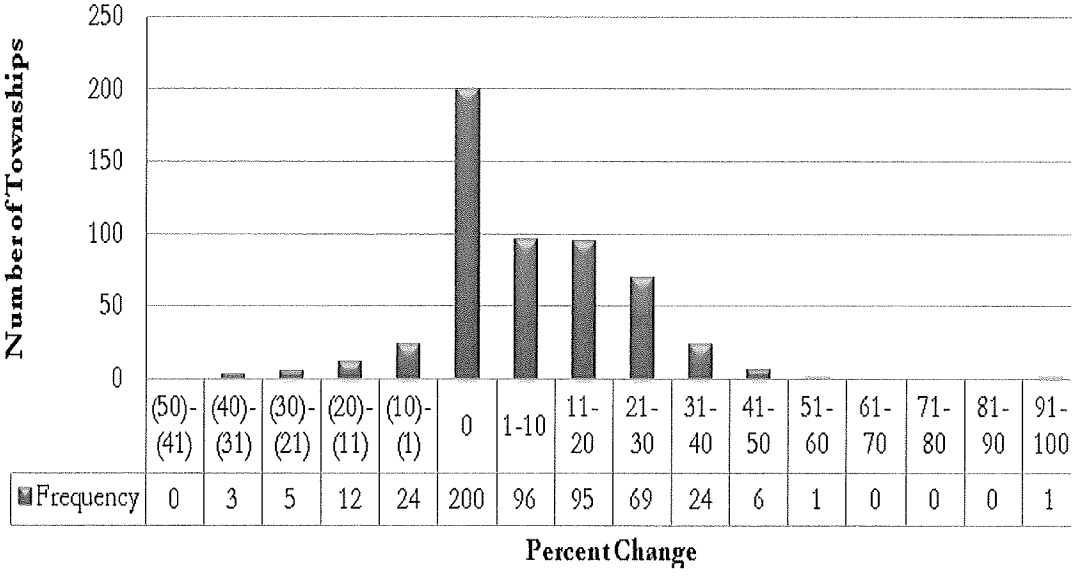


Figure 53. Frequency distribution of percent change in population per township for forested parcels over 20 acres from 1996-2006.

Figures 52 and 53, graphing the percent change in population for all forest land and

parcels 20 or more acres in size, are very similar to each other. While some townships in both screens had slight decreases in population, the largest percent of townships had no change in population over this period.

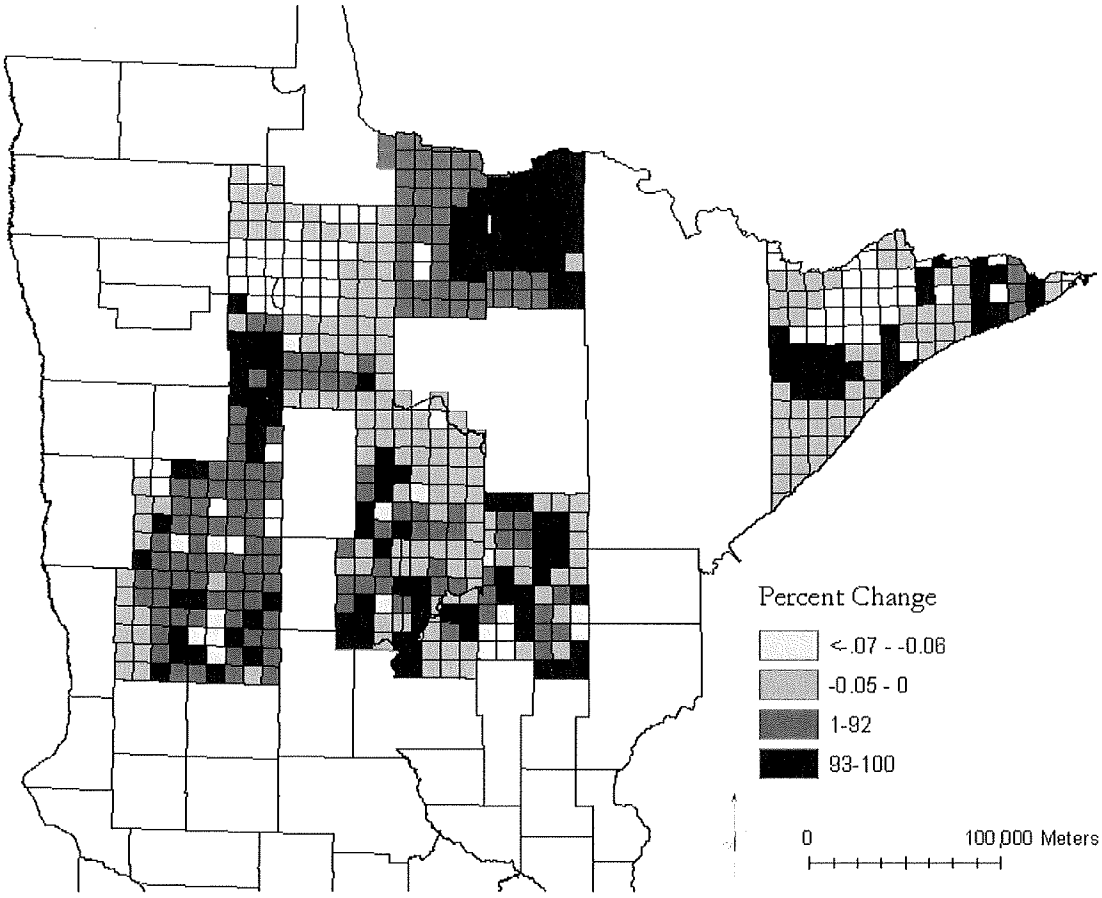


Figure 54. Percent change in building estimated market value per township from 2002-2008

Figure 54 illustrates the percent change in the county assessor's estimate of building market value (EMV) from 2002-2008 per township for all forested parcels. Building estimated market value is the market value for any buildings on a parcel estimated by the county assessor the previous fall before the reporting year. For example, the market value for a building that is reported in 2003 is actually from an assessment made in 2002. These assessed values serve as the basis for property tax assessments. Substantial increases in building EMV can indicate a large increase the number of buildings located on forest land, which also signals an increase in development.

Much of Koochiching and Clearwater Counties experienced a very large increase in building EMV, as did certain portions of Aitkin County and a group of townships in Lake

County. The rest of the study region experienced only marginal changes, both increases and decreases, with few exceptions. Substantial increases in building EMV can indicate a large increase the number of buildings located on forest land, which also signals an increase in development.

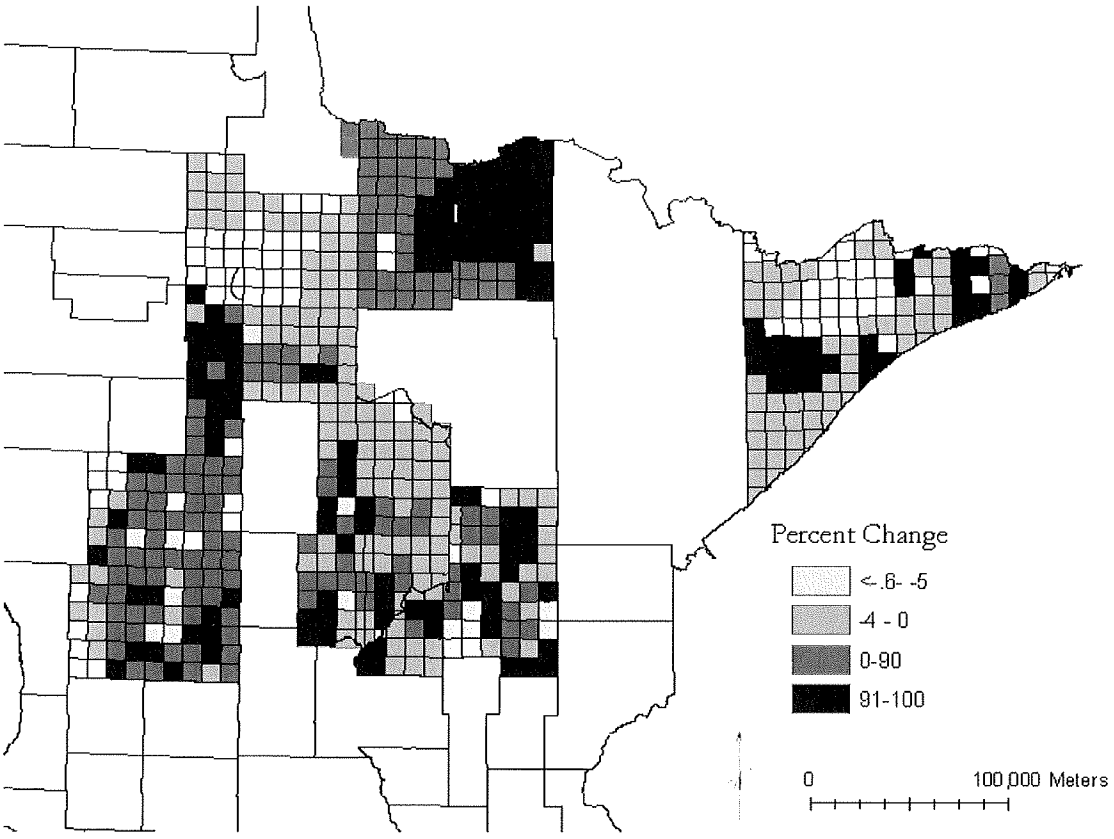


Figure 55. Percent change in building estimated market value in forested parcels over 20 acres per township from 2002-2008.

Figure 55 shows the percent change in building EMV per township from 2002-2008 for all forested parcels 20 acres or greater. Koochiching County still shows a large increase in building EMV. The cluster of townships in Lake County with a large increase when all forest land is considered (Figure 54) is reduced in size when only parcels 20 acres or more in size are considered. Overall, the entire study range has more townships in the -4%-0% change range than in the previous map. This could indicate that more building development happens on forested parcels that are less than 20 acres.

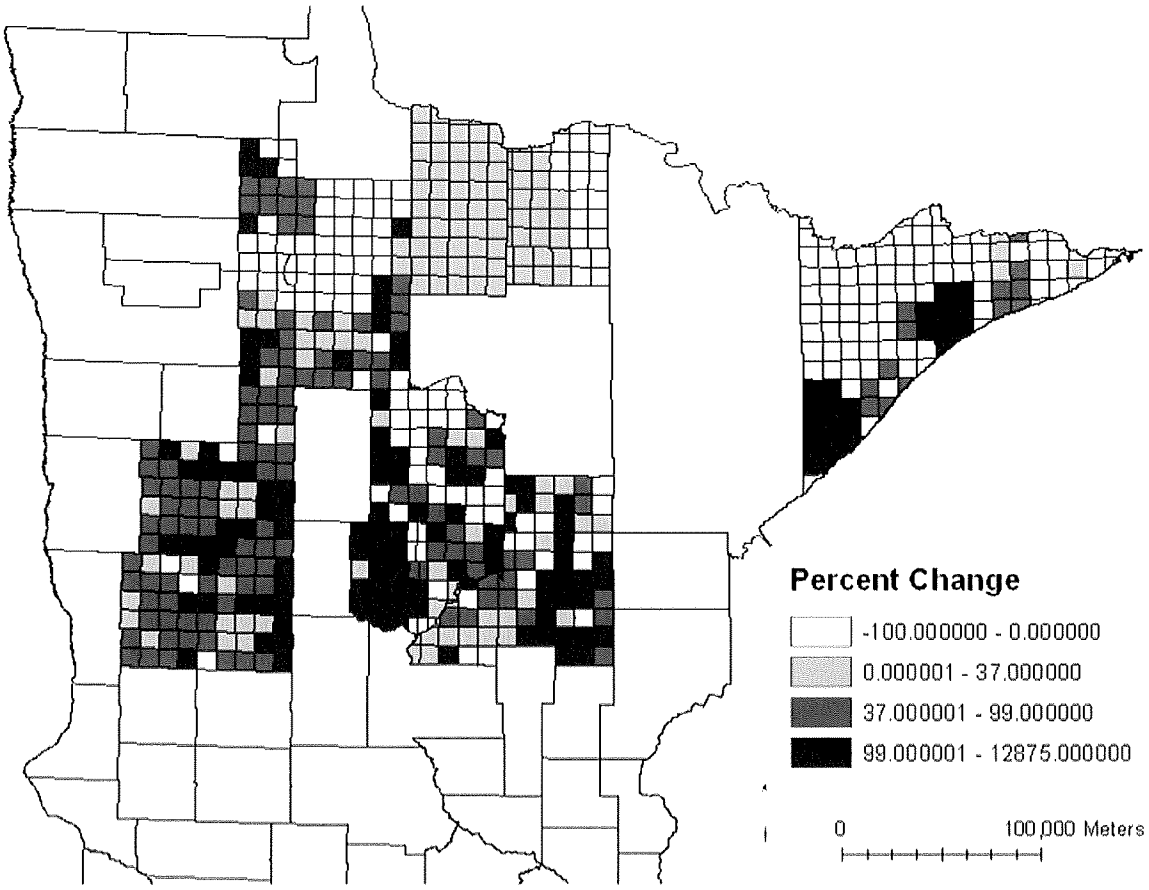


Figure 56. Percent change per township of building estimated market values on seasonal recreational land from 2002-2008.

Figure 56 depicts the building EMV on all seasonal recreation land in the ten county study region. Seasonal recreation land is a property tax classification used in Minnesota for land whose primary purpose is recreation. Seasonal recreation land can include land with and without buildings (e.g., cabins). This study chose to look at changes in building value as a surrogate for measuring development activity. Often, new buildings on property signify growth and development. This map is very different from the maps illustrating building EMV on forested lands (Figures 54 and 55). Across the ten county study area, the northern counties have the smallest increases in building EMV, with some even having a large decrease in building EMV. Building EMV increase on a north-to-south gradient across the study region.

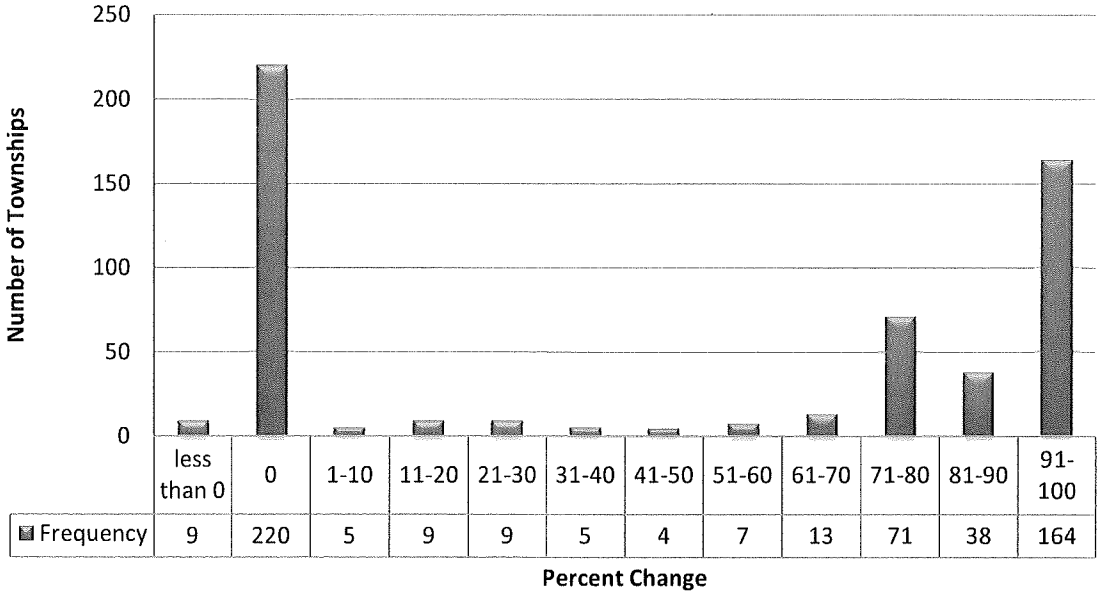


Figure 57. Frequency distribution of percent change in building estimated market value per township for all forested parcels from 2002-2008.

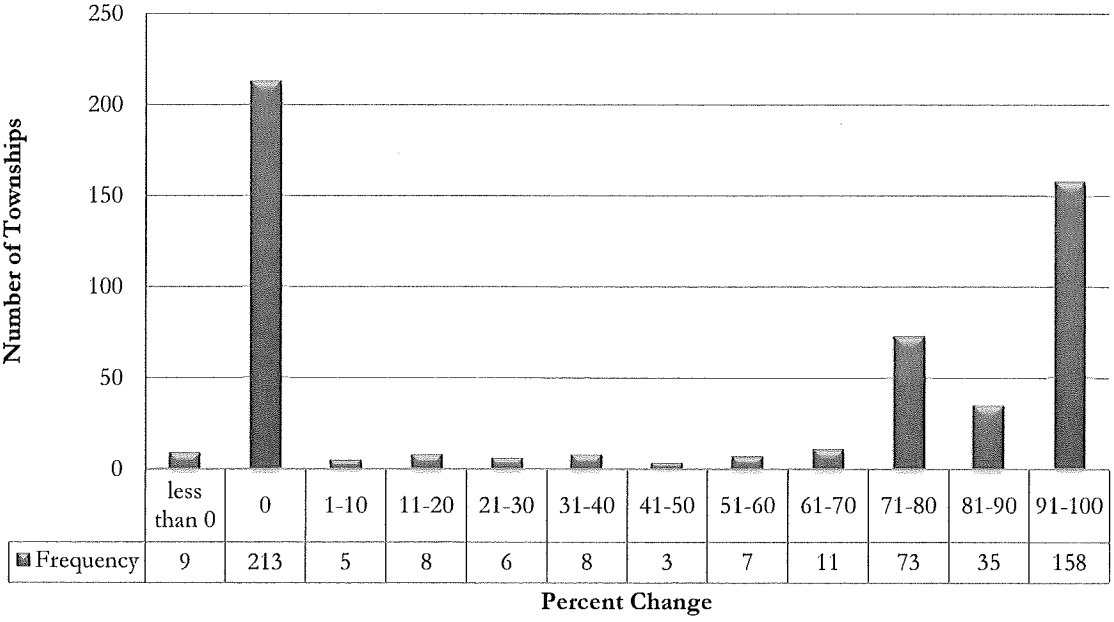
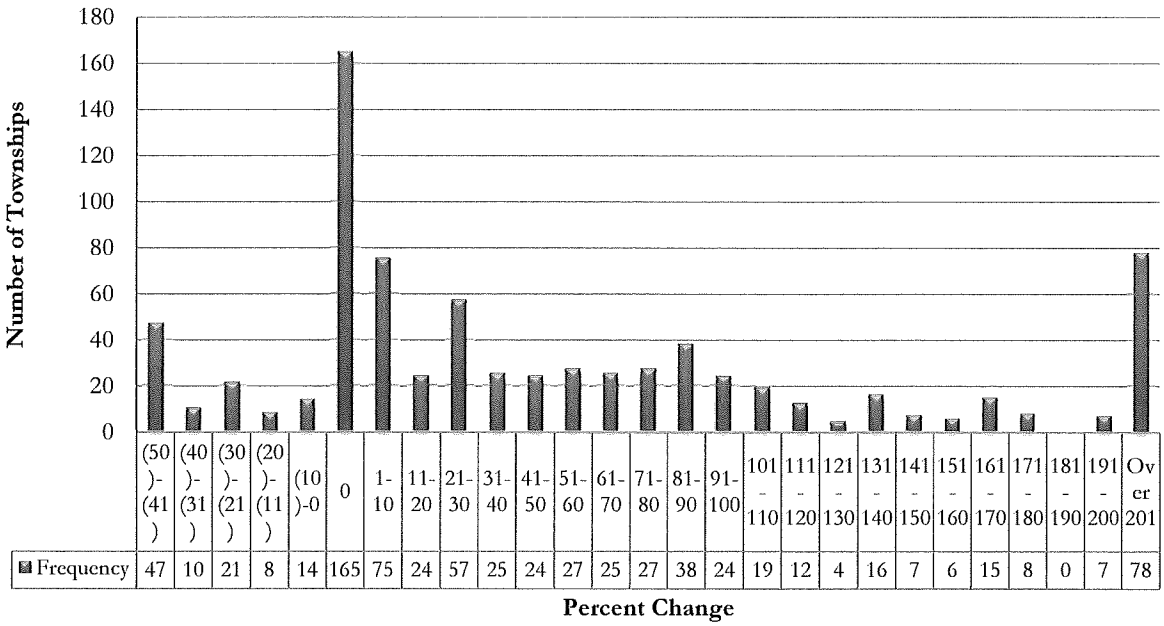


Figure 58. Frequency distribution of percent change in building estimated market value per township for forested parcels over 20 acres from 2002-2008.

Figures 57 and 58, depicting the percent change in building EMVs per township, are very similar to one another. In comparing the data presented in these two histograms, there are huge spikes in the less than 1% change and the 91-100% increase categories, yet hardly any activity in the categories in between. This seems to indicate that for most of the forested land in the study area there was either no increase in building value or a very large increase. This seems to indicate that any development that did occur was major. Rather than a small shed being built on a parcel, it seems likely that a commercial business or large house was built.



	(50)-(41)	(40)-(31)	(30)-(21)	(20)-(11)	(10)-0	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	101-110	111-120	121-130	131-140	141-150	151-160	161-170	171-180	181-190	191-200	Over 201
Frequency	47	10	21	8	14	165	75	24	57	25	24	27	25	27	38	24	19	12	4	16	7	6	15	8	0	7	78

Figure 59. Frequency distribution of percent change in building estimated market value per township for seasonal recreation land from 2002-2008.

Figure 59, illustrating the percent change in building estimated market value per township for seasonal recreational land, is similar to those regarding building estimated market value on forested land in that there is a large number of townships with no change in building EMV from 2002-2008. This graph, however, shows much more variation between bins (i.e., categories in a histogram) than the preceding two. More townships in the seasonal recreation land category had large increases in building estimated market value compared to the forested land category, with 78 townships registering an increase over 200%. Additionally, more townships in this division of land classification had decreases in

building estimated market value.

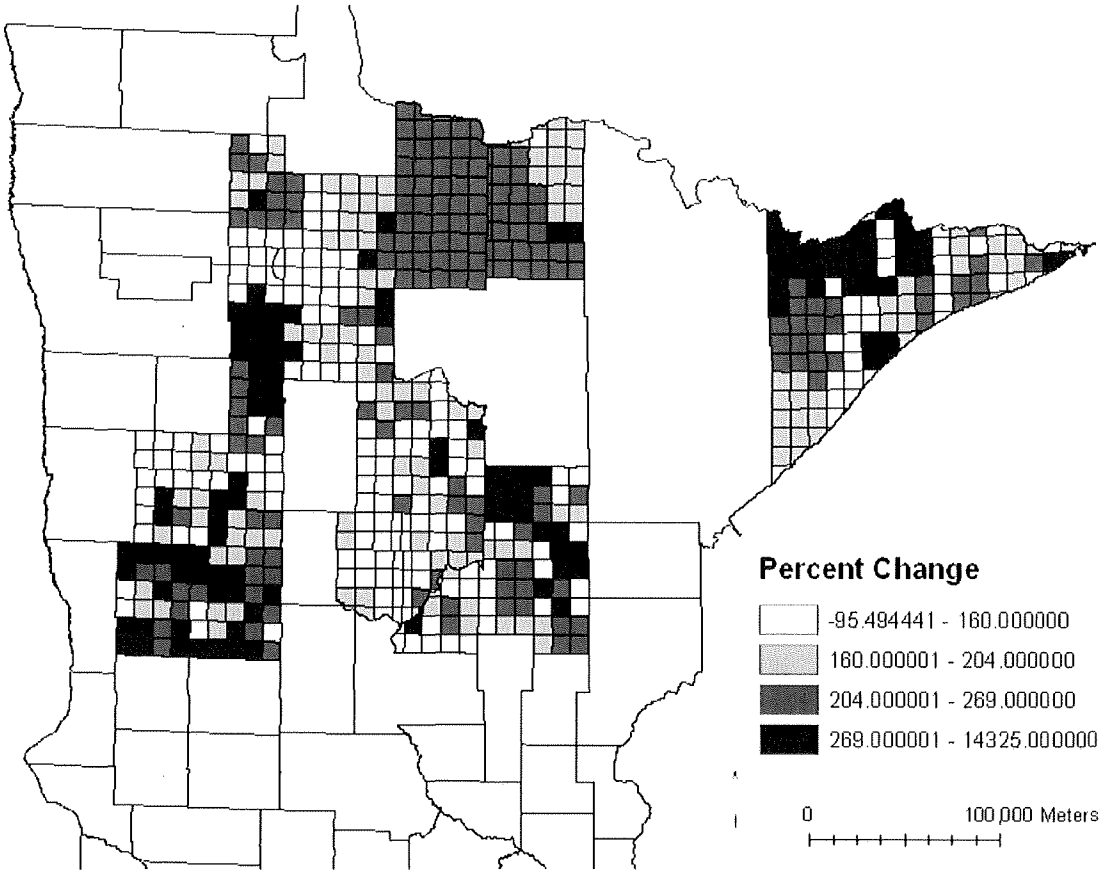


Figure 60. Percent change per township of land estimated market values on forested parcels from 2002-2008.

Figure 60 illustrates the percent change in land EMV from 2002-2008 per township for all forested parcels. Land EMV is the market value for certain classification of land as estimated by the county assessor for property tax purposes. This data comes from the Minnesota market value files, which are compiled from the data that county assessors record. This map shows that more townships experienced an increase in land EMV (on a percentage basis), rather than a decrease. Increases were often dramatic, over 100 percent. Townships in northern Lake, Beltrami, northern Aitkin, and portions of Otter Tail County experienced the greatest percent increase in forest land EMV over this seven year period. Koochiching County townships surprisingly almost all fall into the same category of increase, from 204%-269%. No distinctive regional patterns of township EMV change are apparent

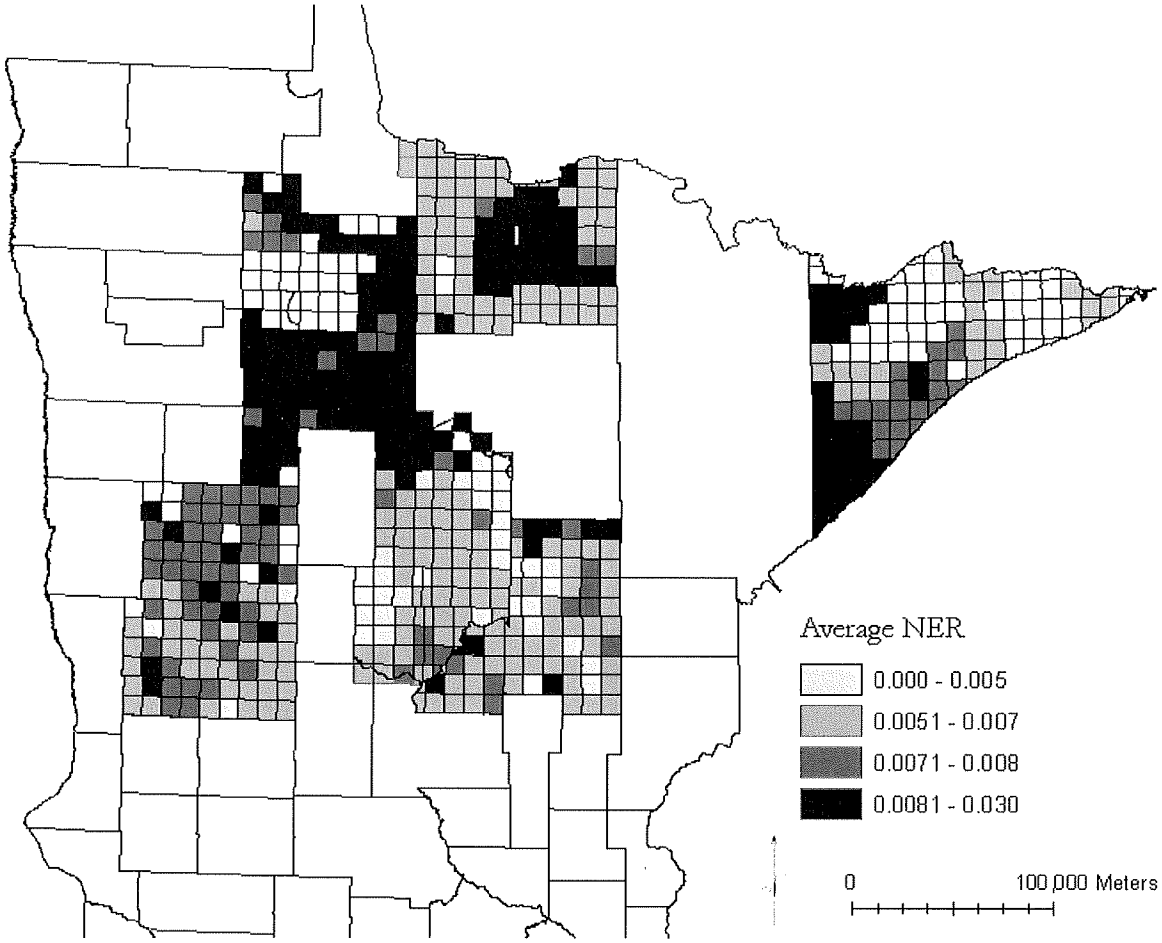


Figure 61. Average net effective tax rate per township.

Figure 61 shows the average total net effective tax rate (NER) per township for all forested parcels. NER is the calculated tax rate for the different property tax classifications in Minnesota and was chosen as the variable that best represents overall property tax liability. We wanted to test if higher tax rates cause people to subdivide and sell their land or, conversely, if lower tax rates across a landscape correspond to less parcelization. Total NER generally tend to be higher in northern counties than in southern counties, with Beltrami, Clearwater, and Southern Lake Counties having the highest NER. A cluster of townships in the middle of Koochiching County also had a high average NER. Additionally, some townships in Cook and Cass Counties had an average total NER of zero. This is most likely due to the fact that data for this variable was not available for every township in every county.

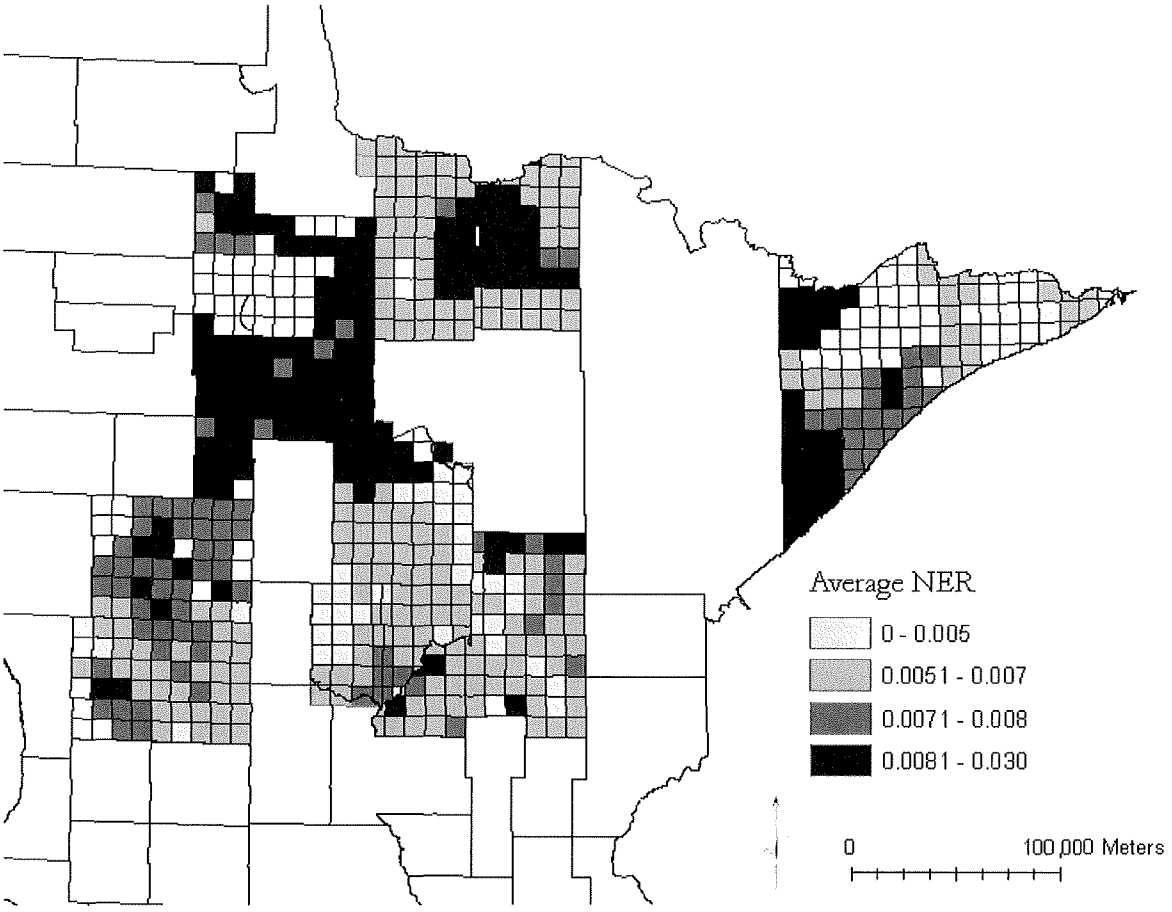


Figure 62. Average net effective tax rate per township in parcels over 20 acres.

Figure 62 shows the average total NER per township for all forested parcels at least 20 acres. Patterns in this map are consistent with the patterns in the previous map (Figure 61) that includes all forested parcels. However, more townships throughout the study area are in the 0-0.005 NER category in Figure 62 than Figure 61.

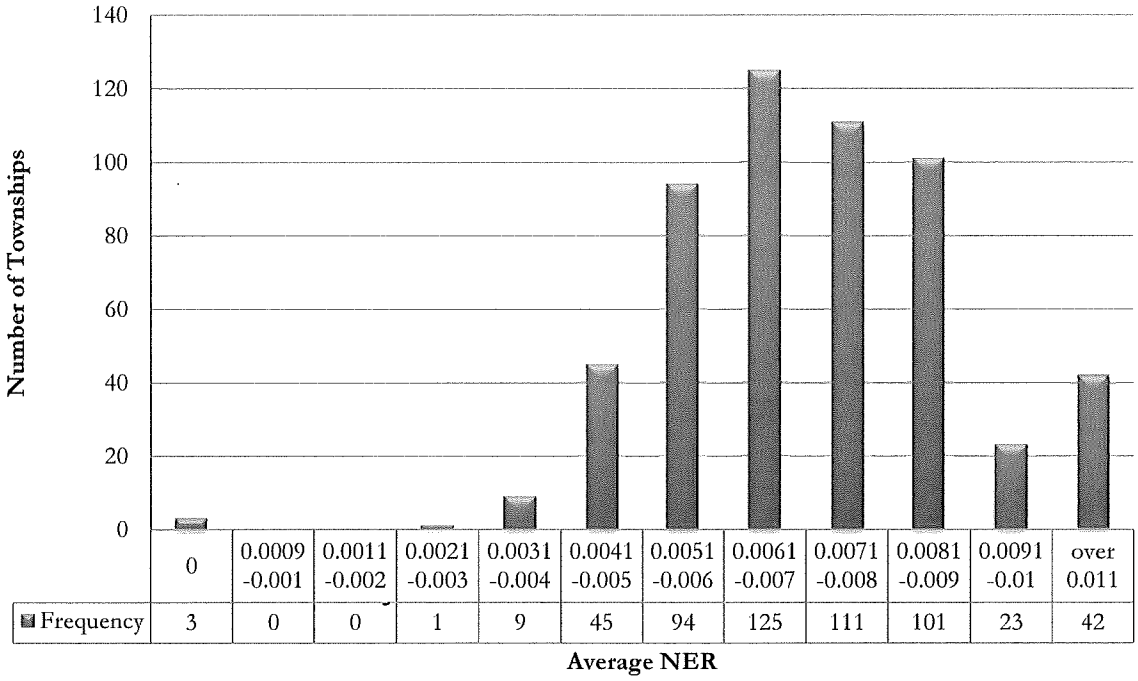


Figure 63. Frequency distribution of average net effective tax rate per township.

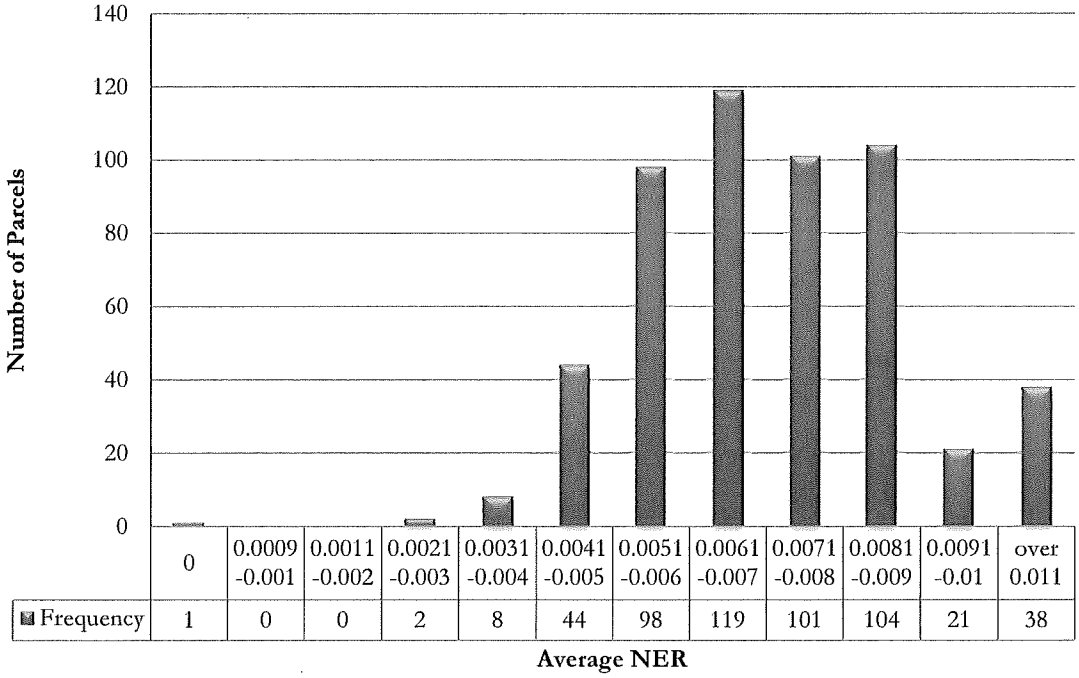


Figure 64. Frequency distribution of average net effective tax rate for forested parcels over 20 acres per township.

The histograms presented in Figures 63 and 64 correspond with the preceding two maps (Figures 61 and 62) and illustrate the frequency distribution of average net effective tax rate per township across the ten county study area. The two histograms are nearly identical, indicating the smaller forested parcels are not correlated with a lower or higher township net effective tax rate.

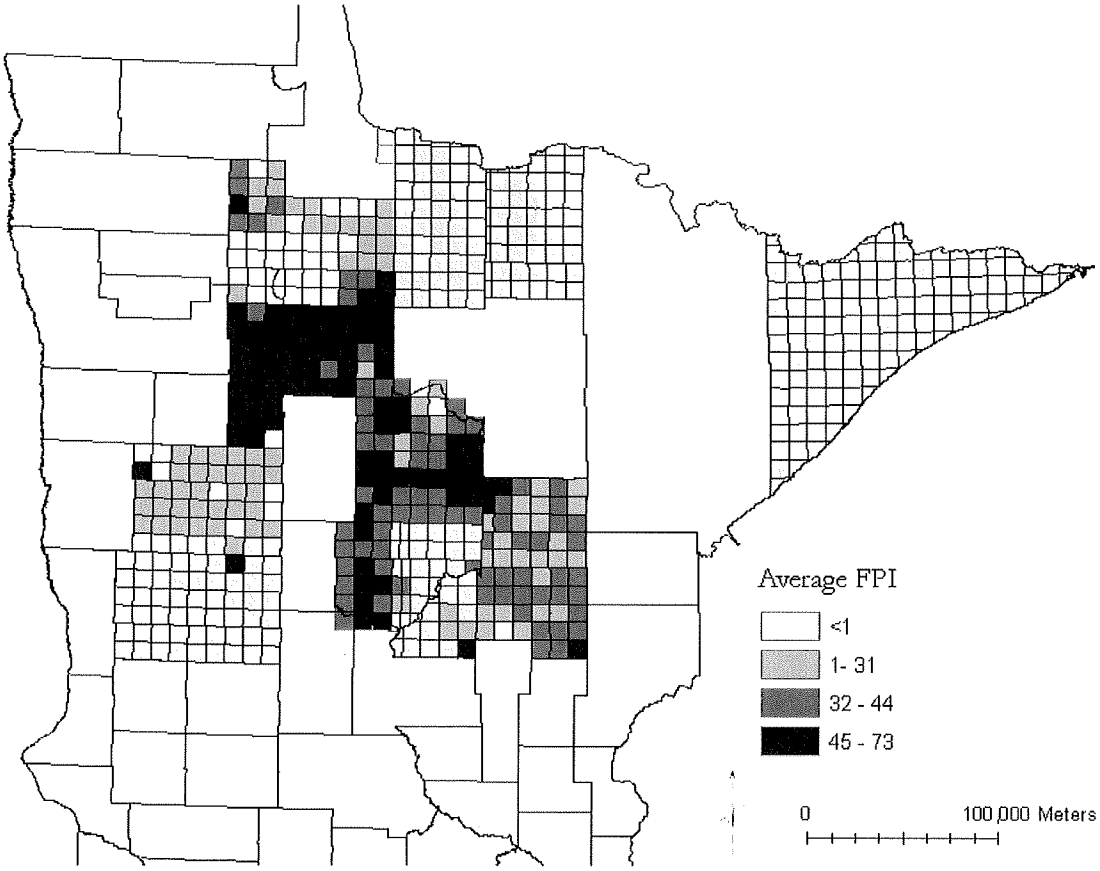


Figure 65. Average forest productivity index rating per township.

Figure 65 indicates the average forest productivity index rating (FPI) per township for all private forested parcels. The Minnesota FPI is a rating system that ranks soils based on their ability to grow quaking aspen. The index can be used to compare the growth potential of one soil to another. Ratings are on a 0-100 scale, with high rates indicating better forest growth potential. Ratings are based on physical and chemical properties of the soil. Three categories were used to rate the soils: 1) their effects on water availability

(including soil drainage class, depth to water table, and available water storage); 2) nutrient availability (including organic matter and exchangeable bases); and 3) other (site) factors such as the bulk density of the rooting zone and stone content. The FPI information can be used to target those areas that have the greatest opportunity to impact forest productivity, as increased parcelization often leads to reduced forest productivity.

FPI ratings are highest in Clearwater and southern Beltrami counties. Cass County has the second highest overall rating. Cook, Koochiching, Lake, and Otter Tail Counties all have an average rating of zero, as FPI rating data was not available for those counties.

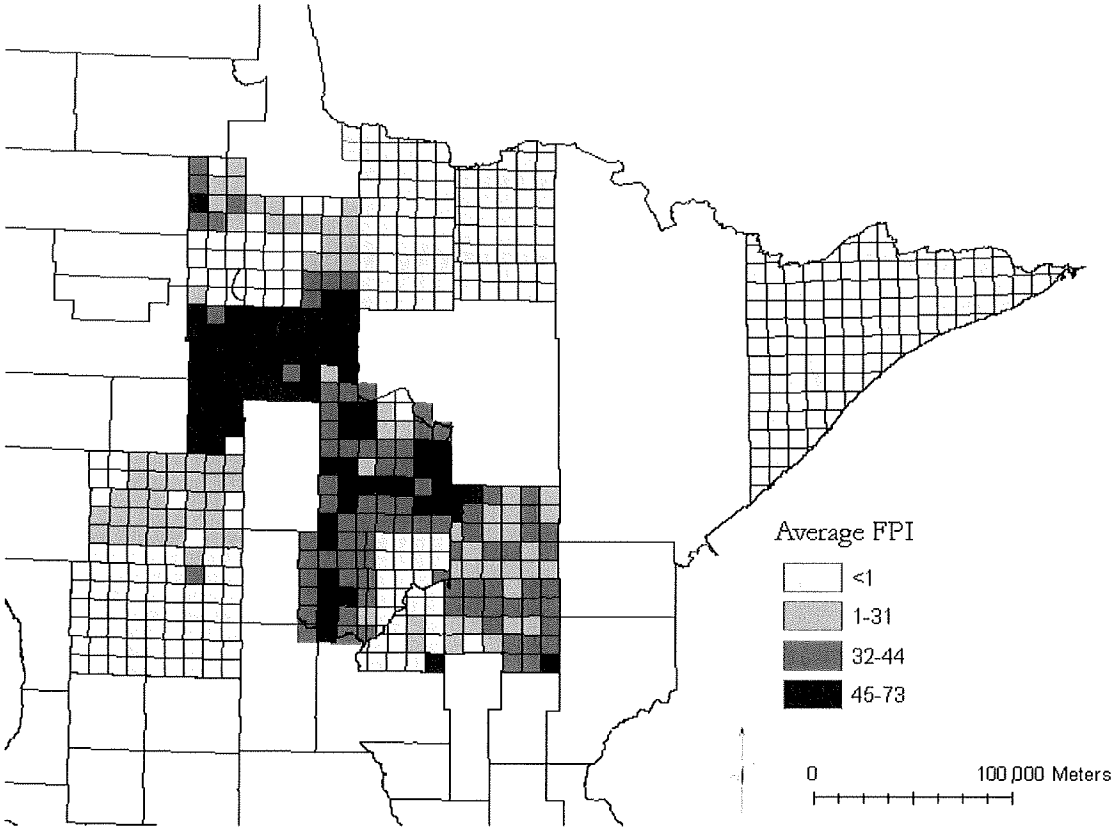


Figure 66. Average forest productivity index rating per township for parcels over 20 acres.

Figure 66 indicates the average FPI per township for all forested parcels 20 acres or more. The same patterns are evident in this map as in the map that included all forested parcels (Figure 65), with Clearwater and southern Beltrami counties having the highest FPI ratings.

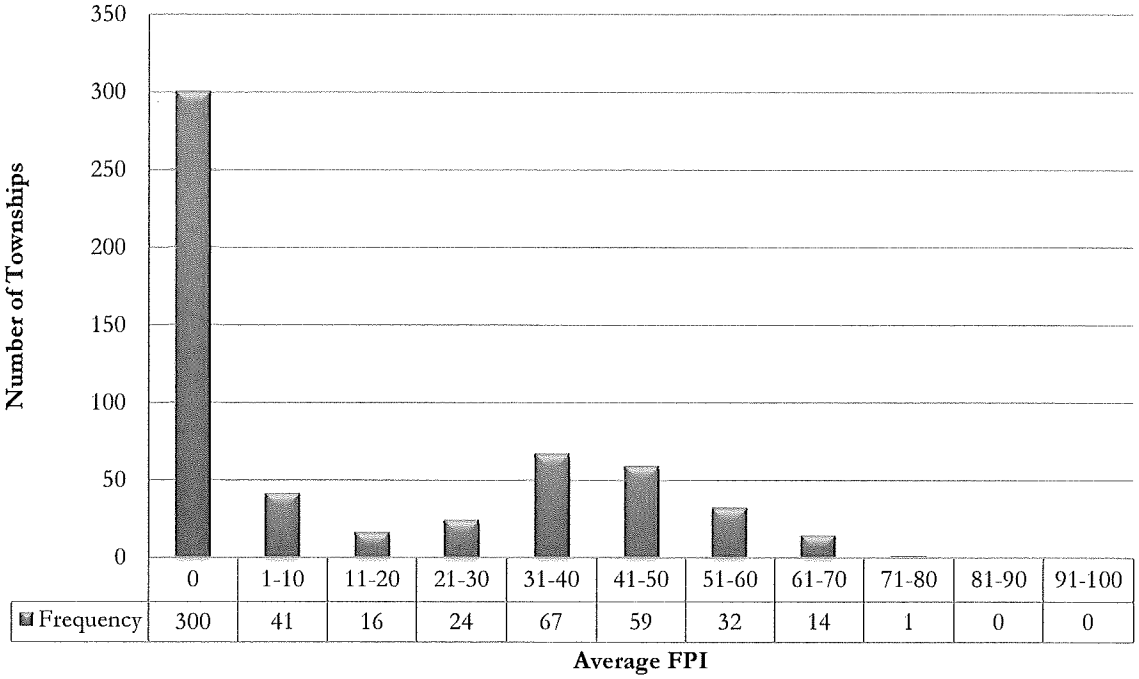


Figure 67. Frequency distribution of average forest productivity index rating for forested parcels per township.

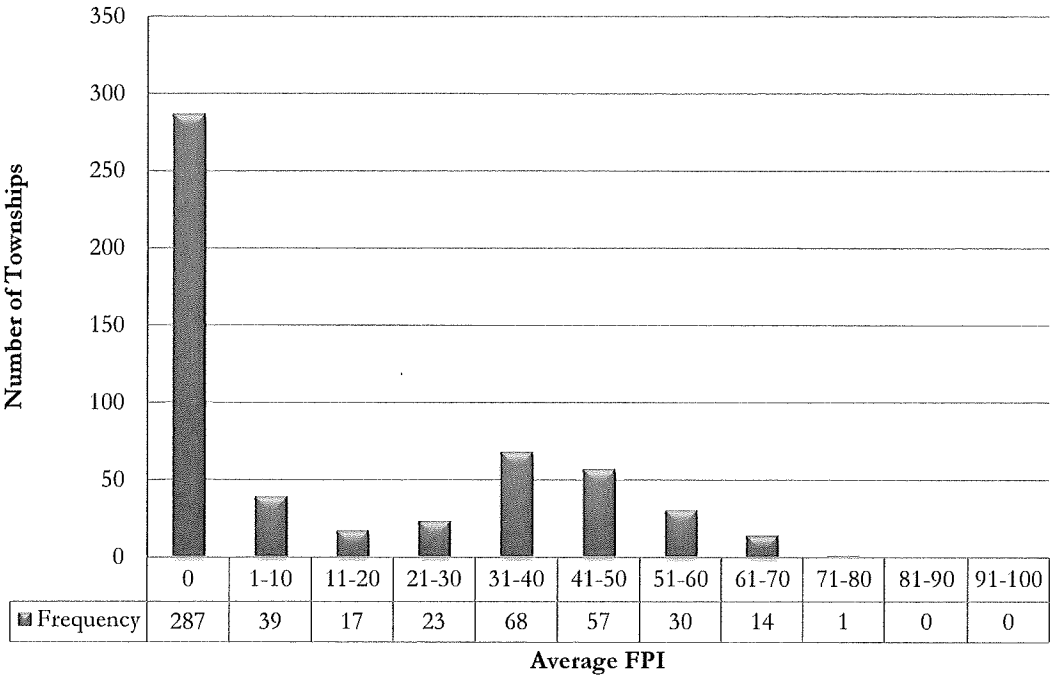


Figure 68. Frequency distribution of average forest productivity index rating for forested parcels over 20 acres per township.

Figures 67 and 68, illustrating average forest productivity index rating per township, and are very similar. Considering only forested parcels 20 acres or more in size (versus all forest land regardless of parcel size) does not have a significant impact on a township's overall FPI index. Most townships have a rating of zero, again because FPI rating data was not available. There are a few townships distributed across the ratings from 1 to 80.

Summary Observations of the Multi-County Analysis

The extensive series of maps and graphs created from the data allowed us to visually display and examine several important physical and economic dimensions of private forest land across the ten county study area. From these maps, relationships were visually discerned between average parcel size, amount of forest land, and total parcels per township. Recognizing the disadvantages associated with average parcel size as an indicator of parcelization, this metric can visually represent important changes that are occurring across a large landscape. From the data, it appears that townships with smaller average parcel sizes most often have the highest numbers of total parcels. Interesting patterns also emerge when analyzing parcels' adjacency to water, roads, and public lands. Surprisingly, the rate of adjacency to water does not drastically change when parcels under 20 acres in size are removed from the analysis. We had expected the effects of small parcels next to lakes to have a more pronounced effect on the level of parcelization within a forested landscape. Moreover, the histograms show that the difference between the analysis done using all private, forested parcels and that done using private, forested parcels 20 acres or more is minor regardless of the driver that was being graphed. These observations suggest that there are specific drivers of parcelization, regardless of the size of a parcel. The statistical analysis that follows is able to lend itself to more conclusive determinations than the visual analysis alone.

Characterizing a Parcelized Landscape

One of the main goals of this study was to describe a parcelized landscape, as well as site and proximity factors associated with a parcelized landscape. Most research has characterized forest parcelization according to average parcel size. However, results from the preceding analysis indicate the use of average parcel size as a measure of parcelization may not accurately portray the distribution of parcel sizes and number of parcels across a landscape. For example, Figure 69 illustrates how using mean parcel size can present very different characterizations of forest land parcelization. The acreage of private forest land represented in these two figures is very different, even though both townships have nearly identical average parcel size. The Crow Wing township in Figure 69 contains 157 private forest land parcels — 133 more than is contained in the Cook County

township. Yet, if average parcel size is used to characterize a parcelized landscape, these two townships would be considered nearly equivalent (mean parcel size of 83.46 and 83.05, respectively). As is obvious from these two figures, the two townships are quite distinct in terms of the degree to which each is parcelized. In the Crow Wing County township, nearly three-quarters of its land covered in private forest land, while private forests contained in the Cook County township covers only 9% of the township's land area.

Another problem with using average parcel size as a measure of a parcelized landscape is its inability to account for the distribution of individual parcel size. The two hypothetical landscapes portrayed in Figure 70 contain the same land area, number of parcels, and average parcel size. Using average parcel size as a metric to describe a parcelized landscape would have described these two hypothetical landscapes as identical, yet they illustrate very different pictures of parcelization. With its entire area covered by small parcels, by most measures, landscape B would be considered to be more parcelized than landscape A, in which small acreage parcels only cover a small portion of its land area.

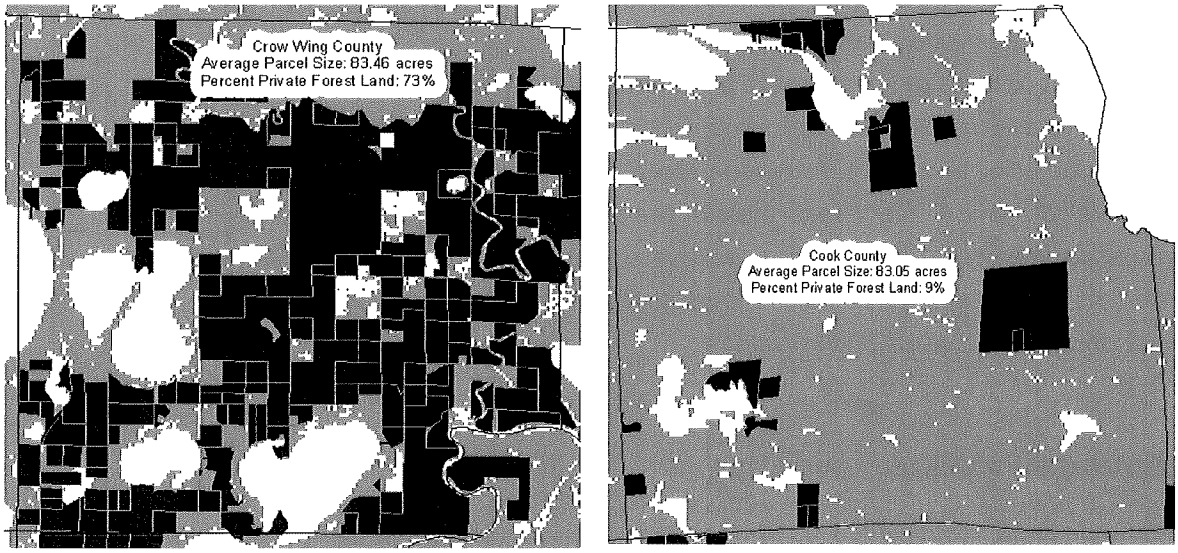
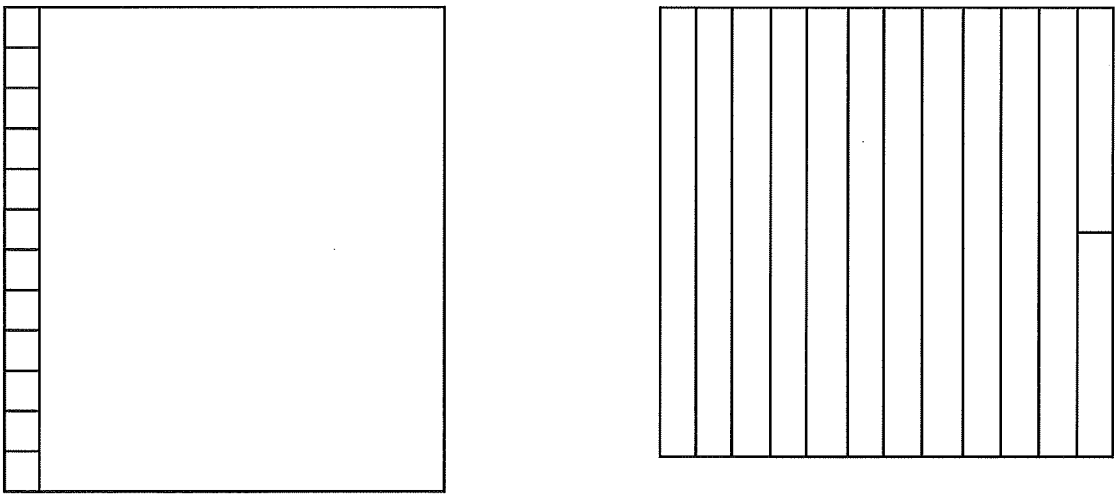


Figure 69. Townships in Crow Wing and Cook counties with nearly equal average parcel size.



Landscape A Landscape B

Figure 70. Two landscapes with the same area, number of parcels, and average parcel size.

A few researchers have used metrics other than mean parcel size to describe forest land parcelization. Pan, Zhang, and Majumdar (2009) used a Gini-coefficient to model county timberland distribution, plotting the cumulative percent of forestland against the cumulative percent of forestland owners to create their Gini-index. This index measures the statistical dispersion of forested land across a geographic area. We felt using a Gini-coefficient could result in a misleading characterization of parcelization, as this metric focuses more on the area in the tail of the dispersion graph, rather than on the majority of the area. Focusing only on the area in the tail of the graph skews the meaning of what is attempting to be explained—the extent of parcelization in forestland parcels. A township with a very large distribution of parcel sizes could have the same Gini- coefficient number as a township with a very narrow distribution in parcel size.

Proposed New Measure of a Parcelized Landscape

To account for the distributional and spatial problems associated with using average parcel size, a new metric was developed to measure the extent to which a forest landscape is parcelized, taking into consideration specific features of a forest landscape. This metric can be expressed as follows:

$$\frac{\textit{percent of acres < a specified acre threshold}}{\textit{mean parcel size}} \times \textit{total private forest land acres}$$

which simplifies to:

percent of acres < a specified acre threshold x number of private forest land parcels

This metric makes two adjustments to average parcel size to better account for the distributional and spatial variability of a parcelized landscape, as illustrated in Figures 69-70. To address the acreage distributional problem, the percent of acres attributed to parcels within a forested landscape (e.g., township) that are less than a threshold acreage value is included. Although the selection of a threshold acreage value is arbitrary, the threshold value suggests the size of parcels that could be associated with a parcelized landscape. To illustrate, assume two landscapes have an average parcel size of 15 acres, yet 90% of the area in one landscape contains parcels less than 20 acres in size (the threshold value used in this case) while only 20% of the other landscape's area has parcels less than 20 acres in size. By adjusting each township's average parcel size to account for the percent of acres in parcels less than 20 acres produces very different measures of a parcelization (i.e., 0.06 for the township with 90% of its land in parcels less than 20 acres versus 0.013 for the township with 20% of its land area containing parcels less than 20 acres in size).

Similarly, the new metric accounts for the spatial extent of a forested landscape by multiplying by the total forest acres per township. The formula accounts for the areal extent of forested landscapes, as the value of the proposed new parcelization metric increases with the size (area) of the forested landscape.

Using the formula described above, a higher value represents a higher level of parcelization (i.e., decreasing the average parcel size, increasing the percent of the landscape in smaller parcels, or increasing the area of the landscape will all increase the value of this new parcelization metric).

While we suggest this metric is an improvement over using average parcel size to describe a parcelized landscape, it has its shortcomings. One is that the specific threshold acreage value selected can impact the value of the parcelization metric. For example, assume each of the two landscapes illustrated in Figure 70 is 144 acres. Each has 13 parcels and an average parcel size of 11.08 acres. Landscape A contains one 132 acre parcel, and twelve 1 acre parcels. Landscape B has eleven 12 acre parcels, and two 6 acre parcels. For most reasonable acreage threshold values (i.e., those that are not extremely small), the proposed new metric characterizes landscape A as being less parcelized than landscape B (i.e., the calculated metric for landscape A is smaller than for landscape B). However, using any threshold acreage value smaller than 6 acres will characterize landscape A as a more parcelized landscape than landscape B. This points to the somewhat subjective nature of selecting a parcel size below which a landscape is considered parcelized.

Characterizing what constitutes a parcelized landscape is also dependent on the spatial arrangement and associated amenity features of the landscape. For example, landscape A in Figure 70 may be considered more parcelized if the row of small parcels is on a lake shore and one is concerned with run-off issues. Conversely, landscape B may be considered more parcelized if focusing on wildlife habitat fragmentation. This limitation notwithstanding, we suggest the proposed metric is a substantial improvement over average parcel size to characterize a parcelized landscape.

Applying the Parcelization Metric to the Study Data

Ordinary least squares (OLS) regression was used to test this new proposed metric for describing a parcelized landscape. Using the percent change in population, net effective tax rate, estimated market value, adjacency to public water, adjacency to public land, adjacency to public roads, and adjacency to a city as independent variables, both mean parcel size within a township and the proposed new parcelization metric were tested as dependent variables.

Diagnostic tests of the data indicated OLS model assumptions (e.g., linearity, constant variance, independence and normal distribution of error terms) were not substantially compromised. Other important aspects of the models used to test the new parcelization metric:

- Townships are the unit of analysis. The PivotTable function in Microsoft Excel 2007 was used to aggregate individual parcel data up to the township level.

- The independent variables were chosen based on findings from previous research suggesting they are associated with parcelization. When reviewing previous studies of parcelization, several characteristics were consistently used to identify associations of parcelization: proximity to water, public land, metropolitan areas, access availability (roads), population, tax rates, and development. Limited by data availability, we incorporated those proxy variables for the associations thought to be most influential.

- Two analyses of the data were conducted depending on whether private forest land was considered to be: 1) at least one acre; and 2) at leas 20 acres. These two levels of analysis were used to test whether there is a large effect from shoreland development, which tends to include small parcels.

- All analyses were conducted using PASW 17.0.3 software (SPSS).

Table 1 identifies the independent variables used in the regressions. Table 4, located in Appendix E-1, contains descriptive statistics for all independent variables from data including all private, forested parcels. Table 5, also located in Appendix E-1, contains descriptive statistics for all independent variables from data including all private, forested parcels 20 acres or more in size.

Table 1. Variables from dataset hypothesized to be associated with a parcelized landscape.

Variable	**Description**	**Hypothesized Effect on Parcelization**
% Change in Population 96-06	Percent change in population per township from 1996-2006	Positive
Average of totalner	Average total net effective tax rate per township	Positive
Totemv08	Average total estimated market value per township	Positive
% of adj_lakeacre	Percent of private, forested acres adjacent to public waters	Positive
% of adj_pblclnacre	Percent of private, forested acres adjacent to public land	Positive
% of adj_roadacre	Percent of private, forested acres adjacent to public roads	Positive
% of 1600macres	Percent of private, forested acres within 1,600 meters of a city	Positive

OLS Models Developed – All Forest Land

The following describes the four OLS models that were developed to identify associations between different measures of a parcelized forested landscape and various parcel-level data (e.g., value, proximity characteristics), aggregated to the township. All four models included all private forest land in the analysis. The left hand side (LHS) variables for these four models include mean parcel size and three new parcelized landscape metrics (incorporating 80, 60, and 40 acre threshold levels) and are described as follows:

Average parcel size *=f(change in population from 1996-2006, net effective tax rate, total estimated market value, adjacency to public waters, adjacency to public lands, adjacency to public roads, within 1600m of a city).*

(percent of acres in parcels under 80 acres /average parcel size)*total forest acres *=f(change in population from 1996-2006, net effective tax rate, total estimated market value, adjacency to public waters, adjacency to public lands, adjacency to public roads, within 1600m of a city).*

(percent of acres in parcels under 60 acres /average parcel size)*total forest acres *=f(change in population from 1996-2006, net effective tax rate, total estimated market value, adjacency to public waters, adjacency to public lands, adjacency to public roads, within 1600m of a city).*

(percent of acres in parcels under 40 acres /average parcel size)*total forest acres *=f(change in population from 1996-2006, net effective tax rate, total estimated market value, adjacency to public waters, adjacency to public lands, adjacency to public roads, within 1600m of a city).*

Table 2 contains the results of these four models. Independent variables with a p-value ≤ 0.05 are considered statistically significant. A positive coefficient that is statistically significant means that as that variable increases in value, the dependent variable increases (meaning a more parcelized landscape). Conversely, a negative coefficient that is statistically significant means that as that variable decreases in value, the dependent variable decreases (meaning a less parcelized landscape).

In Table 2, only percent change in population from 1996-2006 is statistically significant for Model I, using average parcel size as the dependent variable. In Models II-IV, percent change in population is also statistically significant. This indicates that as population increases, so does parcelization, as the sign on the independent variable is positive. Percent of acreage adjacent to public water is also significant in Models II-IV. Again, the sign on all three models is positive, indicating that as more acreage is adjacent to water, the landscape becomes more parcelized.

Table 2. Regressions results using all forested parcels at least one acre.

Model	I			II			III			IV		
Variable	Average parcel size			80 acres			60 acres			40 acres		
	Coeff.	SE	p-Val	Coeff.	SE	p-Val	Coeff.	SE	p-Val	Coeff.	SE	p-Val
% Change in population 96-	-1.481	0.344	0.000	2.250	0.436	0.000	1.872	0.379	0.000	1.386	0.311	0.000
Average of totemv08	-417.890	2632.184	0.874	1441.597	3336.486	0.666	1028.427	2896.654	0.723	1061.409	2367.562	0.654
% of adj_lakeacr	0.000	0.000	0.512	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
% of adj_pbldnacr	-0.127	0.229	0.581	0.826	0.290	0.005	0.730	0.252	0.004	0.548	0.208	0.009
% of adj_roadacr	-0.040	0.169	0.783	-0.055	0.214	0.795	-0.024	0.180	0.898	-0.026	0.153	0.867
% of 1600macre	0.061	0.301	0.839	0.382	0.382	0.318	0.265	0.332	0.425	0.210	0.275	0.440
(Constant)	-0.313	0.311	0.316	0.595	0.395	0.132	0.541	0.343	0.115	0.389	0.280	0.166
	87.566	31.233	0.005	-35.320	39.590	0.373	-32.204	34.371	0.349	-31.977	28.353	0.260
R^2	0.060			0.370			0.375			0.376		
Adjusted R^2	0.042			0.357			0.363			0.364		
F-Statistic	3.260			29.913			30.633			30.274		
Model p-Val	0.002			0.000			0.000			0.000		
n	364.00			364.000			364.000			358.000		

Figures 71-73 illustrate various characterizations of parcelized forest landscapes across the ten county study area using the proposed new metric of a parcelized landscape.

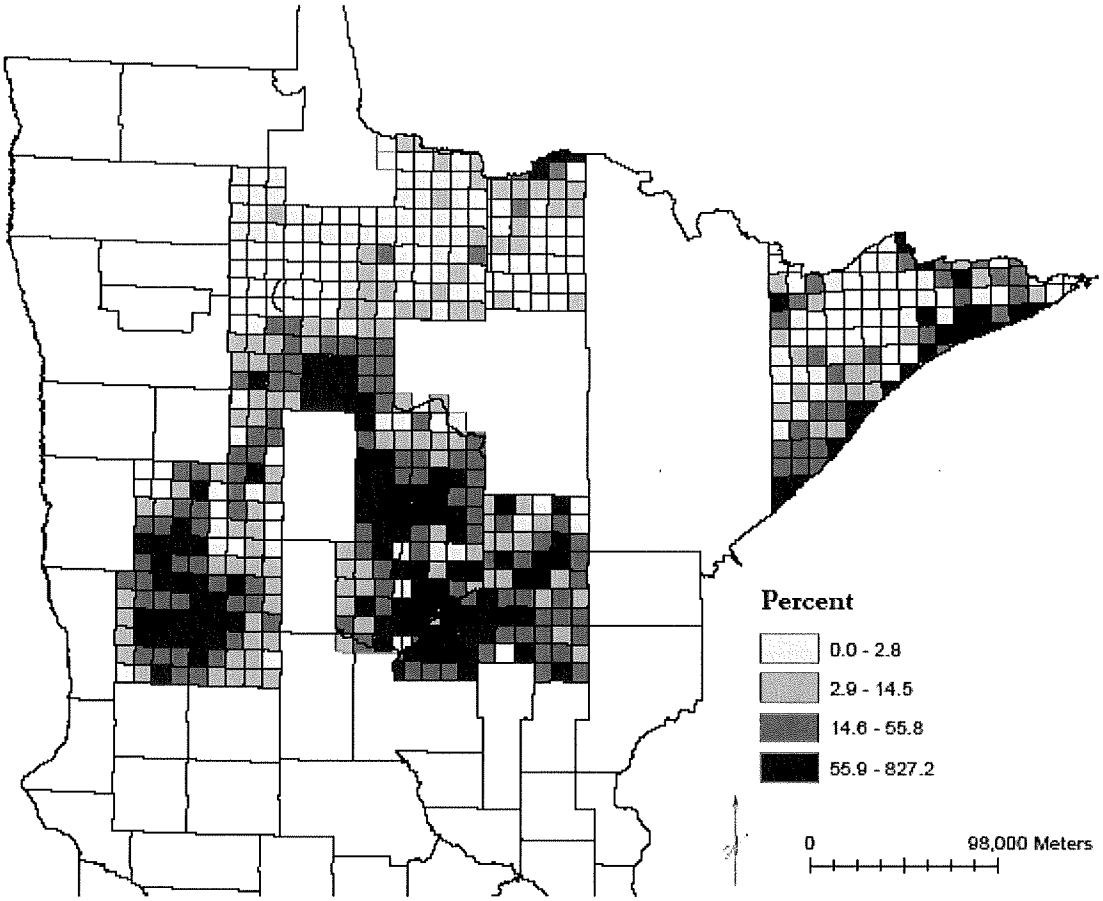


Figure 71. Extent of private forest land parcelization by township across the ten county study area as estimated by the new parcelization metric (40 acre threshold). Darker shading indicates a more parcelized landscape.

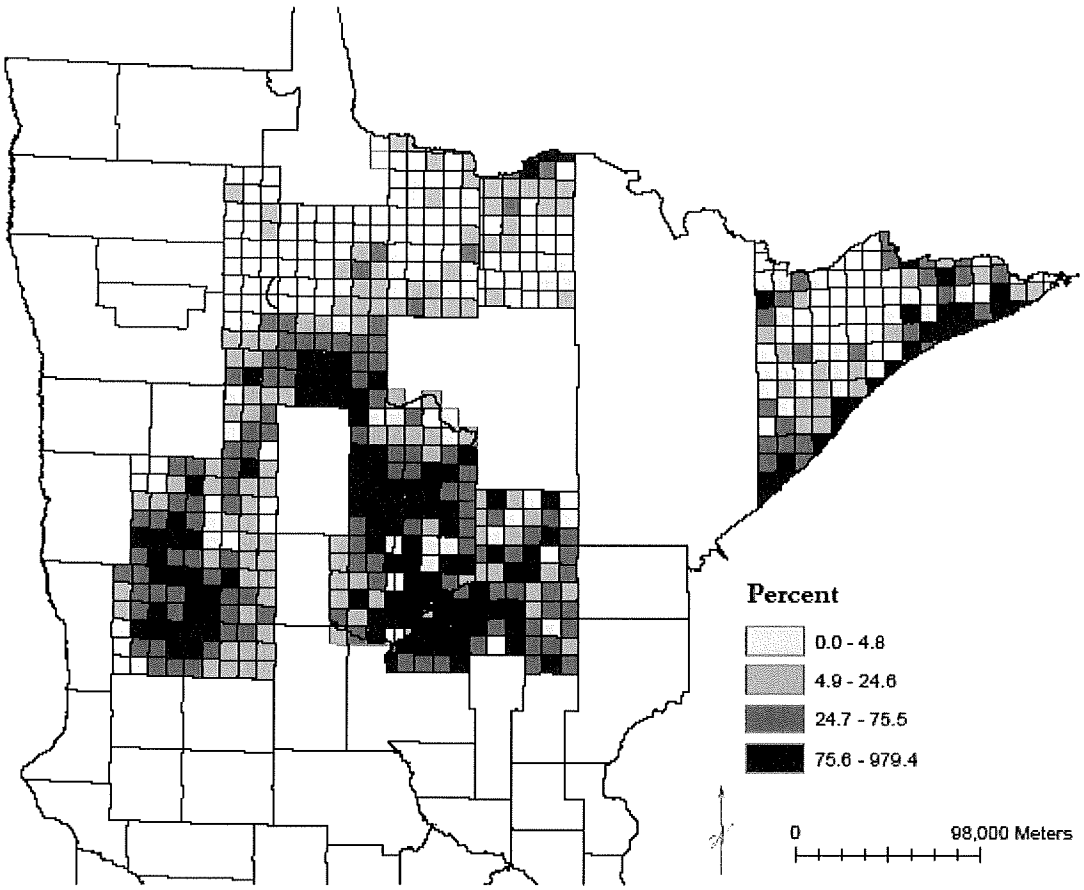


Figure 72. Extent of private forest land parcelization by township across the ten county study area as estimated by the new parcelization metric (60 acre threshold). Darker shading indicates a more parcelized landscape.

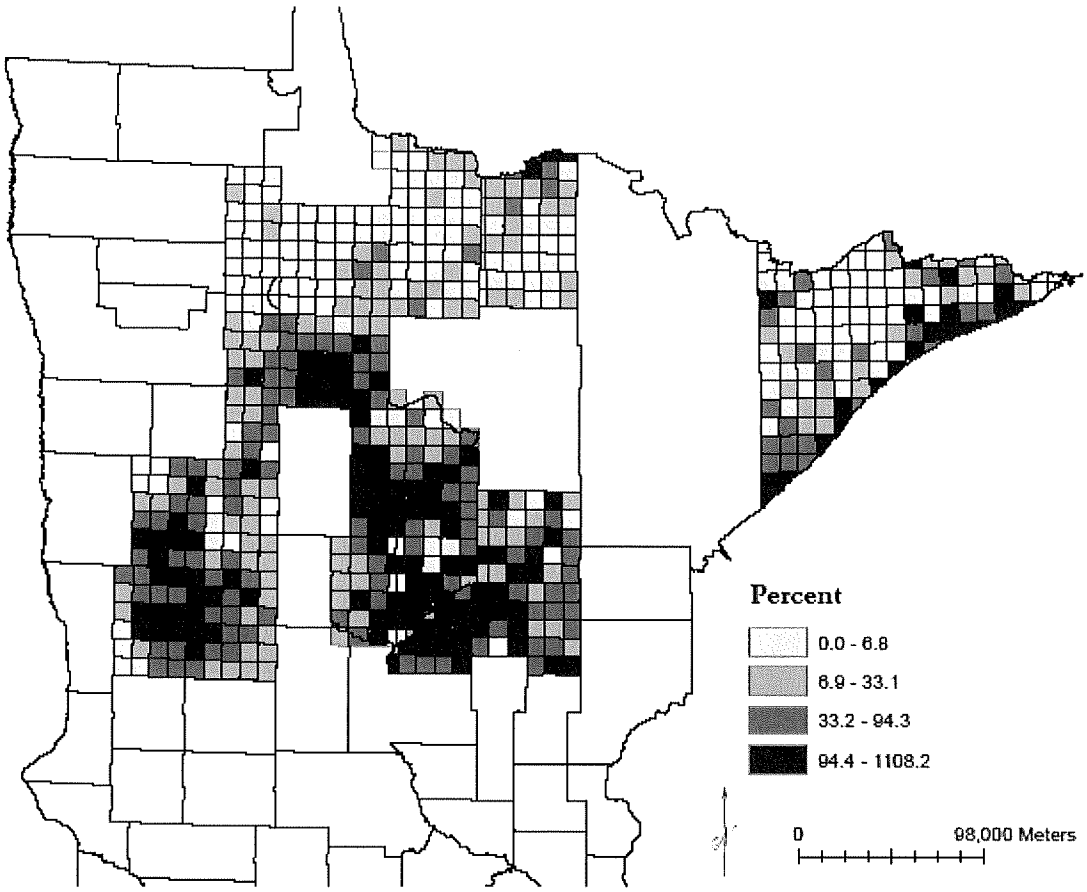


Figure 73. Extent of private forest land parcelization by township across the ten county study area as estimated by the new parcelization metric (80 acre threshold). Darker shading indicates a more parcelized landscape.

OLS Models Developed – All Forest Land in Parcels 20 Acres or More in Size

The results shown in Table 3 are from OLS regressions using data from private forested parcels 20 acres in size. Each regression corresponds to one of the previous regressions that used data from all private, forested parcels. The four previous models were replicated with the dataset truncated at all private, forested parcels over 20 acres in size.

Table 3. Regression results using forested parcels at least 20 acres.

Model	I			II			III			IV		
Variable	Average Parcel Size			80 acres			60 acres			40 acres		
	Coeff.	SE	p-Val	Coeff.	SE	p-Val	Coeff.	SE	p-Val	Coeff.	SE	p-Val
% Change in population 96-06	-1.830	0.382	0.000	0.362	0.064	0.000	0.262	0.047	0.000	0.162	0.030	0.000
Average of totalner	754.503	2875.593	0.793	-46.289	481.569	0.923	-109.634	356.246	0.758	32.352	224.787	0.886
totemv08	0.000	0.000	0.245	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
% of adj_lakeacre over 20	0.616	0.239	0.011	-0.054	0.040	0.178	-0.027	0.030	0.366	-0.026	0.019	0.166
% of adj_pblclnacre over 20	-0.071	0.180	0.693	0.029	0.030	0.336	0.034	0.022	0.135	0.029	0.014	0.045
% of adj_roadacre over 20 acres	-0.064	0.319	0.840	0.148	0.054	0.006	0.087	0.040	0.030	0.046	0.025	0.067
% of 1600macre over 20 acres	-0.312	0.349	0.373	0.069	0.059	0.237	0.055	0.043	0.206	0.035	0.027	0.194
R^2	107.509	33.899	0.002	9.315	5.710	0.104	6.388	4.224	0.131	2.717	2.658	0.307
Adjusted	0.072			0.154			0.167			0.171		
F-Statistic	0.053			0.137			0.150			0.154		
Model p-n	3.932			9.226			10.147			10.327		
	0.000			0.000			0.000			0.000		

The variable percent change in population is significant in all four models and total estimated market value is a significant predictor in Models II-IV. However, the population change variable has a negative influence in the Model I, and a positive influence in the other 3 models. This suggests that when using average parcel size as the left hand side variable increases in population decrease the probability of a parcel being parcelized. That is counterintuitive to most beliefs regarding population increases and parcelization. Percent of acres adjacent to public land is significant in Model IV but not the other three models. Percent of acres adjacent to public roads is significant and positive for Models II and III, but not the other two models.

Figures 74-76 illustrate various characterizations of parcelized forest landscapes across the ten county study area using the proposed new metric of a parcelized landscape when only 20+ acre forested parcels are included.

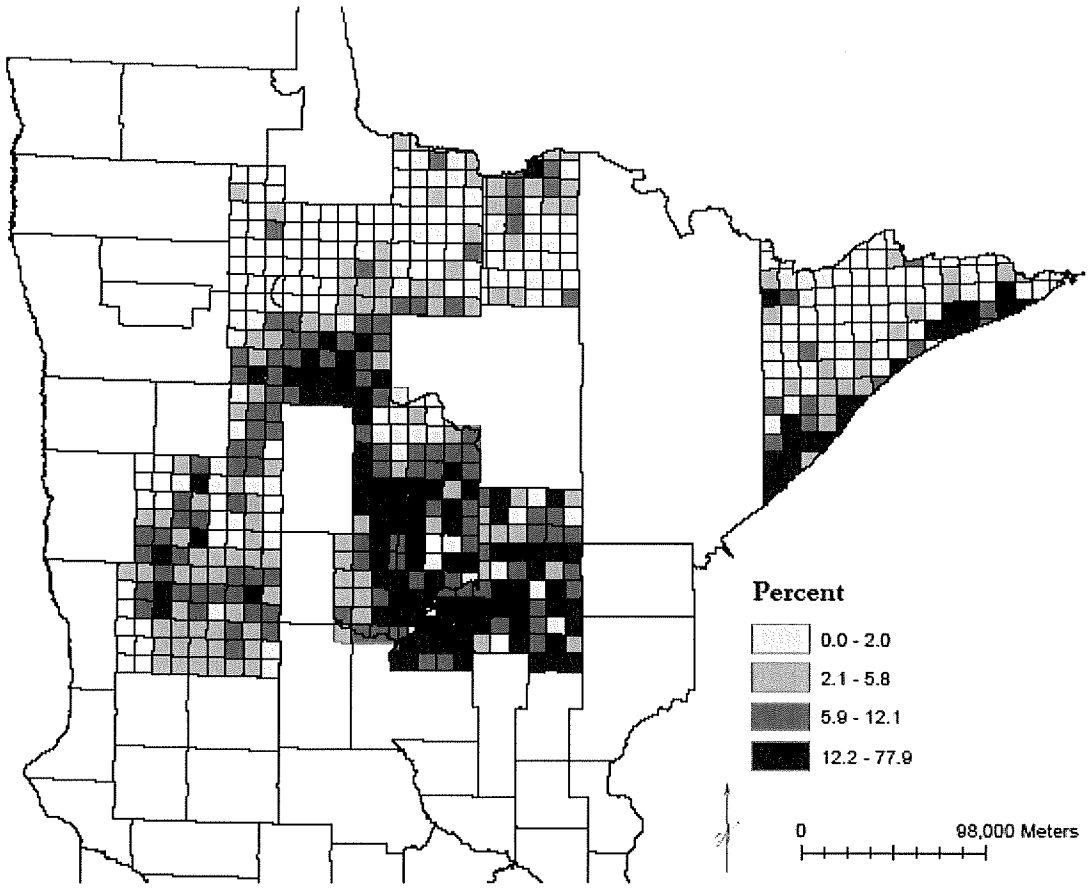


Figure 75. Extent of private forest land parcelization by township across the ten county study area as estimated by the new parcelization metric. Only 20+ acre parcels are included in the analysis (40 acre threshold). Darker shading indicates a more parcelized landscape.

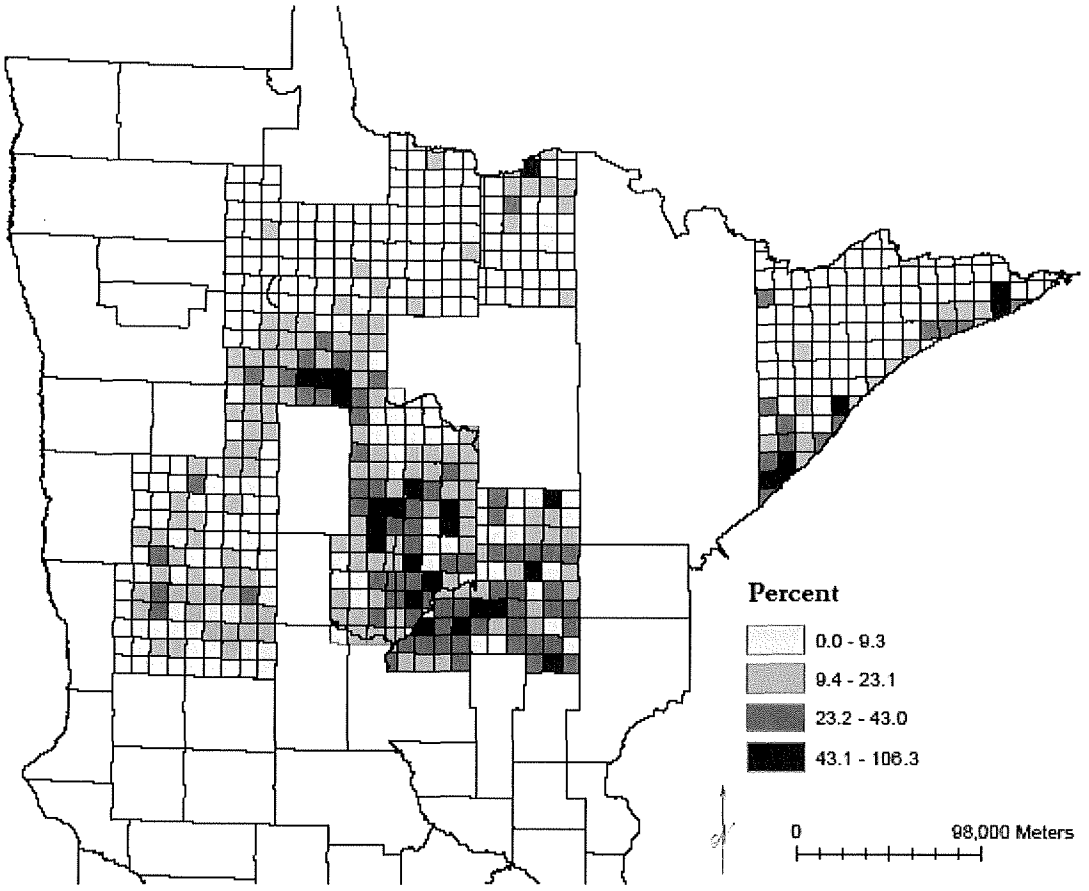


Figure 76. Extent of private forest land parcelization by township across the ten county study area as estimated by the new parcelization metric. Only 20+ acre parcels are included in the analysis (60 acre threshold). Darker shading indicates a more parcelized landscape.

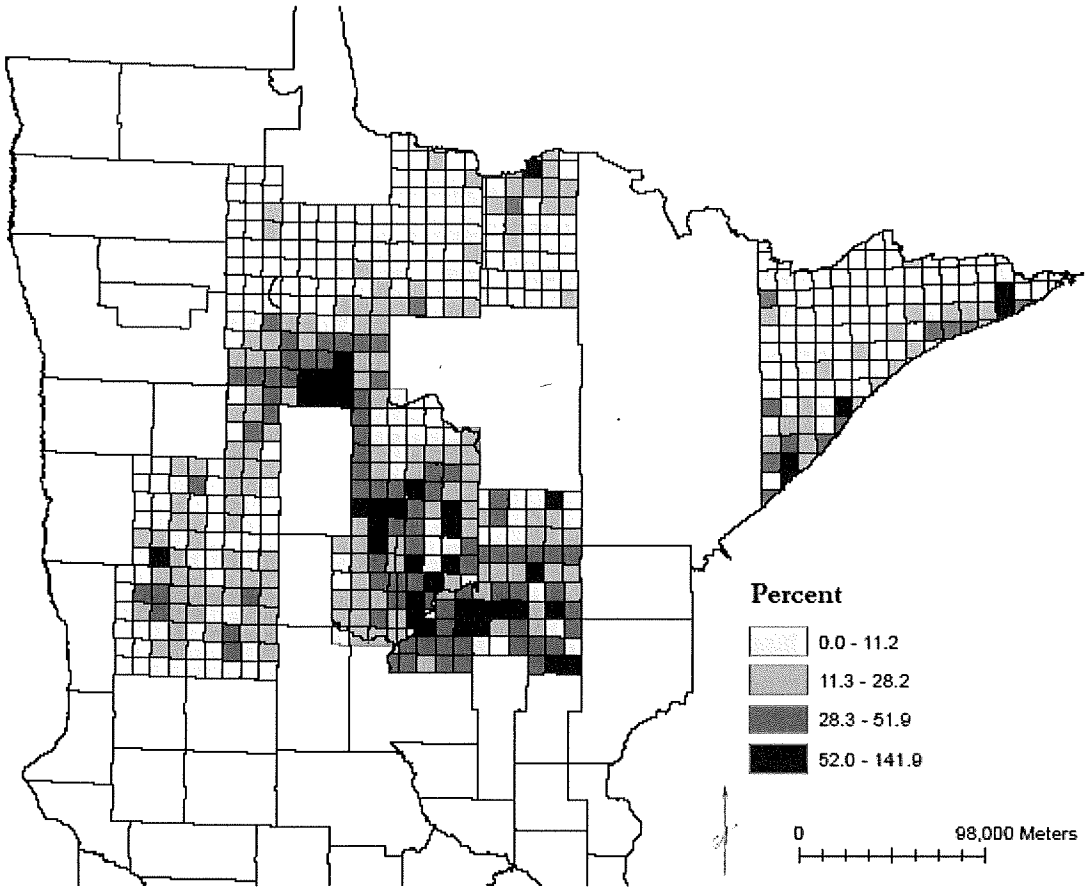


Figure 77. Extent of private forest land parcelization by township across the ten county study area as estimated by the new parcelization metric. Only 20+ acre parcels are included in the analysis (80 acre threshold). Darker shading indicates a more parcelized landscape.

Discussion

When comparing the results from the eight regression models, some patterns emerge. In Models II- IV of Table 2, percent change in population, total estimated market value, and percent of forested acres adjacent to public water are all significant and positive predictors. In Models II-IV of Table 3, percent change in population and total estimated market value are both significant. Change in population is always significantly associated to parcelization and adjacency to public roads is significant in models analyzing parcels 80 acres or less in size and 60 acres or less in size, but not significant once the parcels reach a size under 40 acres. Regardless of the parcel's size, percent change in population always has a significant effect. However, its influence was negative in both models using average parcel size as the independent variable. When analyzing all private, forested parcels, adjacency to public water is significant.

The fit of Model I using all forest land and only parcels at least 20 acres was poor in both instances. The models with the new parcelization metric consistently produced a better fit of the data to the new metric describing a parcelized landscape. The models also identified a number of patterns of association between the predictor variables and the independent variables. For example, change in population was statistically significant at each level (under 80 acres, under 60 acres, under 40 acres) using the new variable. The new metric of parcelization appears to be an improvement over conventional predictor of parcelization, (average parcel size) because it takes into account parcel distribution and amount of forest land per township. By using this new metric we were able to equalize the characteristics of each township, regardless of total land size in each township. This results in more statistically meaningful results regarding the associations of parcelization.

The results from the OLS regressions indicate that the new parcelization metric improves the fit of the models as compared to average parcel size on the set of regressions that use all forested parcels as a data set. A higher adjusted R^2 value is achieved when using the new metric than when average parcel size is used as the dependent variable, suggesting the study's new parcelization metric has greater power in explaining associations with parcelization.

When further analyzing the set of regressions developed from using the data set that included all forested parcels, several patterns regarding associations of parcelization emerge. The influence of the change in population variable became greater at higher successive acreage screening levels. This correlation seems intuitive; as more people move to an area, the landscape will become parcelized to provide housing for the additional population and service industries (e.g., grocery stores, shopping malls) are needed. Adjacency to public roads is significant at the 80 and 60 acre screen, but not at 40 acres. The pattern of significance seems to suggest that access to larger parcels of land is

more important than to smaller parcels. This follows with the idea that additional hunting, fishing, and/or recreational opportunities exist on larger parcels of land. The parcel's EMV and adjacency to public water are significantly correlated with a parcelized landscape at all three acreage levels. This means the higher the taxable value of land, the more likely the land will be divided up and sold.

The fact that adjacency to public water had a significant effect on the extent to which a landscape is parcelized across all acreage levels was expected. It has long been known that waterfront property commands a higher sellable value than non-waterfront property (Doss and Taff, 1996). It stands to reason that owners of waterfront property will try to capture the greatest economic potential of the land by subdividing the property. The fact that waterfront property is so parcelized is one reason we chose to conduct the analysis based on two data sets; one using all forested parcels and the other only considering forest parcels 20 or more acres in size.

The results from the OLS regressions based on the data set containing forested parcels 20 or more acres in size shows that the new parcelization metric improves the fit of the models as compared to using average parcel size as a measure of parcelization. As with the previous data set that contained all forested parcels, a higher adjusted R^2 value is achieved when using the new parcelization metric than when average parcel size is used as the independent variable. This again suggests the dependent variables have more explanatory power in explaining associations with parcelization when the new metric is used.

Conclusions

Using the results from the analyses, one can conclude that forest landscapes experiencing a large, positive change in population will tend to be more parcelized. This appeared to be true across the ten county study area, regardless of the average parcel size, location of the parcel and amount of forest land in the landscape. This relationship between total estimated market value and parcelization was also positive; the higher total EMV is for the township, the more parcelized the landscape. When parcels under 20 acres in size were removed from the analysis, adjacency to public waters is no longer significant. This can most likely be attributed to the large amount of development along lakeshore within the study area. Adjacency to public land and public roads is significant in parcels 20 or more acres in size. These factors tell a story of accessibility; recreational and hunting access is very important on Minnesota lands. The more forested parcels that are either adjacent to public land or public roads in a township, the more likely that township is to become parcelized. This is an interesting finding, as research has suggested that more

owners surrounding public land makes it more difficult to gain access to that land (Snyder et al., 2009).

There are several additional questions this study not addressed in this study. For example, the study did not identify which adverse impacts associated with a parcelized landscape (habitat fragmentation, biotic community health, forest productivity, recreational access, conversion to developed land uses) are of greatest concern. Depending on the focus of the consequences of parcelization, the strategies for mitigating these effects can be quite different. Because of this subjective nature of characterizing what constitutes a parcelized landscape, each situation and associated solution may be unique. Further analysis is needed to understand how a parcelized landscape impacts goods and services associated with working forests.

Correctly characterizing parcelization across a large area begins with the recognition of important patterns associated with and drivers of parcelization within the landscape. A substantial barrier to making these assessments is the availability of data. In this study, because the area examined was extensive (ten counties), many problems were encountered while attempting to obtain the data needed to make this characterization. For example, each of the ten counties records parcel transactions differently. The frequency by which such parcel records are updated and made available in a GIS format also varies, as does the temporal extent of parcel level data. One county may have spatial GIS data recording parcel owners spanning many years while another county is still working on creating their first GIS database. Characterizing the rate by which a landscape becomes parcelized can only be done if time-series data of parcelization activity is available. Such data would enable researchers to describe the degree to which a landscape is parcelized at separate points in time, which would help identify the characteristics of parcels most susceptible to parcelization. It would be useful to discuss with land management agencies the need to maintain and improve parcel- level data in a GIS format to facilitate such future analyses.

Another issue associated with conducting parcelization studies across a large spatial extent is formatting and interpreting the data that is obtained. It took considerable effort to manipulate the study's 100,000 parcel-level data records within ArcView, Excel, and SPSS. A particularly problematic issue that was encountered with the parcel data was multiple, adjacent parcels with a common owner. For tax or survey purposes, often a 40 acre parcel of land is treated as two separate 20 acre parcels. Even though the same individual owns both parcels, it still appeared in the database as two separate parcels. Without developing computer routines to identify these parcels, dissolved the boundaries between these adjacent parcels, and then merged them into a single parcel record, the analysis would have greatly exaggerated the extent to which Minnesota's northern forest

landscape has been parcelized. We suspect that other studies that have attempted to quantify and characterize parcelization may not have fully accounted for this issue.

Some counties also have multiple ownership records for one parcel; this occurs when more than one person owns and pays taxes on that parcel. A manual inspection based on parcel locations and acreages was carried out to correct this problem as it also would have exaggerated the effects of parcelization. Because of the study's focus on forest parcelization, parcels that were not "forested," defined as having 50% or greater forest cover were not considered, nor were public lands and parcels located within city boundaries. To account for the development along lakeshores, data analysis was performed at two levels; one being all private, forested parcels and the second being all private, forested parcels 20 or more acres in size. Without these careful screens and manipulations of the data, a characterization of the extent to which the ten county study area has been parcelized would have been misleading and/or inaccurate.

This study portrays the difficulties encountered when attempting to model and assess parcelization activity across a spatially-large landscape. It is one of the first to examine parcelization from this point of view -- one that describes the current state of the landscape. The associations with a parcelized landscape identified by this study may be useful in developing strategies to mitigate its effects. The study's methodology and findings provide a framework for the continued study of parcelization and how it relates to many other issues. For example, future parcelization research could examine the relationship between forest parcelization and fragmentation or parcelization and its specific effects on biodiversity, water quality, or recreational access. An important limitation to these follow-up studies is the availability of parcel-level data. At the time the study was undertaken, the data we obtained from the MN DNR to conduct this study is not available for many regions in Minnesota and not likely available in several areas of the United States. Perhaps further research could modify the methodology applied in this study such that similar analyses can be carried out across a range of parcel-level data formats. Overall, the results in this study shed light on the process and subjectivity of defining a parcelized landscape and provide a good base for further research.

Literature Cited

Aitkin County home page. Aitkin County, Minnesota, 2009. Web. 23 June 2010.

Becker County, MN home page. Becker County, Minnesota, 2008. Web. 23 June 2010.

Beltrami County Minnesota. Beltrami County, Minnesota, 2008. Web. 23 June 2010.

Brooks, R.T. 2003. Abundance, distribution, trends, and ownership patterns of early-successional forests in the northeastern United States. *Forest Ecology and Management* 185: 65-74.

Butler, B. J., and E. C. Leatherberry. 2004. America's family forest owners. *Journal of Forestry* 102(7): 4-14.

Cass County, Minnesota. Cass County, Minnesota, 2010. Web. 23 June 2010.

Clearwater County, Minnesota. Clearwater County, Minnesota, 2007. Web. 23 June 2010.

Cook County, Minnesota. Cook County, Minnesota, 2009. Web. 23 June 2010.

Crow Wing County, Minnesota. Crow Wing County, Minnesota, 2008. Web. 23 June 2010.

DeCoster, L. A. 1998. The boom in forest owners—a bust for forestry? *Journal of Forestry* 96(5): 25-28.

Dennis, D.F. 1992. Parcelization and Affluence: Implications for Nonindustrial Private Forests. *Northern Journal of Applied Forestry* 9: 33-35.

Donnelly, S., and T. P. Evans. 2008. Characterizing spatial patterns of land ownership at the parcel level in south-central Indiana, 1928-1997. *Landscape and Urban Planning* 84: 230-240.

Doss, C. R., and S. J. Taff. 1996. The influence of wetland type and wetland proximity on residential property values. *Journal of Agricultural and Resource Economics* 21(1): 120-129.

Drzyzga, S. A., and D. G. Brown. 1999. Land parcelization and forest cover fragmentation in three forested counties in Northern Lower Michigan. In *Proceedings of the Society of American Forests 1998 National Convention*; 1998 September 19-23; Traverse City, MI. SAF Publ. SAF 99-01. Bethesda, MD: Society of American Foresters: 129-135.

Erickson, D. L., Ryan, R. L., and R. De Young. 2002. Woodlots in the rural landscape: landowner motivations and management attitudes in a Michigan (USA) case study. *Landscape and Urban Planning* 58: 101-112.

Fleury, T., and C. R. Blinn. 1996. Ownership fragmentation in the non-industrial private forest lands of northern Minnesota between 1965 and 1990. In: *Baughman, M., Goodman, N. (Eds.) Proceedings: symposium on non-industrial private forests: learning from the past, prospects for the future.* Extension Special Programs, Minnesota Extension Service, pp. 238-247.

Germain, R. H., Anderson, N., and E. Bevilacqua. 2007. The effects of forestland parcelization and ownership transfers on nonindustrial private forestland forest stocking in New York. *Journal of Forestry* 403-408.

Germain, R. H., Brazill, K., and S. V. Stehmann. 2006. Forestland parcelization in Upstate New York despite economic stagnation and a declining population. *National Journal of American Foresters* 23(4): 280-287.

Gobster, P. H., and M. G. Rickenbach. 2004. Private forestland parcelization and development in Wisconsin's northwoods: perceptions of resource-oriented stakeholders. *Landscape and Urban Planning* 69: 165-182.

Gustafson, E. J., and C. Loehle. 2006. Effects of parcelization and land divestiture on forest sustainability in simulated forest landscapes. *Forest Ecology and Management* 236: 305-314.

Haymond, J. L. 1988. NIPF opinion leaders: what do they want? *Journal of Forestry* 86(4): 30-35.

Host, G.E, and T. N. Brown. 2009. Quantifying parcelization potential of forest lands in Itasca County, north central Minnesota. Natural Resources Research Institute, University of Minnesota- Duluth.

Kennedy, T., and D. MacFarlane. 2009. Identifying parcelization and land use patterns in three rural northern Wisconsin towns: Bayfield County project summary. *Center for Land Use Education*.

Kilgore, M.A., and D.G. MacKay. 2007. Trends in Minnesota's forestland real estate market;
potential implications for forestland uses. *Northern Journal of Applied Forestry* 24(1): 37-42.

Kilgore, M.A., S.A. Snyder, J. Schertz, and S.J. Taff. 2008. What does it take to get family forest owners to enroll in a forest stewardship-type program? *Forest Policy and Economics.* 10(2008): 507-514.

Kittredge, D. B., D'Amato, A. W., Catanzaro, P., Fish, J., and B. Butler. 2008. Estimating ownerships and parcels of nonindustrial private forestland in Massachusetts. *Northern Journal of Applied Forestry* 25(2): 93-98.

Koochiching County, Minnesota. Koochiching County, Minnesota, 2010. Web. 12 July 2010.

Lake County, Minnesota. Lake County, Minnesota, 2010. Web. 12 July 2010.

LaPierre, S., and R. H. Germain. Forestland parcelization in the New York City watershed. *Journal of Forestry* 103: 139-145.

Mehmood, S. R., and D. Zhang. 2001. Forest parcelization in the United States: a study of contributing factors. *Journal of Forestry* 99(4): 30-34.

Minnesota Quickfacts from the US Census Bureau. *quickfacts.census.gov.* US Census Bureau, 22 Apr. 2010. Web. 23 June 2010.

Mundell, J., Taff, S. J., Kilgore, M., and S. Snyder. 2007. Assessing trends in forest parcelization and development in Minnesota: an Itasca County case study. *Staff Paper Series No. 192, Department of Forest Resources*. College of Food, Agricultural and Natural Resource Sciences, University of Minnesota, St. Paul, Minnesota.

Otter Tail County, Minnesota. Otter Tail County, Minnesota, 2010. Web. 12 July 2010.

Pan, Y., Zhang, Y., and I. Majumdar. 2009. Population, economic welfare, and holding size distribution of private forestland in Alabama, USA. *Silva Fennica* 41(1): 161-171.

Poudyal, N. C., and D. G. Hodges. 2009. Property taxation and rural land values: their effect on private forestland ownership structure in Texas. *Land Use Policy* 26: 1100-1105.

Rickenbach, M., and T. W. Steele. 2006. Logging firms, nonindustrial private forests, and forest parcelization: evidence of firm specialization and its impact on sustainable timer supply. *Canadian Journal of Forest Research* 36(1): 186-194.

Sampson, N., and L. DeCoster. 2000. Forest fragmentation: implications for sustainable private forests. *Journal of Forestry* 98(3): 4-8.

Snyder, S.A., Kilgore, M.A., Taff, S.J., and J. Schertz. 2009. Does forest land posted against no trespass really mean no hunter access? *Human Dimensions of Wildlife* 14: 251-264.

Woolridge, J.M. 2008. Introductory econometrics: a modern approach, fourth edition. South- Western Cengage Learning.

Zhang, Y., Zhang, D., and J. Schelhas. 2005. Small-scale non-industrial private forest ownership in the United States: rationale and implications for forest management. *Silva Fennica* 39(3) 443-454.

Appendix E-1

Table 4. Descriptive statistics for all forested parcels (at least 1 acre).

	N	Minimum	Maximum	Mean	Std. Deviation
Average of acreage2	373	3.17731	972.366787	71.59281	1.06E+02
Average of totalner	373	0.00313	0.022107	0.007268	0.002148417
totemv08	365	0	1475193700	1.42E+08	1.65E+08
% of adj_lakeacre	373	0	99.910752	30.18216	2.55E+01
% of adj_pblclnacre	373	0	100	48.01474	3.44E+01
% of adj_roadacre	373	0	100	64.19495	1.91E+01
% of 1600macre	373	0	100	9.45	19.108
% Change in population 96-06	373	-43.2836	100	6.933975	1.64E+01

Table 5. Descriptive statistics for forested parcels 20 acres or more in size.

	N	Minimum	Maximum	Mean	Std. Deviation
Average of acreage2 over 20 acres	373	20.7327	1052.27125	113.2917	1.17E+02
Average of totalner	373	0.00313	0.022107	0.007291	2.16E-03
totemv08	365	0	1475193700	1.41E+08	164100000
% of adj_lakeacre over 20 acres	373	0	100	30.19454	2.69E+01
% of adj_pblclnacre over 20 acres	373	0	100	51.76108	3.53E+01
% of adj_roadacre over 20 acres	373	0	100	66.0646	1.97E+01
% of 1600macre over 20 acres	373	0	100	9.68	19.025
% Change in population 96-06	373	-43.2836	100	7.099556	1.63E+01