Middle Rio Grande Wood Supply Analysis

  

Final Report

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Prepared by

Steven Bassett
The Nature Conservancy in New Mexico
212 East Marcy Street, Suite 200
Santa Fe, NM 87501

for

Ciudad Soil and Water Conservation District
6200 Jefferson NE, Room 125
Albuquerque, NM 87109

Abbreviations and Acronyms

4-FRI	Four Forest Restoration Initiative
BDT	Bone Dry Ton
CPLA	Chama Peak Land Alliance
dbh	diameter at breast height
EMAP	Environmental Monitoring and Assessment Program
EPA	Environmental Protection Agency
FIA	Forest Inventory and Analysis
GIS	Geographic Information System
LiDAR	Light Detection and Ranging
MRG	Middle Rio Grande
SWCD	Soil and Water Conservation District
USCB	United States Census Bureau
USFS	United States Forest Service

Conversion Factors

1 cubic foot = 0.012 BDT (Shelley, 2007)

Included Materials

This report is accompanied by an atlas, database and metadata.

All documents and data are available at allaboutwatersheds.org.

Introduction

Wildfire is a major threat to communities and their water supplies throughout the American west. Forests altered by decades of grazing and fire suppression are burning at unprecedented rates (Westerling et al, 2006). Managing forests to minimize risk of wildfire and associated impacts has become a priority in the Southwest and New Mexico, particularly in the Middle Rio Grande (MRG) region including the Albuquerque and Santa Fe metropolitan areas (Robles et al, 2014; RGWF, 2014). The Rio Grande is the primary surface water source in the MRG region and with its tributaries supplies water to agriculture, industry, and municipal utilities serving about one third of the people in New Mexico (RGWF, 2014).

During the past decade the MRG region has seen a dramatic increase in both the size and severity of wildfires (MTBS, 2014). These large fires damage infrastructure, reduce water quality, and diminish the viability of surface water supplies (Combrink et al, 2013). The connection between forest management, fire risk, and downstream communities has become clear and land managers are beginning to understand the actions needed to reduce the size and severity of wildfires. This wood supply analysis was produced as part of a collaborative effort to increase the pace and scale of forest restoration in the Rio Grande watershed.

Landscape-wide forest restoration is needed to remove excess biomass that has accumulated due to fire suppression. Forest restoration can include mechanical thinning, letting wildfires burn, or igniting controlled fires. All of these treatments reduce high volumes of biomass to levels that are less susceptible to catastrophic fires and other disturbances like drought, insects and disease. Mechanical thinning treatments have the added benefit of producing forest products that can support the forest products industry.

A healthy forest products industry will allow treatments to occur in a cost effective manner, however recently the industry has experienced a period of decline. In the 1980’s the New Mexico forest products industry was at its peak; since then processing capacity and production have decreased substantially (Keegan et al, 2001). The commercial timber harvest in New Mexico during 2012 was 25 million board feet, down from 40 million board feet in 2007, and was approximately 10% of the annual harvests during the 1980’s (Sorenson and Morgan, 2012).

The forest products industry in New Mexico faces significant operational, economic and social barriers. Without a healthy forest products industry removal of excess biomass and other forest restoration projects are hindered. Appropriately scaling the forest products industry is vital for increasing the number and area of restoration treatments that can occur in the MRG region.

Additional information is needed before industry can appropriately scale to meet the treatment needs of the MRG region. Land managers and forest industry experts lack comprehensive information about potential product yields from forest treatments in the MRG. The Nature Conservancy in New Mexico and the Ciudad Soil and Water Conservation District (SWCD) entered into a Professional Service Agreement in August, 2014 to generate some of the needed information. Under the agreement The Nature Conservancy was contracted to assist the Ciudad SWCD and New Mexico State Forestry Division with an analysis of timber availability and transportation feasibility in the MRG region. Funding for this analysis comes from the U.S. Forest Service (USFS) and New Mexico State Forestry, with matching contributions from The Nature Conservancy.

Through this agreement, total standing inventory was calculated from USFS Forest Inventory and Analysis program data. Access and transport feasibility were then modeled for 26 communities in and near the MRG region.

Study Area

The Middle Rio Grande region encompasses the Rio Grande valley and all tributary watersheds from just south of Albuquerque into the southern portion of Colorado (Figure 1). A portion of the headwaters of the San Juan River basin is also included because it is the source watershed of the San Juan-Chama Project which diverts water across the continental divide for use in the Middle Rio Grande region. The study area for this analysis was expanded to include the area within 100 miles of the MRG area to incorporate additional wood supplies that can be expected to support the forest industries in the MRG region.

Figure 1. Middle Rio Grande project area.

Similar Studies

Wood supply analyses have been conducted throughout the southwestern United States including in a portion of the study area. A wood supply study conducted in the Four Forests Restoration Initiative (4-FRI) area in Arizona used remote sensed multispectral imagery to classify forest structural attributes that were then validated with field data. Treatments were then modeled based on community consensus for both treatment location and treatment type. The forest structure changes in the modeled treatment areas where used to estimate the timber product yield of the treatments (Hampton et al, 2011; Hampton et al, 2008).

In the study area a wood supply analysis was conducted in the Chama, NM area in 2013 to support the development of additional processing capacity. The study area for the Chama analysis includes all areas within 50 miles of the town of Chama. Two approaches to wood supply analysis were combined in the Chama study; annual harvest statistics were collected from land managers and nationwide forest inventory data was analyzed (CPLA, 2013).

Methods

The 4-FRI and Chama studies utilized time- and resource-intensive approaches. For a rapid assessment of wood supply in the MRG study area a streamlined approach was sought. The methodology selected for this analysis is similar to the approach outlined in appendix D and appendix E of the Chama area study (CPLA, 2013). This approach relies on aggregated forest monitoring data that is extrapolated to large areas and then downscaled to smaller areas.

Because this is a novel approach, an expert panel was convened to guide this analysis into a useful product. Members of the advisory panel include experts from diverse fields that represent conservation organizations, forest managers, academia, and the timber harvesting industry. The panel met five times over the course of the project and made many important contributions. Expert panel members are listed in Appendix A. In addition to the panel of experts, USFS scientists provided feedback on the downscaling methodology.

Total wood supply was calculated for the entire study area using downscaled forest data from the Forest Inventory and Analysis (FIA) program of the United States Forest Service (USFS). Areas precluded from treatment were then excluded from the model. Next accessibility and transportation feasibility were analyzed for cities with existing or planned timber and biomass processing infrastructure.

Wood supply was analyzed for three categories of products: sawlogs, midsize timber, and other biomass. These categories are also reported for each city in the transportation feasibility section of this report. Sawlogs are the portion of the bole greater than 9 inches dbh for softwoods and 11 inches dbh for hardwoods with a minimum top diameter of 7 inches for softwoods and 9 inches for hardwoods. Midsize timber is any bole over 5 inches that isn’t classified as a sawlog. Biomass is all other timber products not included in the sawlog and midsize timber classes, including the bole above minimum top diameter (Miles 2015).

Total Standing Inventory

Ideally stand-level surveys would be completed throughout the study area, either through field-based or LiDAR assessments. Because stand level data is infeasible to collect during this wood supply assessment, existing datasets were considered for the analysis. The USFS has a forest monitoring program in place called the Forest Inventory and Analysis (FIA) program.

The FIA program conducts an annual survey of forested and unforested plots with one sample plot roughly every 6,000 acres (Patterson and Bechtold, 2005). The data from these plots is aggregated into a database (FIADB). FIADB can be queried using EVALIDator, a lightweight database application. Data queries produced from EVALIDator can be summarized to geographic areas. The summary areas used in this report are tessellating hexagons with an area of roughly 160,000 acres, created by the United States Environmental Protection Agency (EPA) as part of the Environmental Monitoring & Assessment Program (EMAP). EMAP hexagons were used because they offered a spatially specific summary of the FIA data.

FIA data representative of the forest products selected for analysis was downscaled from EMAP hexes to a 30 meter grid using spatial datasets for forest type. For each EMAP hex the total volume or weight of each wood product was distributed to pixels in a way that maintains the same distribution of values for forest type that is reported from EVALIDator.

Forest type group was used to summarize the EVALIDator queries. Landfire existing vegetation data was cross-walked to the forest group type classes used in the FIADB using the Society of American Foresters Cover Type attribute. A national forest type group dataset is available from the USFS but it was not used because it intended to portray broad distribution patterns of forest cover in the United States for national scale modeling projects which is inappropriate for this analysis (Ruefenacht et al, 2008).

Once the average quantity of forest products per acre was calculated for each unique combination of EMAP hex and forest group, forest products per pixel was calculated. These estimates have poor accuracy at the individual pixel level but when aggregated to larger areas retain most of the accuracy of the original EVALIDator estimate for the EMAP hexagon. These forest product raster grids were corrected for nesting classes of products that are reported in the FIADB. Sawlog volume as reported in the FIADB is also included in the midsize timber category and the biomass category in the uncorrected data. Midsize timber is also included in biomass in the FIADB. Once the nesting classes were corrected, summaries were prepared for the MRG region.

Treatable Areas

Some areas within the MRG area are unlikely to be treated; steep slopes, wilderness areas, and areas far from roads are cost prohibitive or unlikely to be allowed by land management agencies. In this analysis, areas more than half a mile from a road or that have a slope greater than 40% were excluded from treatment. Designated Wilderness, wilderness study areas, areas of critical environmental concern, and research natural areas were also excluded. All areas not precluded from treatment are considered treatable in this analysis.

Some areas that are considered treatable in this analysis may be inaccessible or prohibited from treatment. Rivers, cliffs, and other natural features could make additional areas inaccessible. Sensitive ecological sites such as nesting areas for endangered species, and archaeological sites would also likely be excluded when mechanical thinning treatments are planned. These and related factors are not included in this analysis because data is unavailable.

A treatable area mask was applied to the three wood supply raster datasets which were summarized to the Rio Grande Water Fund boundary. Additional summaries of the treatable wood supply were conducted during the transportation feasibility study and are described in the Transportation Feasibility section.

Transportation Feasibility

Transportation feasibility was approximated by calculating the number of miles each pixel is from the nearest city with an existing or proposed mill or processing facility (Appendix B). “Service areas” for each city were delineated with network analysis using road data from the US Census TIGER program and USFS (USCB 2014; USFS 2015). The two separate roads layers were combined with USFS roads being used in areas under USFS management and Census roads being used everywhere else.

Travel distance was calculated from city centers. Facilities are unlikely to be located at the city center but without mapping specific facilities, this approximation provides a consistent analysis. Facilities that are closer to areas with a larger volume of standing inventory will be closer to most of the wood supply while facilities located on the far side of the city from the majority of the wood supply will be further than reported in this study. Service areas and wood supply summaries can be estimated more specifically once locations of proposed infrastructure are known. Due to the nature of the downscaled FIA data improvements in accuracy would be negligible even if mills and processing facilities are precisely mapped.

Distance was the only weighting criteria for transportation feasibility used in this model. Road condition, road width and truck size and weight limitations may factor into true transportation feasibility but accurate data on road condition and traffic restrictions was not available.

Demand for forest products in each city was not analyzed. The CPLA wood supply paper examines the market for timber and biomass products in part of the study area (CPLA, 2013). A broader analysis of the forest products market in the MRG area would be useful for industry but is not included in the scope of this study.

Results

This analysis is intended for the specific application of identifying current standing inventory in the MRG area and estimates for the standing inventory in areas accessible from communities with existing and proposed sawmills and other processing infrastructure. Existing studies focus on estimation for counties and other larger administrative areas (Goeking et al. 2014, Miles 2015). This analysis is designed to provide estimates at a finer scale than the existing products.

Due to the novel methodology used in this analysis care should be taken when using the results. FIA data is a sample of actual forest conditions. This analysis takes that sample and applies the characteristics of that sample to all areas within the geographic area that that sample represents. The assumption that all stands of the same forest type within an EMAP hex are identical is imperfect, but does provide an estimate for pixel-level wood supply.

Two spreadsheets were generated that can be used to summarize the results of this analysis for various geographic and management units. City service areas and the MRG study area are the primary spatial units for which this analysis was intended to provide supply estimates, but the spreadsheets can be sorted by many other attributes including land owner, county, state forestry district, national forest, and vegetation type. Summaries can be generated for small areas but while possible is not advised.

Total Standing Inventory

Total standing inventory was estimated for three products: sawlogs, midsize timber, and other biomass. The inventory of each product is presented in a continuous 30-meter raster. Biomass and midsize timber are reported in short tons while sawlogs are reported in cubic feet.

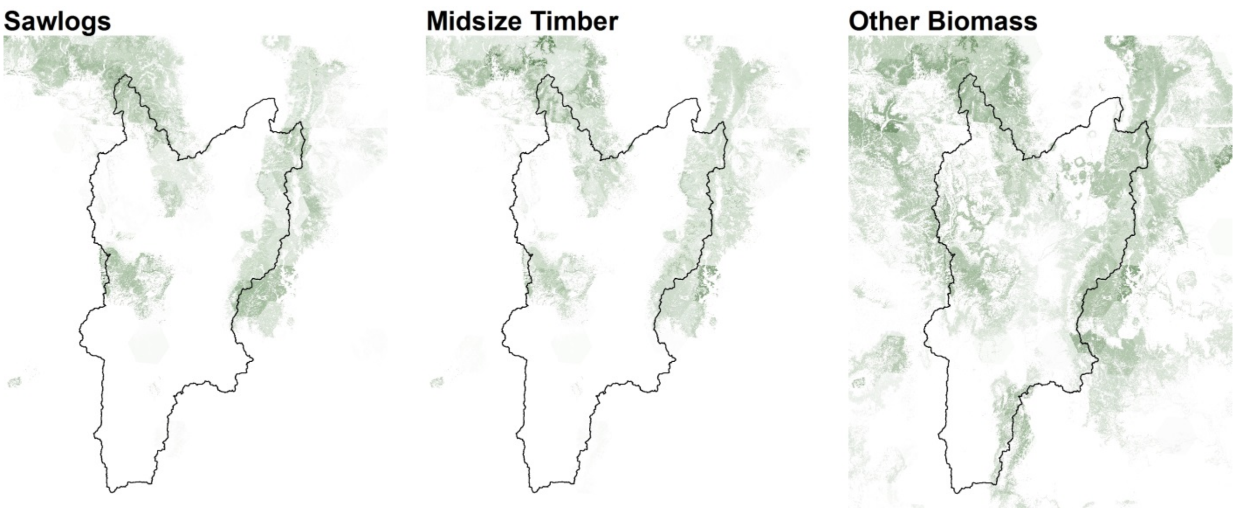

Figure 2. Total standing inventory. These datasets accompany this report.

The high resolution of these datasets conveys a high degree of precision but they should not be used for large scale maps, only aggregations of many pixels should be used. Several anomalies are apparent when reviewing the data. The elm, ash, cottonwood forest type group appears to have the highest density of sawtimber. This is likely due to the forest type group having a small extent, when the sample size is small even a few misclassified pixels can have an outsized effect on estimates. Errors such as this are minimized when aggregations of pixels are used; the wood supply represented by any pixels represents all stands of that forest type. When pixels are aggregated, the average deviation of the modeled wood supply from actual wood supply decreases.

Artifacts of the downscaling process are also clearly visible in the datasets. The outlines of EMAP hexagons are visible where estimated wood supply abruptly changes due to differences in the underlying FIA summaries.

The majority of the standing inventory of each product in the MRG area is located on USFS land. Private lands also hold a large portion of the standing inventory (Table 1). More than 5% of the standing inventory of each product is on tribal lands. BLM lands hold about 5% of the small diameter biomass but contribute less than 1% of the midsize timber and sawlog inventory.

Table 1. MRG total inventory by ownership.

	Biomass		Midsize Timber		Sawlogs		Area	
Owner	***short tons***	***pct***	***short tons***	***pct***	***cubic feet***	***pct***	***acres***	***pct***
BLM	1,071,421	4.6%	66,488	0.4%	8,787,594	0.4%	568,784	8.1%
DOD	80,551	0.3%	3,315	0.0%	501,589	0.0%	63,037	0.9%
LOCALGOV	2,477	0.0%	194	0.0%	24,492	0.0%	3,156	0.0%
NPS	119,748	0.5%	49,220	0.3%	7,433,621	0.3%	41,302	0.6%
OTHERFED	61,421	0.3%	6,413	0.0%	692,698	0.0%	26,264	0.4%
PRIVATE	6,096,228	26.2%	3,392,859	22.5%	497,865,939	20.3%	2,463,203	35.0%
STATEOTHER	134,388	0.6%	65,868	0.4%	9,263,618	0.4%	53,891	0.8%
STATETRUST	273,800	1.2%	13,383	0.1%	1,838,714	0.1%	171,042	2.4%
TRIBAL	2,059,150	8.9%	970,541	6.5%	149,059,838	6.1%	1,174,331	16.7%
USFS	12,874,199	55.4%	9,908,696	65.9%	1,676,210,732	68.5%	2,377,352	33.8%
VALLESCALDERA	484,595	2.1%	570,046	3.8%	97,012,458	4.0%	88,825	1.3%
Grand Total	*23,257,978*		*15,047,023*		*2,448,691,293*		*7,031,186*	

Treatable Forest

Approximately two million acres of the MRG landscape are precluded from mechanical treatments due to excessive slope, wilderness designation, or distance to road. As noted in the methods section there are other factors that could limit the extent of mechanical treatments. Road access, slope and wilderness designation are the largest factors that preclude mechanical forest treatments in the southwest (Hampton et al. 2008). As more excluded areas are delineated the wood supply estimate will decrease but it will become more accurate.

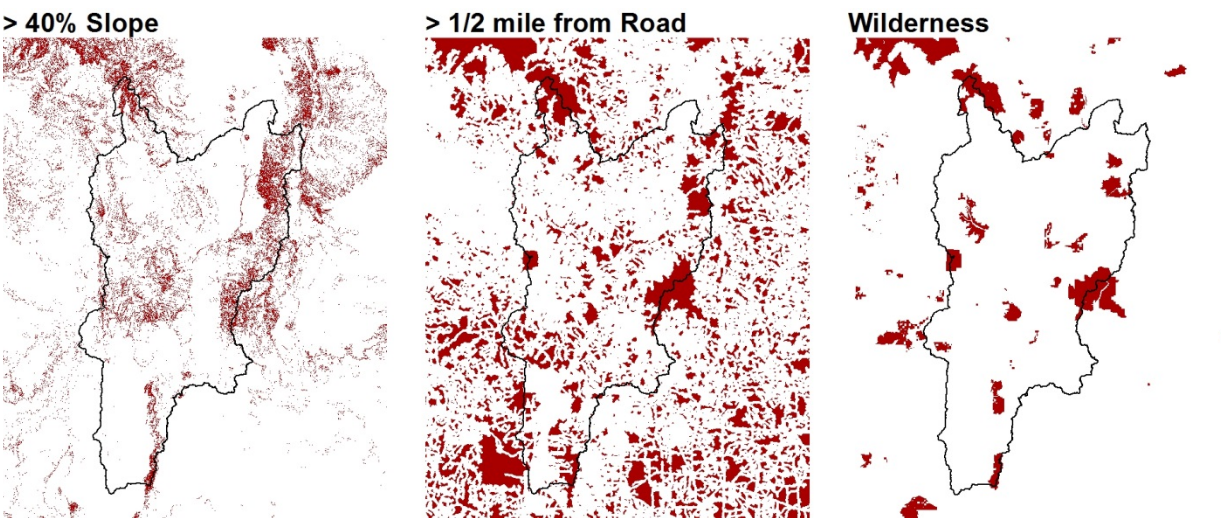

Figure 3. Areas considered precluded from treatment in this analysis.

Most large roadless areas are designated wilderness but there are many other areas without roads that are not designated wilderness. During analysis many errors were discovered in the road network, they have been fixed but there are likely additional errors that were not identified. Of the errors that were found the number of missing and erroneously present roads was fairly equal.

Roughly 30% of the MRG area is precluded from treatments. Those precluded areas hold 51% of the sawlogs, 49% of the midsize timber, and 42% of other biomass. While the forest products in the remaining non-precluded “treatable” areas are considered available for harvest during mechanical restoration treatments, only a portion will likely be harvested.

Forest service land continues to have a majority of the standing inventory even after precluded areas are removed from the inventory. Valles caldera has few precluded areas and while only covering 1.3% of the MRG area supplies over 5% of the treatable midsize timber and sawlog inventory.

Table 2. MRG wood supply not precluded by slope, wilderness designation, or distance to road.

	Biomass		Midsize Timber		Sawlogs		Area	
Owner	**short tons**	**pct**	**short tons**	**pct**	**cubic feet**	**pct**	**acres**	**pct**
BLM	649,573	4.8%	31,446	0.4%	4,031,616	0.3%	362,963	7.3%
DOD	46,032	0.3%	2,175	0.0%	329,201	0.0%	43,732	0.9%
LOCALGOV	2,013	0.0%	134	0.0%	16,666	0.0%	2,800	0.1%
NPS	28,338	0.2%	25,924	0.3%	4,343,532	0.4%	9,490	0.2%
OTHERFED	46,737	0.3%	5,113	0.1%	545,445	0.0%	21,091	0.4%
PRIVATE	4,156,567	30.7%	1,757,334	22.8%	245,419,019	20.4%	2,051,349	41.1%
STATEOTHER	97,911	0.7%	28,713	0.4%	4,056,312	0.3%	40,590	0.8%
STATETRUST	219,857	1.6%	7,668	0.1%	1,019,315	0.1%	127,117	2.5%
TRIBAL	1,126,696	8.3%	385,718	5.0%	72,260,399	6.0%	778,498	15.6%
USFS	6,826,951	50.4%	5,042,332	65.6%	804,367,620	66.8%	1,483,904	29.8%
VALLESCALDERA	341,789	2.5%	404,517	5.3%	67,518,489	5.6%	64,776	1.3%
Grand Total	*13,542,464*		*7,691,074*		*1,203,907,613*		*4,986,309*	

Transportation Feasibility

The average road distance from treatable areas to a city with a mill or other processing infrastructure is about 20 miles (Figure 4). Demand for forest products is not equal in each city but without market data assumptions about demand were not made. Future analysis could benefit from knowing the demand for forest products in each city. It is likely that demand for forest products will vary greatly between the cities evaluated in this analysis.

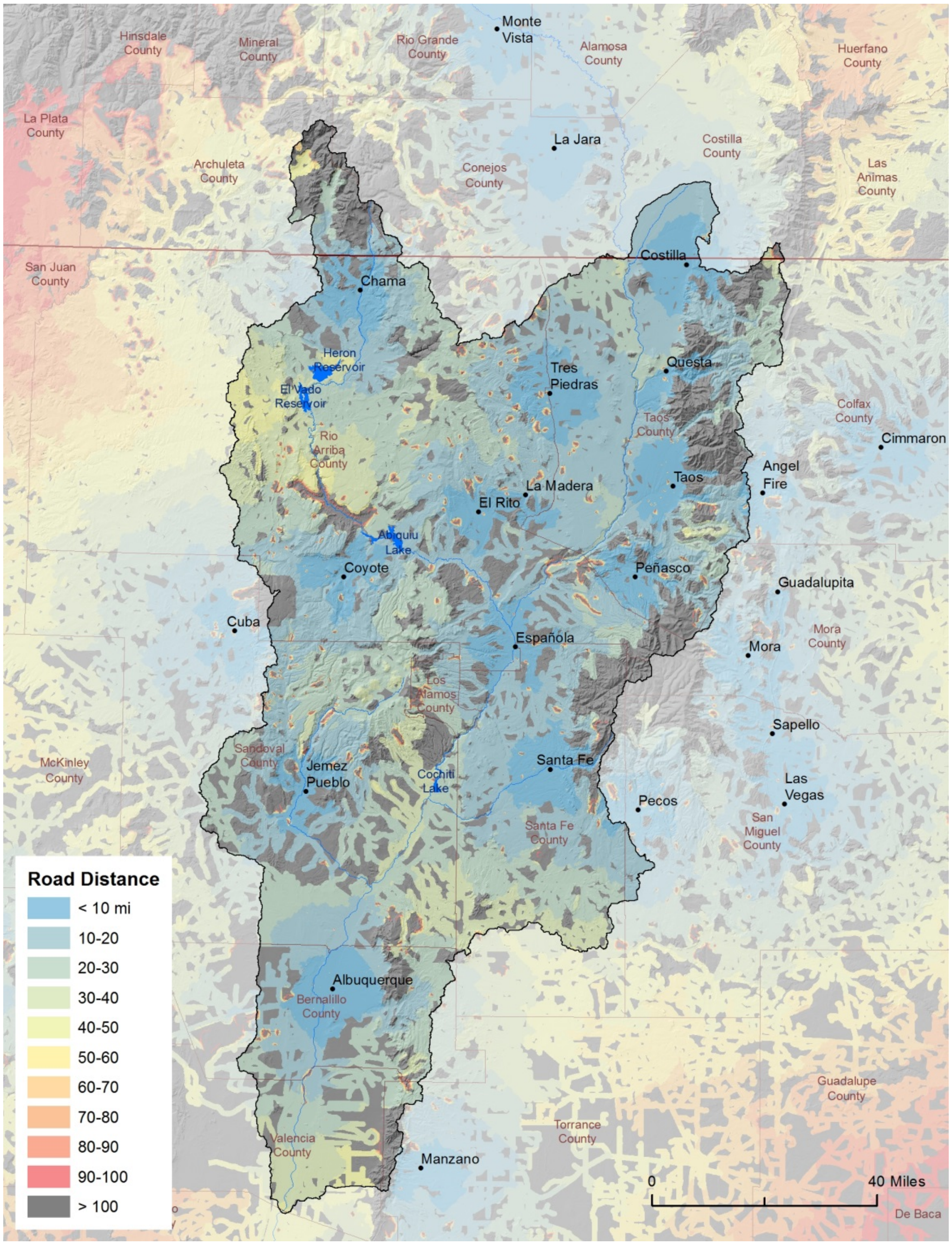

Figure 4. Travel distance along roads from all cities with existing and proposed mills or other processing facilities.

City level transportation feasibility estimates may prove more useful than the study-area data. The attached Wood Supply Atlas provides a graphical display of the city service area, wood supply and transportation feasibility (see figure 5 for example pages). If more detail is desired about the location of the wood supply relative to cities, shapefiles are included with this report. The tabular results of the analysis are also included and allow interpretation of additional attributes include forest type, county and state forest district.

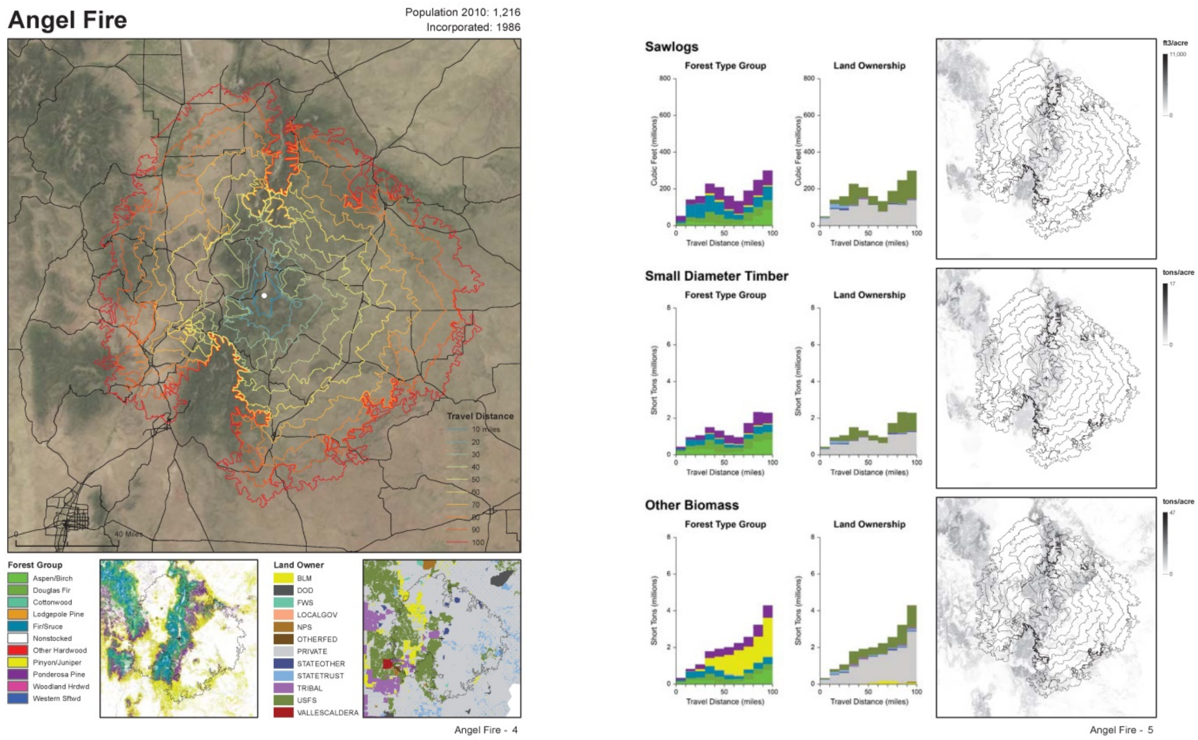

Figure 5. Sample page from the atlas included with this report.

Discussion

Despite the limitations of the downscaled FIA data used in this analysis it still provides wood supply estimates for service areas and other geographies that are not available from existing sources. This analysis could be refined to include more accurate road data, information about demand and processing capacity, and delineation of forecasting of planned restoration treatments. Future wood supply analyses will benefit from next-generation forest inventory data including wall-to-wall LiDAR coverage.

Direct comparisons to existing studies are difficult due to differences in methods and summary geography. The closest comparable study is the total standing inventory estimates for the Chama area as calculated in Appendix D of the CPLA report (2013). In the CPLA report a 50-mile road distance was used to create an estimate of total available biomass. As in this study, road accessibility, wilderness, and slopes greater than 40% were used to preclude areas from treatment. The estimate for total biomass from the CPLA report is 42,370,000 green tons. Our estimate for approximately the same area is 48,737,000 green tons. The difference between the estimates can be explained by the exclusion of “non-stocked” lands in the CPLA report, differences in underlying road and slope data, different conversion factors, and the use of different FIA data to create the downscaled estimates.

Several documents and datasets accompany this report. An atlas of wood supply and transportation feasibility allows city-level comparisons of wood supply by forest type and ownership. Spatial and tabular datasets allow for custom analysis of specific scenarios. A data dictionary is also included that describes the datasets used in this report and the atlas.

The wood supply estimates and transportation feasibility analysis in this report are a first step towards scaling the forest products industry of the Middle Rio Grande region. As industry grows, restoration treatments can increase in pace and size. These restored forests will provide many benefits to the communities of the MRG region.

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Appendix A: Expert Panel Members

An expert panel was convened to bring industry expertise to this project. Conference calls were held roughly every month to update the panel on progress and to request information when assumptions had to be made during analysis.

Kim Kostelnik (Sakak Consulting)

Laura McCarthy (Director of Conservation, The Nature Conservancy in New Mexico)

Adrienne Miller (GIS Analyst from Highlands University)

Brent Racher (Racher Resource Management, LLC)

Susan Rich (Forest and Watershed Health Coordinator, NM State Forestry)

Mary Stuever (Chama District Forester, NM State Forestry)

Appendix B: Cities with Mills and Processing Facilities

Existing

City	Description
Albuquerque	Sawmill, pallets, fuelwood, vigas, poles cerbels, small processing
Angel Fire	Sawmill
Chama	Sawmill, vigas, firewood
Cimarron	Shavings
Costilla	Sawmill
Cuba	Vigas, poles
El Prado	Sawmill
El Rito	Sawmill
Española	Sawmill
Guadalupita	Firewood, Small Products
Jemez Pueblo	Firewood, poles, lumber, posts
La Jara	Sawmill
La Madera	Logging and milling
Las Vegas	Sawmill, vigas, poles
Manzano	Vigas, mill, firewood
Milan	Sawmill and pellets
Monte Vista	Sawmill
Mora	Sawmill, vigas, firewood
Pecos	Houselogs
Penasco	Forest products and charcoal
Questa	Sawmill
Raton	Post and pole
Santa Fe	Sawmill
Sapello	Sawmill
Tres Piedras	Sawmill and other forest products

Proposed

City	Description
Albuquerque	Pellets
Española	Pellets
Jemez Pueblo	Pellets