



URBAN WOOD UTILIZATION IN VIRGINIA, NORTH CAROLINA, AND GEORGIA: A COMPARISON OF INDUSTRY PRACTICES AND PERCEPTIONS

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**Sarah M. Stai
P. Eric Wiseman
Kathryn Fernholz**



DOVETAIL PARTNERS, INC.

Urban Wood Utilization in Virginia, North Carolina, and Georgia: A Comparison of Industry Practices and Perceptions

Prepared by: Sarah M. Stai,¹ P. Eric Wiseman,² and Kathryn Fernholz¹

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Introduction

Urban areas in the United States – in the South and nationwide – have expanded rapidly over the last few decades. This expansion has led to an estimated 4 billion trees in urban areas across the U.S.³ If the broader definition of “metropolitan areas” is used, the estimate increases to 70 billion trees growing in population centers throughout the country.⁴ As urban land is projected to continue increasing in the continental U.S. (nearly tripling in size by 2050),⁵ the discipline of urban forestry will continue growing in importance.

Of concern to urban foresters and urban residents alike is the fate of trees that are removed from private yards, small wooded lots, and municipally owned areas. Whether tree removal is due to damage from disease or storms, construction and development, or other factors, the volume of wood removed is substantial. Estimates of this volume range from 16 to 38 million green tons per year nationwide; even the lower end of this range is larger than total annual harvests from U.S. National Forests.⁶ Historically, urban trees have been disposed of rather than being utilized as lumber or value-added products. Recently, however, this approach has been undergoing a shift, with increasing awareness of the magnitude of wood being wasted and the potential for better use of this raw material.

The transition from a disposal mindset to one of utilization for urban wood ultimately affects a wide range of stakeholders – from arborists, foresters, loggers, haulers, sawyers, millers, and wood product developers to local governments, builders, landowners, and consumers. For all professionals in the lumber and wood products supply chain, there can be challenges, such as high costs related to handling and disposal of removed trees; there can also be market opportunities for turning a disposal problem into an array of valuable products. For entire communities, urban wood utilization has implications for broader environmental issues such as resource sustainability, carbon sequestration, and air quality.

¹ Dovetail Partners, Minneapolis, MN

² Department of Forest Resources and Environmental Conservation, Virginia Polytechnic Institute and State University, Blacksburg, VA, Email: pwiseman@vt.edu

³ Urban areas as defined by the U.S. Census Bureau include (1) urbanized areas with populations of 50,000 or more, (2) places that contain some urbanized areas within their boundaries, or (3) places with at least 2,500 people and located outside of urbanized areas. See additional details in the following source: Nowak, D., Noble, M., Sisinni, S., and Dwyer, J. 2001. Assessing the U.S. Urban Forest Resource. *Journal of Forestry* 99(3):37-42.

⁴ Metropolitan areas are delineated by counties based on urban areas within them. For example, the U.S. Census Bureau defines the Raleigh metropolitan area as Wake, Nash, Franklin, and Johnston counties and the Durham-Chapel Hill metropolitan area as Durham, Orange, Chatham, and Person counties (www.census.gov/programs-surveys/metro-micro.html).

⁵ See Dovetail Report: Using Industrial Clusters to Build an Urban Wood Utilization Program: A Twin Cities Case Study (2010), available at: www.dovetailinc.org and listed under “Citations” at the end of this report.

⁶ See Dovetail Report: Urban Forests and Urban Tree Use: Opportunities on Local, State, National, and International Scales (2014), available at: www.dovetailinc.org and listed under “Citations” at the end of this report.

As with any shift in traditional practices, there is a trade-off between the pros and cons. Potential benefits of urban wood utilization include disposal cost avoidance, niche market development, competitive advantage, long-term business viability, environmental stewardship, and community engagement. Potential challenges include supply chain logistics, economic factors, stakeholder communications, and public awareness.

In 2015, researchers in the Department of Forest Resources and Environmental Conservation at Virginia Polytechnic Institute and State University (Virginia Tech) published a series of studies based on surveys about wood waste generation and utilization in urban areas of Virginia, North Carolina, and Georgia. The surveys addressed the following objectives:

- Identifying the origins and amount of wood waste generated through municipal and private arboricultural operations in urban areas of each state;
- Characterizing the fate of this urban wood waste;
- Examining the perceptions of municipal employees and private sector arborists about the needs, opportunities, and barriers to urban wood utilization; and
- Identifying opportunities to improve awareness, knowledge, and technical capacity of municipal employees and private sector arborists for urban wood utilization.

The purpose of this report is to summarize and synthesize the Virginia, North Carolina, and Georgia studies conducted by Virginia Tech. Full citations of the three studies are provided at the end of this report.⁷ Because data were not analyzed statistically across the three states, the comparisons described in this report should be viewed without inferring that any similarities or differences are statistically significant.

Methods

The survey methods were initially developed for the Virginia study. The researchers conducted separate surveys of stakeholders in interface forestlands (i.e., areas in peri-urban and ex-urban areas around the state where traditional forest management and harvesting operations are undertaken) versus urban forests (i.e., areas within highly urbanized jurisdictions where landscape tree maintenance and land clearing operations are the primary source of waste wood). In urban forests, the survey targeted municipal government employees and private-sector arborists.

For the North Carolina and Georgia studies, the surveys focused on urban forests and targeted the same two stakeholder groups (municipal government employees and private-sector arborists) as in Virginia. While certain survey questions were edited for clarity and/or state-specific needs, the North Carolina and Georgia studies were essentially based on the same survey instrument as in the Virginia study.

In the survey, respondents were directed to answer questions based on conditions in their “local operation,” which meant either the individual municipality (public sector) or the individual

⁷ All three reports are available at <http://www.urbanwoodexchange.org/resources.php>. Some survey data (e.g., respondent and operational characteristics, ability to estimate wood waste generation and fate) included in the North Carolina and Georgia reports were not included in the Virginia report but are available in a Virginia Tech Master’s thesis authored by J.B. Endahl; see full citations at the end of this report.

business (private sector) that they represented. In each state, the major urban municipalities were chosen for the study at the discretion of the researchers with guidance from state forestry officials.

Additional details on methods, including pilot testing, survey administration, statistical analysis, and the survey instrument itself, can be found in the individual state studies. Survey response rate was higher for municipal respondents than for private-sector respondents in all three states (Table 1).

Table 1			
Survey Response Rate			
Group	Virginia	North Carolina	Georgia
Urban Municipalities ^a	56 of 91 (61%)	45 of 69 (65%)	34 of 68 (50%)
Private-sector Arborists ^b	239 of 774 (31%)	170 of 531 (32%)	179 of 601 (30%)

^a The municipal employees who were most knowledgeable about waste wood generation and utilization within the jurisdiction included urban foresters, solid waste managers, engineers, planners, and public works and parks and recreation administrators; a single person was solicited for the survey in each locality except for certain municipalities depending on program structure or size of geographic area.

^b Private-sector arborists were identified through cooperation with the International Society of Arboriculture Mid-Atlantic Chapter (Virginia) and Southern Chapter (North Carolina and Georgia). Specifically, contact information was obtained for individuals who were Certified Arborists, a professional credential held by an assortment of tree care service proprietors and consultants.

Findings

For all three states, the majority of operations generated urban wood waste (Table 2). In Virginia and Georgia, municipal operations generated urban wood waste at a notably higher rate than private operations, while in North Carolina the percentages were similar between the two groups.

Table 2			
Percentage of Operations Generating Urban Wood Waste			
Group	Virginia	North Carolina	Georgia
Municipal	87%	71%	73%
Private	67%	75%	52%

The findings can generally be broken down into responses to five questions, each of which is summarized below. Detailed data comparisons are provided in Appendix 1.

- A. Where is urban wood waste coming from?
- B. What is the fate of urban wood waste?
- C. What are the motivations and perceptions of urban wood utilization?
- D. What are the incentives and barriers to urban wood utilization?
- E. What are the educational and technical assistance preferences of stakeholders?

A. Where is urban wood waste coming from? (see Appendix 1, page 1)

Land Use Origin: Municipalities generated the highest percentage of urban wood waste from a combination of public greenspace and rights-of-way (58-71%), while private operations generated the highest percentage from a combination of private residential and commercial lands (54-63%). Private residential and commercial lands were also an important source of urban wood waste for municipalities (21-42%), likely due to curbside pickup (see next paragraph). Similarly, public greenspace and rights-of-way were an important source of urban wood waste for private operations (38-42%), likely due to private operations having municipal contracts.

Management Practice: For municipalities, curbside pickup generated the highest percentage of urban wood waste in all three states (32-44%), followed by tree pruning (23-31%) and tree removal (22-32%). For private-sector arborists, nearly all urban wood waste was generated from tree pruning (44-52%) and tree removal (34-43%).

B. What is the fate of urban wood waste? (see Appendix 1, pages 1-2)

For respondents who could provide estimates of the amount of urban wood waste generated through their operations, there were additional questions regarding the breakdown of urban wood waste into three types – logs, chips, and brush. For these questions, small sample sizes and high variability in the data precluded firm conclusions. It appeared, however, that there was a tendency for municipalities to generate more chips and brush and for private operations to generate more logs (Table 3). The difference in generation of logs between the two groups was largest in North Carolina (6% municipal versus 59% private) and smallest in Virginia (30% municipal versus 33% private), again noting that high variability is behind these numbers.

Table 3			
Average Percentage of Total Urban Wood Waste by Type			
Group	Virginia	North Carolina	Georgia
Municipal	47% brush	67% chips	48% chips
	30% logs	27% brush	44% brush
	23% chips	6% logs	10% logs
Private	57% chips	59% logs	57% chips
	33% logs	24% brush	35% logs
	10% brush	17% chips	8% brush

For the estimated amounts of urban wood waste generated, the researchers examined the fate of each of the three types (logs, chips, and brush). There were five potential fates:

1. material taken to a solid waste facility or another location for disposal;
2. material left on-site without utilization;
3. material left on-site to be utilized by the property owner;
4. material utilized in-house by the operation; and
5. material transferred to a third party for utilization.

Total utilization (i.e., the sum of average percentages for fates 3, 4, and 5 above) was at least 50 percent across the board except for logs and brush from Georgia municipalities (21% and 40%, respectively) and logs from North Carolina municipalities (26%). The specific fates for the two groups compared as follows.

- Municipalities in North Carolina and Georgia had the highest reported rates of disposal for logs (both 68%) and brush (46% and 60%, respectively), while disposal was the most or second-most common fate for chips (35% and 33%, respectively). In these two states, the remaining chips and brush were generally utilized in-house or transferred to a third party, which implies utilization but does not allow specific fates to be estimated. Virginia municipalities consistently had the lowest rates of disposal and the highest rates of in-house utilization, especially for chips and brush (47% and 43%, respectively).
- Private operations reported lower rates of disposal overall, compared to municipalities. They generally reported higher rates of transfer to third parties, though not always so, while the rates of in-house utilization were quite variable across all three states and wood waste types.

For material utilized in-house by the operation, the researchers then asked what urban forest products were generated. In-house utilization patterns were similar across the two stakeholder groups, except for municipal vs. private operations in North Carolina.

- The most common urban forest products from logs were firewood (42-63%) and lumber (17-33%) (excluding Georgia, where there was not an adequate sample for reporting).
- The most common urban forest products from brush were mulch (52-76%, except 15% for North Carolina municipalities) and compost (10-33%, except 59% for North Carolina municipalities).
- The most common urban forest products from chips were mulch (63-81%) and compost (13-21%).

C. What are the motivations and perceptions of urban wood utilization? (see Appendix 1, page 2)

Respondents were asked to indicate their level of agreement with statements about motivations for urban wood waste utilization (environmental, financial, logistical, and regulatory). The researchers reported average levels of agreement for the two stakeholder groups (on a scale where 1 = strongly agree, 3 = neutral, and 5 = strongly disagree), noting that each of these groups contains diverse individuals employed by operations of varying scale and scope. Accordingly, the researchers cautioned that there are important differences within the groups to consider.

Although municipal and private respondents in Virginia and North Carolina did not express strong agreement or disagreement with the statements about motivation, the levels of agreement for both stakeholder groups in these two states could be ranked in the following order of importance:

1. environmental reasons,
2. financial and logistical reasons, and
3. regulatory reasons.

In general, Georgia showed a more neutral stance or leaned more toward slight disagreement compared to the other two states. For both stakeholder groups in Georgia, the levels of agreement could be ranked in the following order of importance:

1. logistical reasons,
2. financial and regulatory reasons, and
3. environmental reasons.

Respondents were then asked to indicate their level of agreement with certain perceptions. The perception statements took the form “Urban forest waste...”

1. ...disposal is a major cost for my operation.
2. ...utilization is important to my clients.
3. ...utilization is a major revenue source for my operation.
4. ...utilization will be a major issue for the urban forestry industry in the future.
5. ...utilization is a major issue for the urban forestry industry currently.

Each state had a different pattern in terms of agreement with the perception statements.

- In North Carolina, the statement about disposal costs showed the highest agreement among private operations, and that level of agreement was higher than among municipalities. Private operations also agreed more strongly than municipalities that urban wood utilization is important to their clients, which may be attributable to the private sector having more direct contact with their clientele on a daily basis and thus being more attuned to their values. Municipal and private operations only slightly viewed urban wood utilization as a major revenue source, and they tended to see urban wood utilization as not being a major issue for the industry currently but more so an issue for the future.
- Georgia respondents in both groups had higher agreement than in North Carolina (somewhat agreed versus neutral/somewhat disagreed) that urban wood utilization is a major issue for the industry currently, with its importance in the future being closer to neutral. For the Georgia groups, importance to clients had the highest level of agreement, followed by a relatively neutral stance on disposal costs, and slight disagreement that utilization was a major revenue source for them.
- As in North Carolina, Virginia respondents in both groups tended to see urban wood utilization as not being a major issue for the industry currently but more so an issue for the future. As in Georgia, importance to clients had the highest level of agreement for the Virginia groups, followed by a relatively neutral stance on disposal costs, and slight disagreement that utilization was a major revenue source for them.

***D. What are the incentives and barriers to urban wood utilization?
(see Appendix 1, page 3)***

Respondents were presented with a list of incentives and barriers and asked to rank them from highest to lowest importance based on their perceptions.

Incentives: According to the percentage of respondents who ranked each incentive in their top three, there were five incentives that two or three states had in common (Table 4). These five incentives were ranked in the top three by 41-77% of respondents.

Table 4			
Incentives Ranked in the Top Three by Respondents in Two or More States			
Incentive	Rank of Incentive (based on % of respondents)		
	1st	2nd	3rd
1. Avoidance of transportation or shipping costs	GA (both groups) NC (private)	NC (municipal)	VA (both groups)
2. Environmental sustainability of the operation/ community	NC (municipal)	all other state/group combinations	
3. Avoidance of disposal fees	VA (both groups)		NC (municipal)
4. Value-added service to clients			GA (both groups) NC (tying with #3 for municipal respondents)
5. Additional revenue			GA (tying with #4 for private respondents) NC (private)

The other listed incentives were ranked in the top three by 44% or fewer respondents. These incentives included “opportunity to produce urban forest products for use elsewhere within the operation/community” and “support local industries or businesses.”

Overall, North Carolina and Georgia were the most similar in ranking of incentives. Nearly half of private respondents (41-46%) in these two states considered additional revenue as a major incentive for urban wood utilization, suggesting that they might undertake or increase utilization if markets and networks could be profitably developed. Private respondents ranked avoidance of disposal fees as a major incentive at a lower frequency (34-38%) than avoidance of transportation or shipping costs (61-74%), which suggests that moving urban wood waste around is more problematic than paying for its disposal in these two states. By contrast, both

municipal and private respondents in Virginia ranked avoidance of disposal fees as a major incentive most frequently (69-79%) and at a higher frequency than avoidance of transportation or shipping costs (44-53%).

Barriers: As with incentives, there were certain barriers that two or three states had in common, based on the percentage of respondents who ranked each incentive in their top three (Table 5). There was less consensus about barriers than incentives, however, as reflected in the lower average percentages of the top-rated barriers (38-56%).

Table 5			
Barriers Ranked in the Top Three by Respondents in Two or More States			
Incentive	Rank of Barrier (based on % of respondents)		
	1st	2nd	3rd
1. Lack of local processors of urban wood waste	VA (private) NC (private)	GA (private) NC (municipal)	VA (municipal) GA (municipal)
2. Lack of in-house space for stockpiling urban wood waste	GA (both groups)	VA (both groups) NC (private)	NC (municipal)
3. Lack of in-house equipment for processing urban wood waste	VA (municipal) NC (municipal)		
4. Logistical difficulties of transporting urban wood waste to processors			VA (private) NC (private)

Other top barriers in Georgia were “lack of in-house knowledge or skill for processing urban wood waste or marketing urban forest products” (came in second for municipal respondents) and “logistical difficulties of handling urban wood waste on tree service job sites” (came in third for private respondents). These logistical difficulties were thought to be related to the time and equipment constraints of working on small urban lots.

The other listed barriers were ranked in the top three by 31% or fewer respondents: “lack of local consumers of urban forest products,” “lack of communication between urban wood waste producers and urban forest product consumers,” and “local regulations or permitting requirements.”

The researchers found it notable that private respondents frequently viewed lack of local processors as a barrier (47-48% across the three states), but private respondents viewed lack of local consumers as a barrier less frequently (24-34%). They suggested that this result may hint at an untapped demand for urban forest products that could be met if more local processors could be brought into urban wood utilization. Another observation was that more private respondents across all three states (31-45%) viewed logistical difficulties of transporting urban wood waste to processors as a top barrier than municipal respondents (18-29%). The researchers suggested this observation may be due to municipalities having trucking equipment specifically designed for hauling urban wood waste generated by citizens or having better access to their processing destinations.

E. What are the educational and technical assistance preferences of stakeholders? (see Appendix 1, page 4)

Experiences with education and training on urban wood utilization were notably consistent across all three states. Based on their level of agreement with statements provided in the survey (on the same scale as for motivations and perceptions), respondents expressed neutral to somewhat positive attitudes about education experience. Interestingly, however, within the narrow range of average levels of agreement, the average levels of agreement followed a consistent pattern for each group across all three states (Table 6).

Table 6						
Experience with Education on Urban Wood Utilization						
Education Statement	Average Level of Agreement*					
	Municipal			Private		
	VA	NC	GA	VA	NC	GA
I have engaged in self-education or training about urban wood utilization in the past year.	2.94	2.83	3.00	2.84	2.62	2.78
I will engage in self-education or training about urban wood utilization in the coming year.	2.71	2.64	2.50	2.63	2.43	2.64
I have found satisfactory opportunities for education or training on urban wood utilization when I have sought it.	2.92	2.79	2.96	2.97	2.95	2.95

*The level of agreement was based on 1 = strongly agree, 3 = neutral, and 5 = strongly disagree. The highest average level of agreement (i.e., the lowest number) within the stakeholder groups of each state is highlighted in dark gray, the intermediate average in medium gray, and the lowest average level of agreement (i.e., the highest number) in light gray.

Overall, there was only a slight indication that respondents had sought self-education about urban wood utilization in the past, with only a bit more interest in self-education in the future. Respondents were generally neutral about their ability to find satisfactory education or training on urban wood utilization when they sought it. The researchers suggested this neutral attitude may result from the overall perception that urban wood utilization is not a major issue for urban forestry now or into the near future (see summary for question C, above).

Respondents were presented with a list of educational and technical assistance programs and asked to rank them from highest to lowest importance based on their perceptions. According to the percentage of respondents who ranked each program in their top three, there were five programs that two or three states had in common (Table 7). These programs were ranked in the top three by 31-52% of respondents.

Table 7 Educational and Technical Assistance Programs Ranked in the Top Three by Respondents in Two or More States			
Incentive	Rank of Program (based on % of respondents)		
	1st	2nd	3rd
1. A local, centralized facility for receiving, sorting, and stockpiling urban wood waste	VA (both groups) NC (private) GA (municipal)	NC (municipal) GA (private)	
2. A cooperative business facility for selling and/or producing urban forest products	GA (tying with #1 for municipal)	VA (municipal)	VA (private) GA (private) NC (both groups)
3. An online database that networks urban wood generators, urban wood processors, and urban forest product producers	GA (private)	VA (private) NC (private)	VA (municipal)
4. Hands-on workshops or field demonstrations	NC (municipal)	VA (private)	
5. Educational seminars or conferences	VA (tying with #1 for municipal)		GA (municipal)

Other programs ranking in the top three included “an educational website,” which came in second for municipal respondents in Georgia and tied with “Cooperative Extension and state forestry publications.” The latter program also came in third for private respondents in Georgia.

The wide range in preferences for educational and technical assistance programs reflects the diversity in municipal and private operations represented by the respondents. There was, however, a theme across all three states in ranking centralized or coordinated facilities or resources highly as preferred programs. This response reinforces that two of the top barriers across the three states were a lack of local processors and a lack of in-house space for stockpiling urban wood waste. It was also notable that consistently more private than municipal respondents showed a preference for an online database to network urban wood waste generators and processors with producers of urban forest products.

Conclusions/Recommendations

In this report, we compared practices involved in wood waste generation and utilization for municipal and private operations in urban areas of Virginia, North Carolina, and Georgia through a series of surveys conducted in 2015. Generally, there were high rates of disposal of urban wood waste, though utilization was estimated to reach 50 percent or more in some cases. When urban wood waste was utilized in-house, the urban forest products were most commonly firewood, lumber, mulch, and compost.

We also compared perceptions related to urban wood waste in Virginia, North Carolina, and Georgia. Firm conclusions are difficult due to small sample sizes and high variability in the data, but the variation highlights the diversity of issues and perspectives represented by different stakeholders across the three states. Municipality size, the distribution of urban areas across states, and the scale and scope of private operations are a few of many factors affecting urban wood utilization in the region.

The findings suggested that the most important incentives for increasing urban wood utilization across the three states were:

1. avoidance of transportation or shipping costs,
2. enhancing environmental sustainability of the operation or community,
3. avoidance of disposal fees,
4. providing a value-added service to clients, and
5. generating additional revenue.

The most frequently cited barriers were:

1. a lack of local processors of urban wood waste,
2. a lack of in-house space for stockpiling urban wood waste,
3. a lack of in-house equipment for processing urban wood waste, and
4. logistical difficulties of transporting urban wood waste to processors.

Arguably, the most consistent response across states and stakeholder groups related to preferences for specific educational or technical assistance programs. There appeared to be an overall consensus regarding the need for centralized or coordinated facilities or resources, including a local, centralized facility for receiving, sorting, and stockpiling urban wood waste; a cooperative business facility for selling and/or producing urban forest products; and an online database that networks urban wood generators, urban wood processors, and urban forest product producers.

Taken together, this comparison of findings suggests the following next steps:

- 1) emphasize local strategies that can be tailored to an urban area's unique context and that can bring private and public stakeholders together;
- 2) examine local opportunities for centralized facilities, product cooperatives, and/or online databases that can help diverse stakeholders address key barriers to increased urban wood utilization; and
- 3) explore state-level partnerships that could facilitate localized approaches through the sharing of outreach, education, networking, and other efforts.

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Citations

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Urban Wood Utilization in Virginia, North Carolina, and Georgia:
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APPENDIX 1

A. Where is urban wood waste coming from?

What is the land use origin of the urban wood waste generated?*

Municipal Operations	VA	NC	GA
Private residential	21	36	26
Private commercial	3	6	6
Public greenspace	34	25	21
Rights-of-way	42	33	47
Other	0	0	0
Total (%)	100	100	100

Private Operations	VA	NC	GA
Private residential	46	39	36
Private commercial	17	16	18
Public greenspace	14	18	14
Rights-of-way	21	22	28
Other	2	5	4
Total (%)	100	100	100

Which management practices generate urban wood waste?*

Municipal Operations	VA	NC	GA
Tree pruning	31	23	31
Tree removal	32	22	24
Curbside pickup	32	44	39
Small woodlot logging	2	4	2
Land clearing	3	6	4
Other	0	1	0
Total (%)	100	100	100

Private Operations	VA	NC	GA
Tree pruning	45	44	52
Tree removal	43	42	34
Curbside pickup	2	5	6
Small woodlot logging	3	3	3
Land clearing	4	5	4
Other	3	1	1
Total (%)	100	100	100

*Values shown are the average percentage breakdowns reported by respondents.

B. What is the fate of urban wood waste?

What is the fate of LOGS derived from urban wood?*

Municipal Operations	VA	NC	GA
Disposal (solid waste facility/other)	24	68	68
Transfer to 3rd party for utilization	26	11	21
In-house utilization	27	8	0
Left on-site (utilization by landowner)	14	7	0
Left on-site (no utilization)	9	6	11
Total (%)	100	100	100

Private Operations	VA	NC	GA
Disposal (solid waste facility/other)	20	22	19
Transfer to 3rd party for utilization	42	34	33
In-house utilization	16	25	25
Left on-site (utilization by landowner)	13	11	15
Left on-site (no utilization)	9	8	8
Total (%)	100	100	100

Urban forest products created from LOGS by in-house utilization*

Municipal Operations	VA	NC	GA[^]
Firewood	42	46	-
Lumber	18	33	-
Furniture, Cabinetry, Veneer	17	14	-
Pallets, Flooring, Art/Novelty, Other	15	7	-
Mulch	8	-	-
Total (%)	100	100	-

Private Operations	VA	NC	GA
Firewood	52	57	63
Lumber	17	19	21
Furniture, Cabinetry, Veneer	4	1	3
Pallets, Flooring, Art/Novelty, Other	10	23	13
Mulch	17	-	-
Total (%)	100	100	100

[^]A dash here and elsewhere indicates where values were not reported due to lack of sample size.

What is the fate of CHIPS derived from urban wood?*

Municipal Operations	VA	NC[#]	GA
Disposal (solid waste facility/other)	14	35	33
In-house utilization	47	31	34
Transfer to 3rd party for utilization	29	19	28
Left on-site (utilization by landowner)	5	8	2
Left on-site (no utilization)	5	6	3
Total (%)	100	100	100

Private Operations	VA	NC	GA
Disposal (solid waste facility/other)	9	12	10
In-house utilization	22	46	26
Transfer to 3rd party for utilization	53	20	33
Left on-site (utilization by landowner)	9	15	21
Left on-site (no utilization)	7	7	10
Total (%)	100	100	100

[#]This column sums to 99% but represents 100% due to rounding.

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APPENDIX 1

Urban forest products created from CHIPS by in-house utilization*

Municipal Operations	VA	NC	GA
Other	0	-	2
Pellets	3	3	0
Biomass	1	3	11
Compost	21	13	14
Mulch	75	81	73
Total (%)	100	100	100

Private Operations	VA	NC	GA#
Other	5	-	1
Pellets	2	1	0
Biomass	10	8	3
Compost	20	18	21
Mulch	63	73	75
Total (%)	100	100	100

*This column sums to 99% but represents 100% due to rounding.

What is the fate of BRUSH derived from urban wood?*

Municipal Operations	VA	NC	GA
Disposal (solid waste facility/other)	21	46	60
Transfer to 3rd party for utilization	28	41	21
In-house utilization	43	5	18
Left on-site (no utilization)	5	4	0
Left on-site (utilization by landowner)	3	4	1
Total (%)	100	100	100

Private Operations	VA	NC	GA
Disposal (solid waste facility/other)	20	33	35
Transfer to 3rd party for utilization	32	14	10
In-house utilization	31	33	27
Left on-site (no utilization)	13	11	15
Left on-site (utilization by landowner)	4	9	13
Total (%)	100	100	100

Urban forest products created from BRUSH by in-house utilization*

Municipal Operations	VA	NC	GA
Other	0	-	37
Pellets	-	-	0
Biomass	4	26	0
Compost	21	59	10
Mulch	75	15	53
Total (%)	100	100	100

Private Operations	VA	NC	GA
Other	13	10	0
Pellets	-	-	0
Biomass	7	1	15
Compost	28	33	32
Mulch	52	56	53
Total (%)	100	100	100

*Values shown are the average percentage breakdowns reported by respondents.

C. What are the motivations and perceptions of urban wood utilization?

My operation seeks to increase urban wood waste utilization for...**

Municipal Operations	VA	NC	GA
...environmental reasons	2.08	2.60	3.72
...financial reasons	2.36	2.76	3.34
...logistical reasons	2.42	2.81	3.15
...regulatory reasons	2.70	3.12	3.43

Private Operations	VA	NC	GA
...environmental reasons	2.28	1.61	3.60
...financial reasons	2.69	2.66	2.96
...logistical reasons	2.49	2.75	2.79
...regulatory reasons	2.95	3.87	3.17

Urban forest waste...**

Municipal Operations	VA	NC	GA
...disposal is a major cost for my operation	3.19	2.39	3.18
...utilization is important to my clients	2.88	2.56	2.23
...utilization is a major revenue source for my operation	4.04	2.66	3.80
...utilization will be a major issue for the urban forestry industry in the future	2.15	2.93	3.02
...utilization is a major issue for the urban forestry industry currently	2.40	3.78	1.98

Private Operations	VA	NC	GA
...disposal is a major cost for my operation	2.95	1.90	3.14
...utilization is important to my clients	2.70	2.16	2.19
...utilization is a major revenue source for my operation	3.87	2.74	3.65
...utilization will be a major issue for the urban forestry industry in the future	1.97	2.91	2.74
...utilization is a major issue for the urban forestry industry currently	2.25	3.72	2.01

**Average respondent score based on level of agreement scale from 1 (strongly agree) to 5 (strongly disagree), with neutral value of 3. The highest average level of agreement (i.e., the lowest number) within the stakeholder groups of each state is highlighted in dark gray, the second highest in medium gray, and the third highest in light gray.

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D. What are the incentives and barriers to urban wood utilization?

Incentives***

Municipal Operations	VA	NC	GA
Environmental sustainability of the operation/community	69	77	67
Avoidance of transportation or shipping costs	44	72	69
Value-added service to clients	33	46	51
Avoidance of disposal fees	79	46	18
Opportunity to produce urban forest products for use elsewhere within the operation/community	36	33	44
Additional revenue	29	31	27
Support local industries or businesses	17	22	24
Other	-	0	0

Private Operations	VA	NC	GA
Environmental sustainability of the operation/community	67	66	56
Avoidance of transportation or shipping costs	53	74	61
Value-added service to clients	34	41	41
Avoidance of disposal fees	69	34	38
Opportunity to produce urban forest products for use elsewhere within the operation/community	36	40	38
Additional revenue	32	46	41
Support local industries or businesses	29	31	17
Other	-	3	7

Barriers***

Municipal Operations	VA	NC	GA
Lack of in-house equipment for processing urban wood waste	56	44	40
Lack of local processors of urban wood waste	42	41	42
Lack of in-house space for stockpiling urban wood waste	52	38	56
Lack of in-house knowledge or skill for processing urban wood waste or marketing urban forest products	33	36	47
Logistical difficulties of handling urban wood waste on tree service job sites	23	33	23
Lack of local consumers of urban forest products	27	33	30
Lack of communication between urban wood waste producers and urban forest product consumers	23	26	21
Local regulations or permitting requirements	17	23	19
Logistical difficulties of transporting urban wood waste to processors	29	18	23
Other	-	8	0

Private Operations	VA	NC	GA
Lack of in-house equipment for processing urban wood waste	30	36	33
Lack of local processors of urban wood waste	48	47	47
Lack of in-house space for stockpiling urban wood waste	41	46	49
Lack of in-house knowledge or skill for processing urban wood waste or marketing urban forest products	25	40	27
Logistical difficulties of handling urban wood waste on tree service job sites	37	37	40
Lack of local consumers of urban forest products	34	24	27
Lack of communication between urban wood waste producers and urban forest product consumers	31	27	28
Local regulations or permitting requirements	21	21	11
Logistical difficulties of transporting urban wood waste to processors	40	45	31
Other	-	4	6

***Based on the percentage of respondents who ranked the item as 1st, 2nd, or 3rd most important incentive or barrier amongst all items in the list. The highest rank within the stakeholder groups of each state is highlighted in dark gray, the second highest in medium gray, and the third highest in light gray. See also Tables 4 and 5 in the text.

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E. What are the educational and technical assistance preferences of stakeholders?

Experience with education and training**

Municipal Operations	VA	NC	GA
I have engaged in self-education or training about urban wood utilization in the past year.	2.94	2.83	3.00
I will engage in self-education or training about urban wood utilization in the coming year.	2.71	2.64	2.50
I have found satisfactory opportunities for education or training on urban wood utilization when I have sought it.	2.92	2.79	2.96

Private	VA	NC	GA
I have engaged in self-education or training about urban wood utilization in the past year.	2.84	2.62	2.78
I will engage in self-education or training about urban wood utilization in the coming year.	2.63	2.43	2.64
I have found satisfactory opportunities for education or training on urban wood utilization when I have sought it.	2.97	2.95	2.95

**Average respondent score based on level of agreement scale from 1 (strongly agree) to 5 (strongly disagree), with neutral value of 3. The highest average level of agreement (i.e., the lowest number) within the stakeholder groups of each state is highlighted in dark gray, the intermediate average in medium gray, and the lowest average (i.e., the highest number) in light gray. See also Table 6 in the text.

Preference for educational or technical programs about urban wood utilization***

Municipal Operations	VA	NC	GA
Hands-on workshops or field demonstrations	29	54	28
A local, centralized facility for receiving, sorting, and stockpiling urban wood waste	46	46	44
A cooperative business facility for selling and/or producing urban forest products	33	41	44
Educational seminars or conferences	46	36	35
An educational website	29	31	37
Cooperative Extension or Virginia Department of Forestry/North Carolina Forest Service/Georgia Forestry Commission publications	27	26	37
An online database that networks urban wood generators, urban wood processors, and urban forest product producers	31	23	26
Industry standards or best management practices	29	23	26
Online webinar	17	18	26
Other	-	0	0

Private	VA	NC	GA
Hands-on workshops or field demonstrations	39	34	32
A local, centralized facility for receiving, sorting, and stockpiling urban wood waste	50	50	40
A cooperative business facility for selling and/or producing urban forest products	36	37	34
Educational seminars or conferences	30	33	33
An educational website	27	34	28
Cooperative Extension or Virginia Department of Forestry/North Carolina Forest Service/Georgia Forestry Commission publications	7	27	34
An online database that networks urban wood generators, urban wood processors, and urban forest product producers	39	42	52
Industry standards or best management practices	32	23	23
Online webinar	18	15	22
Other	-	2	1

***Based on the percentage of respondents who ranked the item as 1st, 2nd, or 3rd most important program



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www.dovetailinc.org

528 Hennepin Ave., Suite 703 Minneapolis, MN 55403 USA

info@dovetailinc.org | **Phone:** +1 612-333-0430 | **Fax:** +1 612-333-0432

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