Urban Wood Waste: Maximizing Log Value for the Sawmill Market

David T. Damery, Lecturer
Brian C.P. Kane, Asst. Professor,
Univ. of Massachusetts, Amherst, MA

How arborists view the issue of "waste wood" is changing. The number of landfills has been steadily shrinking, while tipping fees at the remaining facilities are rising continually. Disposing of waste wood was once merely a time and labor factor, but now carries with it considerably more expense. Many arborists have adjusted to the higher cost of handling waste wood by looking for value-added markets for this material. Market, technology, and government factors outside the tree care industry are contributing to make it easier for arborists to find these markets, if the arborist knows how to handle the wood and what to look for.

There are many markets for waste wood including: lumber, firewood, mulch and compost, chips (for use in engineered wood products, paper, soil erosion control), animal bedding (sawdust and fines), biomass energy, bio-oils, and even chemicals (Peterson 2004). Which of these uses fits best for a particular business depends on many factors. When dealing with any low value or bulky material, like urban tree waste, one consideration is to minimize material handling. This makes sense from the perspective of avoiding costs, but may not yield the most profits for a business. Although it's sometimes easier to move material by bucking it into firewood length, or chipping it, the potential value of keeping larger diameter material in longer lengths should be considered. This is especially true today, as machinery like skid-steers and cranes are increasingly used to move logs after removals. Some saw-millers and wood-workers are equipped to pick up waste wood and remove it from a job site. A quick Google ™ search for "urban sawmilling" yielded over 8,000 results. This reflects the increasing awareness among both portable sawmill operators and arborists about the value of urban trees for lumber, as opposed to firewood.

Often, the highest and best use for urban wood waste can be achieved by keeping it in the largest practical form, a log. Hessenthaler (2000) outlined a "profit pyramid" for wood waste, with finished wood products (such as jewelry boxes) at the top, and wood debris at the bottom. Finished wood products can bring as much as $100 per pound of material at the retail market place. Contrast this with the $90 per ton <u>cost</u> for tipping fees when disposing of wood debris. Of course, there are many separate value added operations that must be performed to turn a log from an urban tree into a jewelry box. The costs and benefits of pursuing higher revenues from more value added handling of wood waste must be carefully considered.

In order to take advantage of any higher value use, the arborist must do two things, convert the urban tree into the best logs possible for their end use and find a buyer.
As a first step, arborists can consider bucking trees to log length for sawing into lumber. We have a great deal of urban wood waste that has the potential to be turned into usable lumber. In the first national inventory of urban tree residues, Whittier et al. (1995)

estimated that 15% of the volume of all urban tree residue is in the form of log sections, “usually with a diameter greater than 12 inches”. If converted to lumber, this volume of material would equal roughly 7% of our annual national demand.

Log value depends on both the quality and quantity of lumber that results after the sawmilling process. The quality and value are reduced when defects are present on the trunk. Defects include branches that form knots, cavities, and cracks; if these are present, it's more difficult to produce quality lumber from the trunk. The arborist can’t control the knots in a tree, but they can maximize the volume of lumber yield from a tree by careful bucking to length. Bucking should be performed to maximize log straightness, and not to achieve maximum log length (Beattie et al. 1993). A 16 foot section with a bend in the middle might yield two straight 8-foot logs. When milled, the two shorter logs will yield a much higher volume of lumber than from the single “bent” log.

Bucking length can be dependent on tree species. Softwoods such as white pine are commonly bucked to even footages (8’,10’,12’,14’,16’) with 2-6 inches additional length per log. The additional length is needed to overcome damage during transport and handling, shrinkage and some end-checking during the drying process, so be sure not to cut trunk logs to exact 2' increments. Hardwoods, probably due to their higher value, are sometimes bucked in single foot increments (8’, 9’, 10’, 11’, etc.) plus the 2-6” of additional trim. Check with your sawmill log buyer for their particular specifications.

In addition to straightness and the lack of defects, both length and diameter influence log value. As noted above, sawmills typically require a minimum log length of 8 feet. Some smaller operators, notably of portable bandsaw mills, may take logs of shorter length, but usually not less than 6 feet. On the other hand, timber framers are an example where long lengths are preferred depending on the species. Douglas Fir is a popular timber framing species in the West and Red Oak and Hemlock are used in the East. Buyers will often pay a premium for long lengths. Not every shade tree will produce adequate length logs, but finding 8' of clear trunk is not as difficult as commonly thought. Of course, handling longer logs requires suitable equipment such as cranes, skid-steers, and log-loaders. Alternatively, working with a local sawmill operator who is willing to pick up logs or mill them on site may also work.

Diameter influences log value in two ways. First, is the volume measure. A “log scale rule” is often used to estimate the volume of sawn lumber that a sawmill is likely to recover from a log of a given length and diameter. Several different log scale rules are in use depending on what region of the U.S. you live in. In the northeast, for example, the International quarter-inch rule is the most popular. Elsewhere, you might find Doyle, Scribner or even a local rule. The volume yield of a log increases exponentially (roughly as diameter-squared) with diameter. For example, using the International quarter-inch rule, a 16 foot log, 12 inches in diameter will yield 95 board-feet of lumber. If the log has twice that diameter (24 inches) the board-foot yield jumps to 425 board feet.

The second effect that diameter can have on log value is the quality of the lumber yielded. Comparing two logs, both without defects, the larger diameter log will yield more wide clear boards. These wide clear boards are given the highest lumber grade and will command the highest price in the marketplace. Comparing wholesale prices for kiln dried hardwoods, for example, the #1 Common grade (#1COM) is discounted on the order of 30%from the highest FAS (Firsts and Seconds) grade depending on the species (Table 1).

Table 1 – Wholesale Prices of Kiln Dried Lumber by Grade and Species

Species	FAS Price ($/bd-ft)	#1COM Price ($/bd-ft)	Difference (%)
Hard Maple	$2.00	$1.40	-30%
Red Oak	$1.80	$1.20	-33%
Yellow Birch	$1.80	$1.20	-33%

Cesa et al. (1994) provide a rough guide for sawlog specs for municipal trees;
Best: 16" minimum diameter and 8ft minimum length,
Good: 14" minimum diameter and 8ft minimum length and
Fair: 12" minimum diameter and 6ft minimum length.

So how does this factor into profit potential for the tree care worker? It is difficult to generalize the conversion of cordwood volumes to sawlog volumes. A reasonable estimate, for comparison purposes, might be to equate 2 cords of fuelwood to 1,000 bd-ft of sawlog volume. Table 2 shows recent pricing for both stumpage (trees still standing) and delivered products comparing cordwood/fuelwood and sawlogs.

Table 2 – Fuelwood vs. Sawlog Pricing

Product	Stumpage Price (1,4)	Delivered Price 2,4)
Cordwood/Fuelwood	$30	$200 (3)
Sawlog - Red Oak	$350	$600
Sawlog - Sugar Maple	$250	$700
Sawlog - White Pine	$90	$300
Sawlog - Yellow Birch	$80	$400

Notes: (1) Stumpage prices are taken from recent Southern New England Stumpage Price Surveys (http://forest.fnr.umass.edu/stumpage.htm)
(2) Delivered prices are estimated from recent mill delivered sawlog prices as reported by Northern Woodlands Magazine (http://www.northernwoodlands.com/mill_prices.html)
(3) Fuelwood delivered prices estimated at $100/cord for cut, split, green, hardwoods.
(4) Prices are listed for equivalent volumes of wood. For cordwood this is the price for 2 cords of material. For sawlogs, prices are give in $ per 1,000 board-feet.

In comparing fuelwood profits to the potential profit from sawlogs, the costs of material handling, storage, and delivery must be taken into effect. Considerably higher prices can be generated from fuelwood by delivering dried material, but this comes at significantly higher material handling, and storage costs.

When trying to get the most value for sawlogs, the arborist should consider several more issues. Both hardwoods and softwoods are susceptible to the growth of fungi and chemical "stain" that can discolor the lumber produced and lower its value. When cutting wood in warm weather, it's best to have logs delivered to a sawmill quickly, within days, not weeks. Frozen conditions delay the progress of stain considerably, and logs can be stored for longer in cold temperatures.

Two additional, "value-added" services that the arborist might want to consider are metal detection and end-coating. The traditional "circular saw" mill, with a fixed base of operations, and typically high volume production, will often refuse to mill urban trees due to the presence of metal (lags, bolts, rods, fence posts) and other debris (concrete and brick) that might be in the trunk. Hitting an embedded metal object can damage equipment, which delays production; it also poses a serious threat of injury. These impacts are somewhat reduced when the sawmilling is performed with a thin-kerf portable bandsawmill. Sawblades are much less expensive for these operations and are easily replaced. Regardless, scanning logs with a metal detector can provide a level of assurance that there are no embedded metal objects in the log. Hand held metal detectors can cost as little as $100, but more typically are in the $200-300 range. This may be a requirement for some sawmills and may make the difference between being able to sell a log for lumber vs. firewood. Check with mills in your area to see if they already have metal detectors installed.

End-coating is achieved by "painting" the ends of freshly cut logs with a sealant that slows the drying process from the ends of logs and helps to prevent checking and end-splits Forest products businesses that are familiar with the kiln-drying process recognize that end splits and checks can reduce the usable length of a sawn board, and lower its grade and value significantly. Hardwoods are particularly susceptible to loss in value through end splitting. Logs and lumber dry fastest through the ends of the logs as opposed to across the grain. Logs that dry too quickly will develop splits, beginning as micro-checks often within 24 hours of felling.

By carefully considering what happens to a log after the tree is felled, arborists can improve their ability to sell this material at a much higher value than that of firewood.
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