

Appendix

Land Managers, & Forest Products Operators

Frostburg State University, *Availability of Land and Products*

**Consulting Report to the Maryland Department of
Natural Resources – Forest Service**

Working Woodlot Initiative

Availability of Land and Product

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Executive Summary

The Working Woodlot Initiative is a project concerning the feasibility of logging tracts of land ten acres or less in Allegany County, Maryland. The Woodlot project, backed by the Maryland Department of Natural Resources – Forest Service (MD DNR – Forest Service), investigates how to sustain forest management on smaller tracts of land while profiting economically and remaining stewards of the land.

Partnering with MD DNR – Forest Service are Frostburg State University, Penn State University, West Virginia University and various consulting foresters. Each University is targeted with satisfying different study objectives. For instance, Frostburg State University (FSU) is performing a spatial analysis of the Availability of Land and Product throughout Allegany County. Claire Ruffing and Zach Rawe are students in FSU's Geography Department who, under the direction of Dr. Fritz Kessler Associate Professor of Geography, are developing a Geographic Information System (GIS) by compiling raw data from Maryland Forest Stewardship Plans developed by Foresters. Inside the GIS is an extensive database of forest stand data which will ultimately be used to carry out a spatial analysis of the distribution of Forest Stewardship lands in Allegany County, MD which is reported in this document. Additional benefits include allowing the MD Forest Service to gain knowledge of how many tracts of lands 10 acres or less exist and what type of timber volume can be removed from these tracts based on predetermined silvicultural prescriptions. This spatial analysis report will be produced by Dr. Fritz Kessler based on the raw data compiled by Mr. Rawe and Ms. Ruffing.

Forest Stewardship Plans

To develop a GIS of Forest Stewardship Plans throughout Allegany County, MD raw data from 11 years of Forest Stewardship Plans in Allegany County, MD was compiled. The Forest Stewardship Plans are developed by MD DNR – Forest Service Foresters who evaluate privately owned tracts of land in Allegany County and establish Forest Management Plans for these properties and their forest holdings. The plans compile data from each forest stand in the property owner’s land holdings and include stand types within the property, acreage of overall property and stands within, dominant species in stands, development stage, age, stocking, acceptable growing stock, unacceptable growing stock, site growth potential, and recommended silvicultural practices. The plans are on file at the offices at MD DNR – Forest Service Office in Cumberland, MD. Mr. Rawe and Ms. Ruffing relied upon a master list of existing Forest Stewardship lands in Allegany County to extract and copy pertinent parts of each Forest Stewardship Plan including title page, maps and stand description and practices. This data collection process covered approximately twelve months resulting in 271 Forest Stewardship Plans being copied and ultimately converted from hard-copy paper format into digital format.

Developing the GIS

All Forest Stewardship Plans contained information and maps of landowner property boundaries and also stand descriptions and recommended practices within the boundaries. This information served as the raw data from which the GIS would be created and ultimately the spatial analysis conducted. Using ESRI’s ArcView 3.3, two polygon shapefiles, property and forest stands, were created. Each shapefile had specific attributes attached to each property and forest stand to describe location, contact numbers, stand description and recommended practices, which will be described later.

Aerial Ortho-Photography

The first step in developing an effective GIS was acquiring a stable base to assist in the digitization for all property boundaries and Stewardship Forest stands. High resolution black and white digital aerial orthophoto of Allegany County was obtained from Allegany County Planning Office in Cumberland, MD. The air photo was flown in 1998 and digitally rectified to the Maryland State Plane Coordinate System to create the orthophoto. The individual air

photos were merged together to create two tiles (east and west) that covered the entire county. The high-resolution 1:1,200 scale orthophoto was effective for digitizing the property boundaries and Forest Stewardship properties for the GIS database. Figure 1 shows a portion of the western orthophoto tile focusing on Mt. Savage, MD. The detail appearing on the orthophoto allowed for property boundaries to be located effectively as well as also identification of stand types and any previous timber harvests.

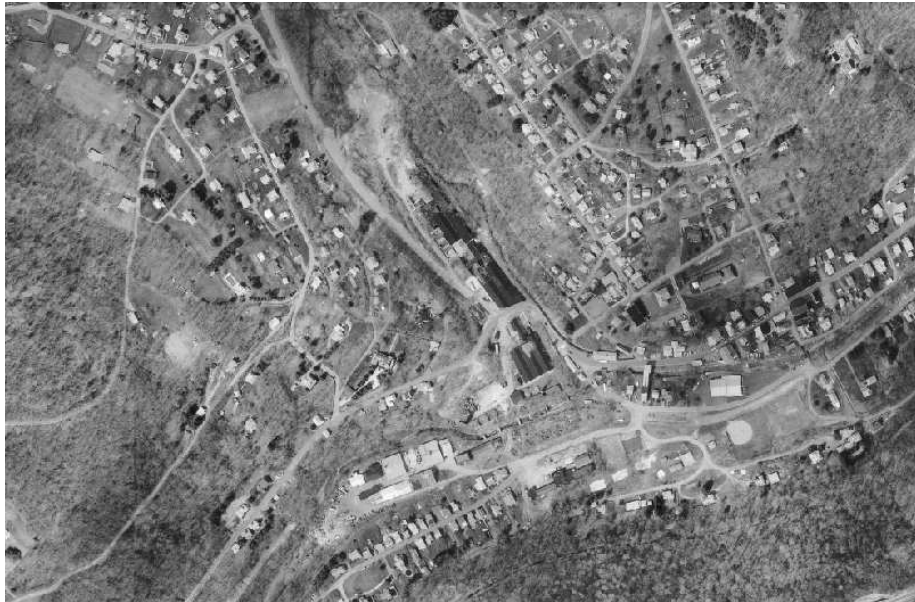


Figure 1. A portion of the western aerial photo tile of Allegany County, Maryland (courtesy of Allegany County Planning Office).

Forest Stewardship Plan Conversion

Each Forest Stewardship Plan was retrieved from the office and then the necessary pages were copied, which usually included the title page, recommended practices page, and any maps or illustrations highlighting the land owner's property boundary and individual forest stands contained within. A sample cover page is shown in Figure 2. The title page contained MD State Plane Northing and Easting values of the general property location. These coordinates were instrumental in locating the properties on the orthophoto. Once the general area of the property was located on the orthophoto, the map included in the Forest Stewardship Plan was referenced to learn specific information about the property boundary. A typical property map found in the Forest Stewardship Plans is shown in Figure 3. Contained within each property map included significant corners, roads, topographical features, existing forest stands, vegetation, and drainage in the area.

Using this information, the property boundaries and forest stands were digitized as accurately as possible using information from MD Real Property Search. Many plans contained maps that already included the orthophoto and this greatly aided in the digitization process. However, some older plans such as those shown in Figure 3, predated 1998 and did not include an aerial photo. Thus, some of these older property boundaries were difficult to locate but were digitized as accurately as possible. In some cases where the location of the properties could not be completely ascertained, these properties were set aside to be clarified at a later time by MD DNR – Forest Service Foresters who had existing knowledge of the location of these properties.

FOREST STEWARDSHIP PLAN

for

Mr. USA
111 Main Street
Mt. Savatge MD

location

Murley's Branch Road,
north of Warm Springs Road.

Maryland Grid
N682/E358

in
Allegheny County




on

19.42 acres forested
1.2 acres cleared for homesite

Prepared by

Daniel B. Hedderick, Regional Stewardship Forester
Rick Latschaw, Regional Stewardship Biologist

December 16, 1993



Maryland
Department of
Natural Resources

Figure 2. A typical title sheet from a Forest Stewardship Plan. Note the inclusion of the Maryland State Plane grid coordinates (N682/E358).

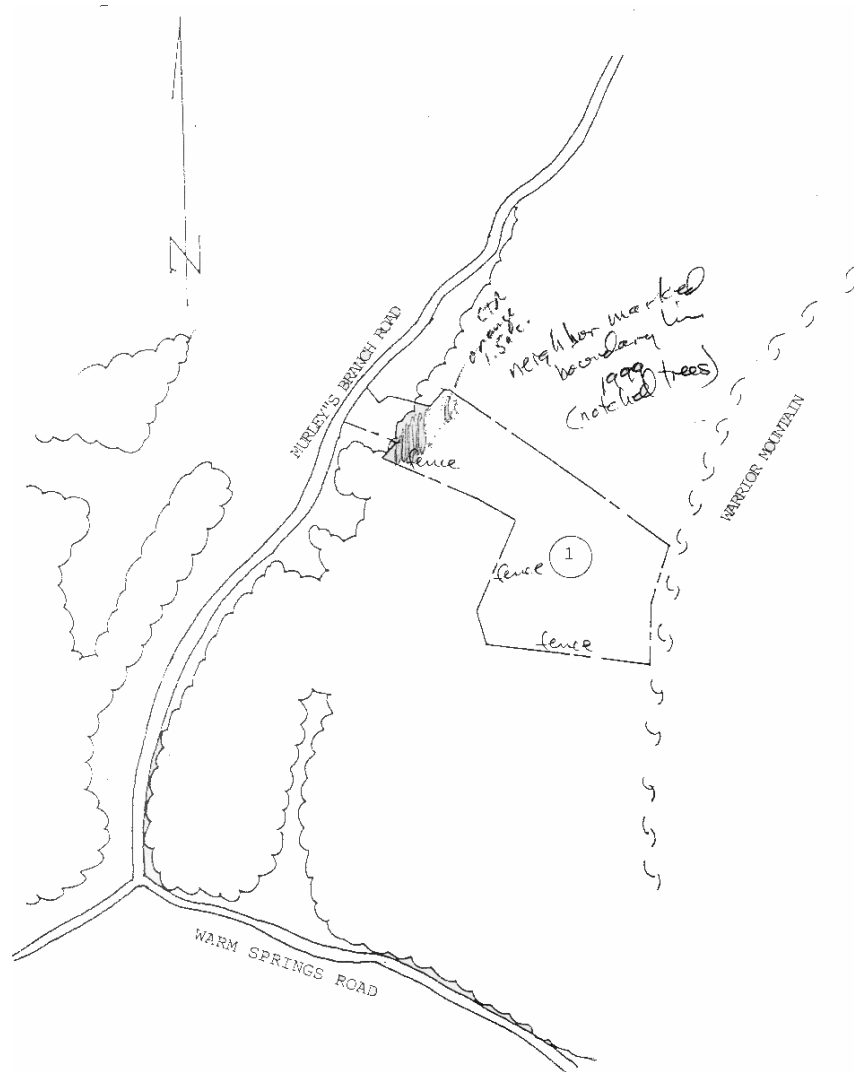


Figure 3. A typical map included in a Forest Stewardship Plan showing the property boundary and the forest stand.

The digitization process began by digitizing the property boundary. Figure 4 shows the result of a sample property boundary digitized on top of the aerial photograph. Once the digitization process was complete for a property boundary, the individual forest stands contained within each property boundary were digitized. Figure 5 shows the individual forest stands digitized inside the property boundary. Note that the forest stands often did not cover the entire property boundary. In many cases, there was land area set aside for the dwelling that was not part of the Forest Stewardship Plan and thus was not digitized as a separate entity into the GIS database.



Figure 4. An example of a property boundary digitized on top of the aerial photograph.



Figure 5. An example of individual forest stands digitized on top of the aerial photograph.

Coding the Attribute Table

After the property boundary and forest stand boundaries were digitized, the next step was to create and populate the attribute table for each shapefile. The property shapefile contained the following attributes: a physical address, descriptive address, land owner name and contact number if available. Information on each property boundary was derived from the corresponding Forest Stewardship Plan's title page. Table 1 shows a sample of the descriptive information contained within the property boundary shapefile attribute table.

Shape	Polygon
ID	0
Address_1	
Address_2	Mt. Savage Road
Owner	Mr. USA
Phone Numb	111-111-1111
City	Mt. Savage
Zip	00000
State MD	

Table 1. An example of the descriptive information contained within the property boundary shapefile attribute table.

The forest stand shapefile contained the following attributes: stand description and recommended practices for each forest stand including; stand types within the property, acreage of overall property and stands within, dominant species in stands, development stage, age, stocking, acceptable growing stock, unacceptable growing stock, site growth potential, recommended silvicultural practices and estimated volumes for each stand. This attribute information was retrieved from each Forest Stewardship Plan's Stand Description and Recommended Practices Table (see Figure 6) and entered into the forest stand shapefile attribute table. Table 2 shows an example of the descriptive information available in the forest stand shapefile attribute table. Each field in the attribute tables was formatted as string, text, or integer depending on the type of data to be entered.

STAND DESCRIPTION AND RECOMMENDED PRACTICES

Owner's Objective: Primary - Forest Products
 Secondary - Wildlife

Stand #	Area Acres	Dominant Species	Development Stage	Age	Stocking	% Des. Trees	% Undes. Trees	Site Growth Potential	Recommendations and Practices
1	47.448	White Oak Chestnut Oak	Sawtimber, Pole and Sapling	Uneven-Aged	Adequate	31%	69%	Poor	Create snags; thin for firewood.
2	11.5	Virginia Pine Chestnut Oak	Pole	Uneven-Aged	Adequate	57%	43%	Poor	Thin for firewood.
3	6.5	Chestnut Oak A mix of pine and other hardwoods	Pole	Uneven-Aged	Low	21%	79%	Poor	Let grow and re-examine in 15 years.
4	8	White Oak	Pole	Uneven-Aged	Low	42%	58%	Excellent	Let grow and re-examine in 15 years.

(See reverse side for definitions)

Figure 6. An example of the descriptive information contained within the Stand Description and Recommended Practices table.

Shape	Polygon
ID	0
Address_1	Mt. Savage Road
Stand_no	1
Acres	36.22
Dom species	Sugar Maple, Elm, Black Locust, Black Cherry
Dev_stage	Pole timber & Sawtimber
Age	Even aged (53 yrs)
Stocking	Adequate
Zdes_trees	70.00
Zundes_tre	20.00
Site_growth	Average
Rec_practi	Crop tree release. Establish brush piles.
Present_co	
Soil_type	
Spacing	
Cords_acre	
Brdt acre	

Table 2. An example of the descriptive information contained within the forest stand boundary shapefile attribute table.

As a way to reference each forest stand, an id-number was assigned. In most cases, the id-number was taken directly from the Forest Stewardship Plan map. For example, in Figure 3 the forest stand was identified with the number 1. The attribute tables created were effective for entering data, but some codes and adjustments had to be made as there was often an inconsistent coding of the forest stands. The stand number column was

created as an integer. It was found that some stand numbers in the original plans also contained letters and numbers and were labeled as 1A or Field A or B. In this case new coding practices had to be created. Table 3 shows a list of codes used in the attribute table that identified each forest stand. If a stand was identified with a letter, then the first number in the revised coding scheme was sequential to match the alphabetical order (1 = A, 2 = B, 3 = C, and so forth). The next two digits were used to match the sequential ordering of the alphabetical characters (e.g., A = 11, B = 22, C = 33, and so forth). In cases where only a single letter was used to identify a stand, two digits were used that matched the sequential order of the letter (e.g., A = 11, B = 22, C = 33, and so forth). This coding scheme was only used in a handful of occurrences as most of the forest stands were labeled with numeric digits.

<i>Stand code on Forest Stewardship Plan</i>	<i>Code entered into GIS database</i>
1A	111
2C	233
3B	322
B	22

Table 3. An example of the codes used to identify individual forest stands when non-numerical id-numbers were present on the Forest Stewardship Plan maps.

In the case where the stand was actually an agricultural field the codes were used in the stand number column and then the agricultural field numbers were entered into the dominant species column before the types of species were entered.

Computing Volumes

The availability of the product portion of the study involved computing volume estimates for stands that had a commercial harvesting operation recommended within the Forest Stewardship Plans. Whether or not the forest stand was recommended for harvesting was indicated on the Stand Description and Recommended Practices Table. These volumes will allow for MD Foresters to gain knowledge what type and quantity of product that can be removed from stands that are 10 acres and less.

All stands that called for a timber harvesting activity (commercial and non-commercial thinning, crop tree release, timber stand improvement, patch cuts and

regeneration harvest) had volumes computed for them as long as cruise data was available in the Forest Stewardship Plans. Some stands volume estimates have been previously computed and were added to the forest stand shapefile's attribute table as respective stands were digitized. In some cases, volume data could not be computed due to cruise data not being available in Forest Stewardship Plans that were handled by private consultants. In cases where volume data was not available, codes were inserted into the forest stand shapefile's attribute table (see Table 4) indicating volume data not available.

Volume Code	Meaning
“?”	Volume data not available
“0”	No significant volume or (let grow)

Table 4. An example of the codes used to describe instances where volumes were not computed.

In most Forest Stewardship Plans the basal area for plots in the stand has already been computed and if already written by MD DNR - Forest Service Foresters the stand was thinned to the appropriate basal area and stocking level. If the stocking level is not already pre-determined a standard basal area of 70 sq.ft./ acre will be followed. The total basal area minus the desired stocking level basal area for optimum growth removed from the acres of the stand on the property.

In all circumstances, the basal area from mature merchantable sawtimber and unacceptable growing stock from the merchantable sawtimber was removed first to try and reach the appropriate residual basal area. Then non-merchantable sawtimber was removed to try and reach the appropriate residual basal area. Mature and merchantable sawtimber acceptable growing stock and were computed as volume (thousand board ft / acre) and non-merchantable including poletimber and small trees were removed as firewood (cords / acre) and displayed as cords per acre for each lot. In some instances the unacceptable growth stock of merchantable sawtimber was partially computed as firewood. In cases where a high number of trees were tallied as poletimber and small trees, the stand required that all the basal area be removed from the UGS of the poletimber and small trees for firewood. If the optimum basal area is not met by removing the mature trees and UGS then the appropriate board footage and cords was removed from the acceptable growth stock in order to thin stand to the desired basal area. While some

stands required methods outside the standards these are the general procedures that were followed to ensure quality control of volume computations in this project for Allegany County.

Spatial Analysis of Stewardship Data

This section reports the data found through the spatial analysis of the Stewardship Data. Data on Allegany County in its entirety will be presented first followed by statistics on the Stewardship Properties. Next, data on small property owners whose land contains 10 acres or less of forested land in Allegany County will be discussed. Finally, data on the available timber volumes from the Forest Stewardship Plans will be presented.

Allegany County Land Cover Statistics

Allegany County, MD has a total area of 1,113 km² (430 mi²), of which 1,102 km² (425 mi²) is land area. Of the 425 mi² (272,000 acres) of total land area, approximately 197,186 acres of the land area is forested or about 78%. In Allegany County, the Maryland Department of Natural Resources currently possesses approximately 62,339 acres of land throughout its various parks and recreational areas. It is also interesting to note that the majority of all urban development and agricultural land uses have occurred on only 20% of the total county land area. Figure 7 illustrates the spatial extent of the deciduous, evergreen, and mixed forested land. Figure 7 illustrates the forest type throughout Allegany County and was compiled through the EPA's BASINS hydrologic unit code. The land cover data is compiled at a scale of 1:250,000.

Stewardship Property and Forest Stand Statistics

There are 291 Stewardship Properties coded into the database. The total land area encompassed by these Stewardship Properties is 25,206.65 acres (39.37 mi²) with the average Stewardship Property containing 86.62 acres (0.14 mi²) of land. Figure 8 shows the spatial distribution of the Stewardship Properties contained within the database. Note that the Stewardship Properties are well distributed throughout Allegany County. However, there are two areas that appear to lack Stewardship Properties. These areas include the Green Ridge State Forest complex located in the eastern part of Allegany County and the Dan's Mountain State Park/Big Savage Mountain areas located in the southeastern and western portions of Allegany

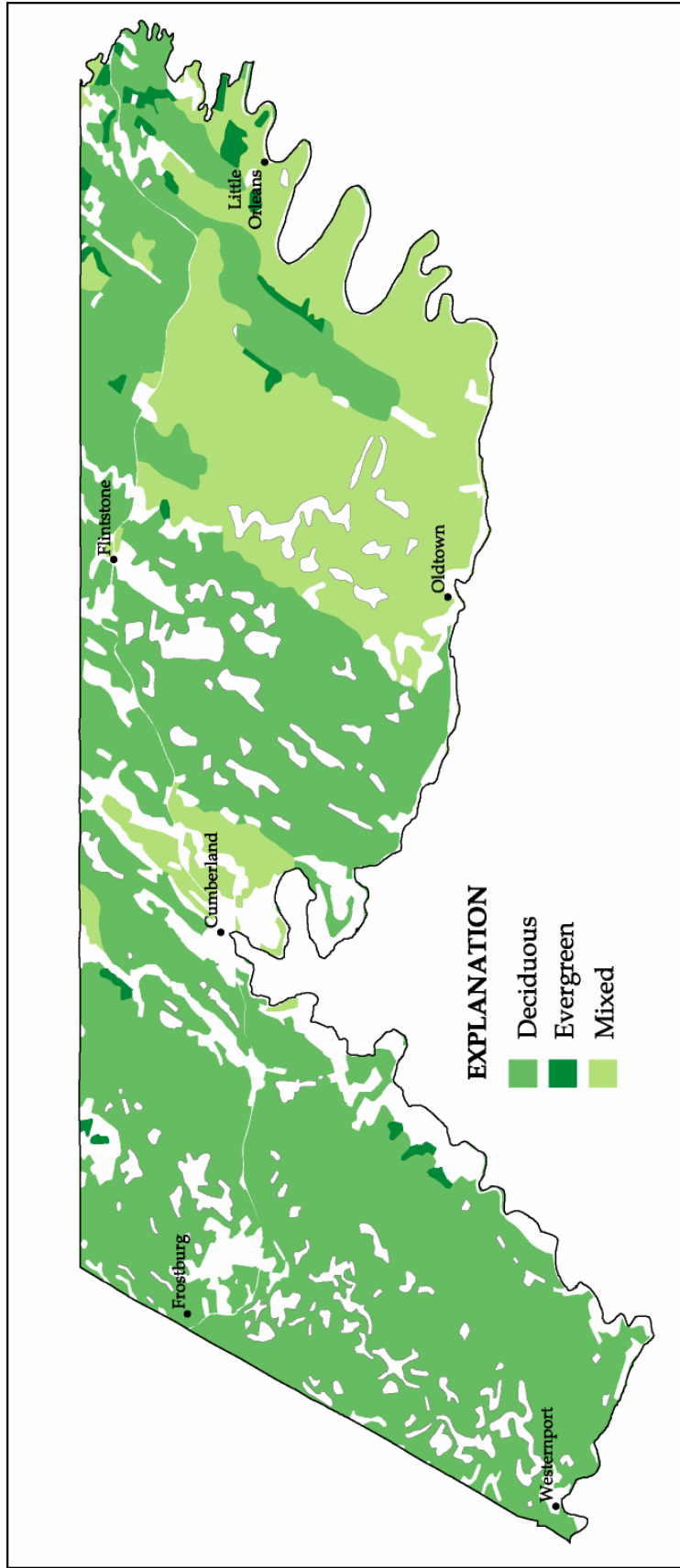


Figure 7. Spatial distribution of forested land cover types in Allegany County, MD. Data obtained from EPA BASINS website: http://www.epa.gov/waterscience/ftp/basins/gis_data/hu/c/

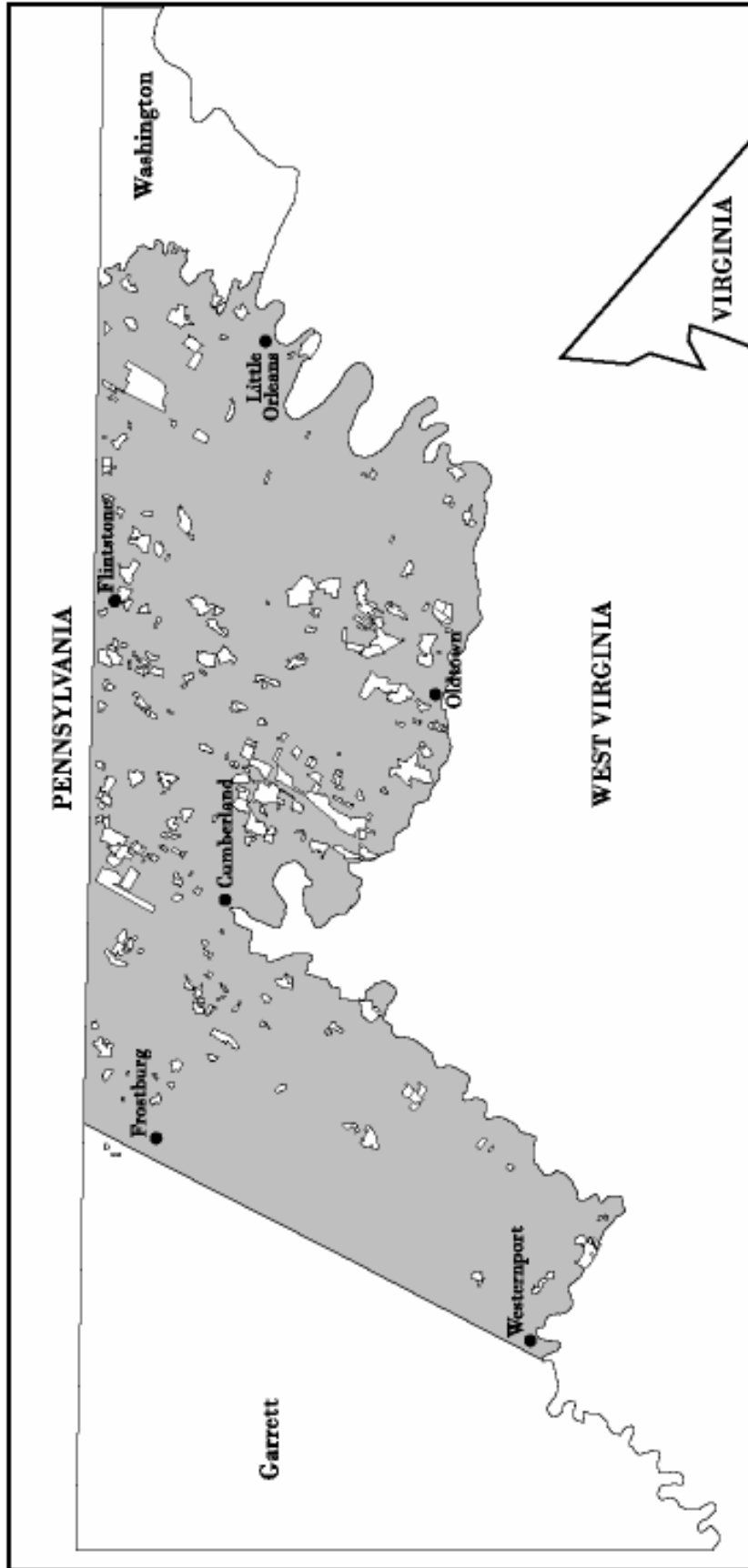


Figure 8. Spatial distribution of the Forest Stewardship Plan Properties in Allegany County, MD.

County, respectively. The acreage value was derived from the cover sheet of the Stewardship Plan. Contained within each Forest Stewardship Property is at least one associated forest stand of varying acreage. There are a total of 1,214 forest stands included within the 291 Stewardship Properties. The total forested acreage included with these 1,214 stands is 23,929.40 acres (37.37 mi²). The stands range in size from less than 0.1 to 3,780 acres (0.0001 to 5.9 mi²) with the average number of acres per forest stand yielding 19.71 acres (0.03 mi²). It is interesting to note that if the largest stand of 3,780 acres is taken out of the calculations, the stands range in size from less than 0.1 to 693.0 acres (0.0001 to 1.08 mi²) with the average number of acres per forest stand yielding 16.61 acres (0.02 mi²). Table 5 classifies the stand acreage according to the number of stands and total acreage found within the range. The acreage values were recorded directly from the Stewardship Plan. You will note that the total acreage in the Stewardship Properties (25,206.65 acres or 39.37 mi²) is about 1,277 acres greater than the total acreage in the Stewardship Forest stands (23,929.40 acres or 37.37 mi²) suggesting that those Stewardship Plan property owners have a majority of their land forested.

Acre Range	Number of Stands	Total Acreage		Acre Range	Number of Stands	Total Acreage
<10	704	3,075.48		50.1 to 60	21	1,157.65
10.1 to 20	240	3,489.69		60.1 to 70	13	844.95
20.1 to 30	107	2,633.83		70.1 to 80	5	375
30.1 to 40	58	2,025.24		80.1 to 90	6	509.95
40.1 to 50	28	1,274.69		90.1 to 100	6	360.7
				> 100.0	26	7,982.22

Table 5. A classification of forest stands including total number and acreage

Figure 8 illustrates the spatial distribution of the 1,214 forest stands. The Working Woodlot Initiative is interested in the economic feasibility of harvesting timber on tracts of land that are ten acres or less. From the database, there are a total of 704 forest stands that encompass ten acres or less of forested land. Within these 704 forest stands there is a total of 3,075.48 acres (4.08 mi²) of forested land with an average of 4.36 acres (less than 0.01 mi²) per forest stand.

Small Forest Properties County-Wide

Within Allegany County, there are a total of 4,041 private land owners whose properties include forested land of 10 acres or less. In total, these 4,041 property owners land holdings total 8,957 acres (14 mi²). These properties average out to be 2.2 acres of forested land per private property owner. This private forested acreage totals approximately 4.5% of the total forested acreage within Allegany County.

As previously described, there are 291 Stewardship Plan properties in the Stewardship Plan database and contained within these properties are 1,214 forest stands. The total forested stand acreage within these 1,241 forest stands is 23,929.40 acres (37.37 mi²). Of the 291 Stewardship properties that were recorded, there are 240 properties that contain at least one forested tract of 10 acres or less. Several properties have multiple tracts with 10 acres or less. In a few rare instances, entire singular properties contain forested tracts that are either 10 acres or less or divided into several forested stands that are 10 acres or less. These 240 properties constitute 83% of the total 291 Stewardship Properties, which is rather considerable. Thus, it is reasonable to assume that out of the 4,041 total properties within Allegany County mentioned above that approximately 83% of those landowner's properties would contain at least one forested tract or 10 acres or less, which is a rather considerable percentage.

However, it is interesting to note that these 240 properties amounts to a total of 3,075.48 acres of forested land. Comparing the acreage of these 240 properties to the total acreage of forested land found in all Stewardship Plan properties (23,929.40 acres or 37.37 mi²) an approximate percentage of 12.8% is returned. Thus, approximately 13% of the total acreage of forested land is contained on tracts of 10 acres or less within the Stewardship Plan properties. In other words, based upon these numbers, it seems as if most private land owners in Allegany County whose property contains forested land comprises a rather small total percentage forest acreage. If we compare the 3,075.48 acres of forested land within the Stewardship Plans of ten acres or less to the total forested land within Allegany County (197,186 acres), this constitutes a very small percentage of the total forested acreage (approximately 1.5%) county-wide. From the database, the relative percentage acreage of Stewardship Plan land owners who have forested land of 10 acres or less is rather small county-wide.

Timber Volume Statistics on Tracts Less Than Ten Acres

From the database, there are 704 forest stands that encompass 10 acres or less of forested land. From those 704 forested lands, 301 forest stands were recommended by the Stewardship Plan to let the stand grow and thus no significant volume data was computed. There were an additional 234 forest stands that had no volume data available to use in the computation of cords per acre or board feet per acre. The remaining 169 forest stands include a total of 1,339 available cords with 4.85 average number of cords per acre per forest stand. The maximum number of cords per acre was 189 while the minimum number of cords per acre above 0 was 0.5. In the 169 forest stands there were 82 forest stands that had enough data and/or timber data to compute the number of board feet per acre. Within these 82 forest stands, there are 195,900 board feet with an average number or board feet per acre at 2,389.02 per forest stand. The maximum number of board feet per acre was 12,000 while the minimum number of board feet per acre above zero was 200. Of the 704 forest stands, there are 25 stands in which the Forest Stewardship Plans state that the site growth potential is “Excellent”. Table 6 lists the balance of the site growth potential recommendations for all 704 stands.

Site Growth Potential	Number of Stands	Site Growth Potential	Number of Stands
Excellent	25	Fair to Good	1
Average	115	Fair	130
Average to Fair	1	Fair to Poor	4
Very Good to Excellent	2	Poor to Excellent	1
Very Good to Good	3	Poor to Very Good	2
Very Good	12	Poor to Good	4
Good to Very Good	6	Poor	262
Good	92	Very Poor	1
Fair to Average	3	Extremely Poor	1
		Not Available	7

Table 6. A summation of the Forest Stewardship Plans’ site growth potential for the forest stands having 10 acres or less of forested land.

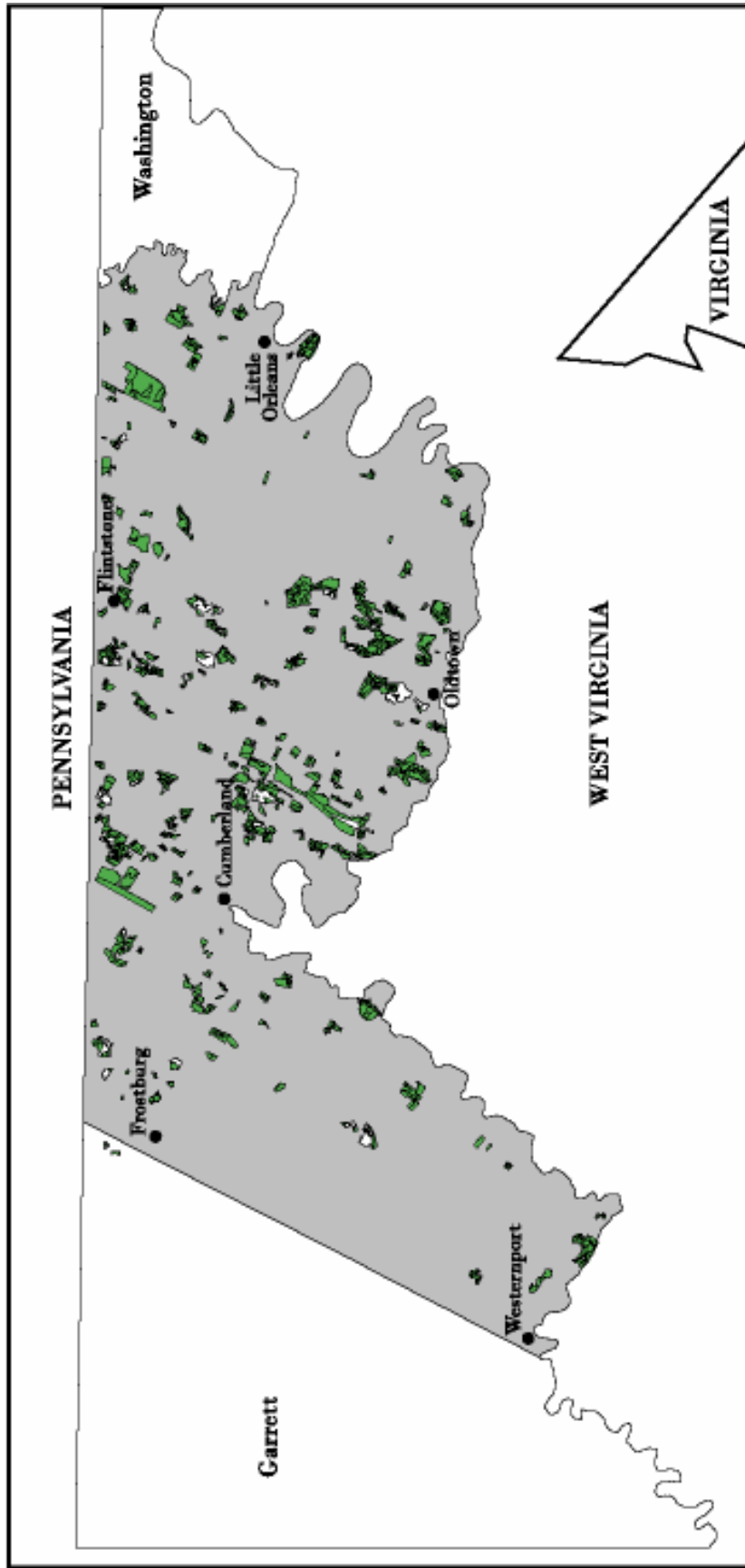


Figure 9. Spatial distribution of the Stewardship Plan forest stands in Allegany County, MD. The white areas are part of the landowner's property boundaries that are not considered for forested.

Conclusion

This summary provided details of the development of a GIS database for the purpose of examining the economic feasibility of timber harvesting small plots of land (< 10 acres) on privately own tracts of land in Allegany County, MD. In addition to simply examining the data, this GIS database can also be used as a tool by the Foresters in order to quickly locate specific properties and extract detailed information about these properties located throughout Allegany County. The process of developing the GIS database involved copying pertinent information from the Forest Stewardship Plans with respect to forest stand recommendations and practices. Property boundaries and forest stands were digitized from the Forest Stewardship Plans and attribute tables were created detailing information on each landowners property and the forest stands contained within. There were 291 Stewardship Properties that were digitized into the GIS database. Contained within these 291 properties, there were a total of 1,214 forest stand containing 23,929.4 acres. Of those 1,214 forest stands, there were 704 stands that contained ten acres or less of forested land with an average acreage of 4.36. Of the 291 properties within the database, 240 properties contained forested stand of 10 acres or less and constitute 83% of the total 291 Stewardship Properties. Given that these 240 properties amounts to a total of 3,075.48 acres of forested land compared to that total acreage of forested land within the Stewardship Plan properties results in an approximate percentage of 12.8%. If we then compare the acreage of the 240 Stewardship Plan properties to the total forested acreage in Allegany County (197,186 acres), a rather small percentage of the total forested acreage (approximately 1.5%) is found county-wide.

Development of this GIS database allows for timely evaluation of Stewardship Properties throughout Allegany County. In addition, as new stewardship lands are consulted these hardcopy plans can be added to the database to keep an up to date and accurate tally of Stewardship Lands in Allegany County, Maryland.