



# A regional assessment of urban saw timber quantity and quality for southeast lower Michigan

(How much wood could a woodchuck chuck if it lived in downtown Detroit?)

David W. MacFarlane

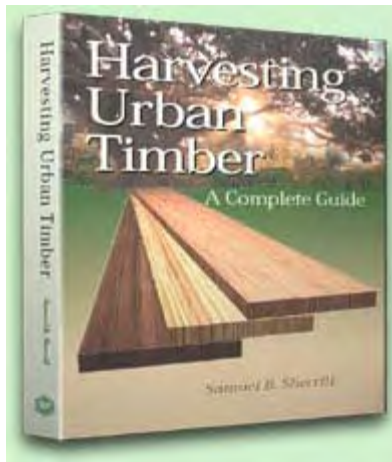
# Acknowledgements

## Funding \$\$\$:

- Jessica Simons, Southeast Michigan Resource Conservation and Development Council
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## Research collaborator:

Sam Sherill,  
University of Cincinnati



## Field Crew:

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Ben Rubin



# Urban forest (tree) values

- Aesthetics / Beautification
- Real Estate Value
- Environmental protection
  - Shade / energy efficiency
  - Air purification (e.g.,  $\text{SO}_2$ ,  $\text{NO}_2$ ,  $\text{O}_3$ )
  - Water purification / water shed protection
  - Carbon sequestration
- Wildlife habitat

# Urban wood utilization

**“Every year in our cities and towns, thousands of trees and the lumber they contain are thrown away in landfills, buried on construction sites, ground up for mulch, or cut for firewood. At the same time, we pay dearly at lumber yards and home centers for many of the hardwoods and softwoods we continue to burn, bury, grind, and throw away.” -Sam Sherill**



AYLES  
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484-8318

*Three Thirty Three*



Gorham Enterprises Inc.



Urban Tree Salvage carries most Ontario grown hardwood species.

Prices quoted in board feet 1bdft = (12" x 12" x 1") / 144"

Pricing is subject to change without notice

Rough sawn unfinished Slabs Mixed Species (2/9/7)

Hard Maple	Grade	4/4	6/4	8/4	WD
	Figured	\$6.00	\$6.75	\$7.60	RW-RL
	#1	\$3.30	\$4.00	\$4.90	RW-RL
	#2	\$2.80	\$3.30	\$4.10	RW-RL
<b>Soft Maple</b>					
	Figured	\$5.80	\$6.50	\$7.00	RW-RL
	#1	\$3.20	\$3.90	\$4.80	RW-RL
	#2	\$2.60	\$3.10	\$3.90	RW-RL
<b>Red Oak</b>					
	Figured	\$7.50	\$8.00	\$9.00	RW-RL
	#1	\$4.75	\$5.50	\$6.00	RW-RL
	#2	\$4.00	\$4.75	\$5.00	RW-RL
<b>White Oak</b>					
	Figured	\$7.75	\$8.25	\$9.25	RW-RL
	#1	\$5.00	\$5.75	\$6.50	RW-RL
	#2	\$4.25	\$5.00	\$5.50	RW-RL
<b>Poplar</b>					
	#1	\$2.90	\$3.50	\$4.00	RW-RL
	#2	\$2.00	\$2.50	\$3.00	RW-RL
<b>Old Growth Pine *</b>					
	#1	\$4.50	\$5.50	\$6.50	RW-RL
<b>Horse Chestnut **</b>					
	Figured	\$6.50	n/a	\$8.50	RW-RL
	#1	\$4.50	n/a	\$6.50	RW-RL
<b>Honey Locust **</b>					
	Figured	\$6.50	n/a	\$8.50	RW-RL
	#1	\$4.50	n/a	\$6.50	RW-RL
<b>Black Locust **</b>					
	Figured	\$6.50	n/a	\$8.50	RW-RL
	#1	\$4.50	n/a	\$6.50	RW-RL



ASH 4  
2' x 17-20" x 102'  
Live edge both sides, nice grain  
\$230

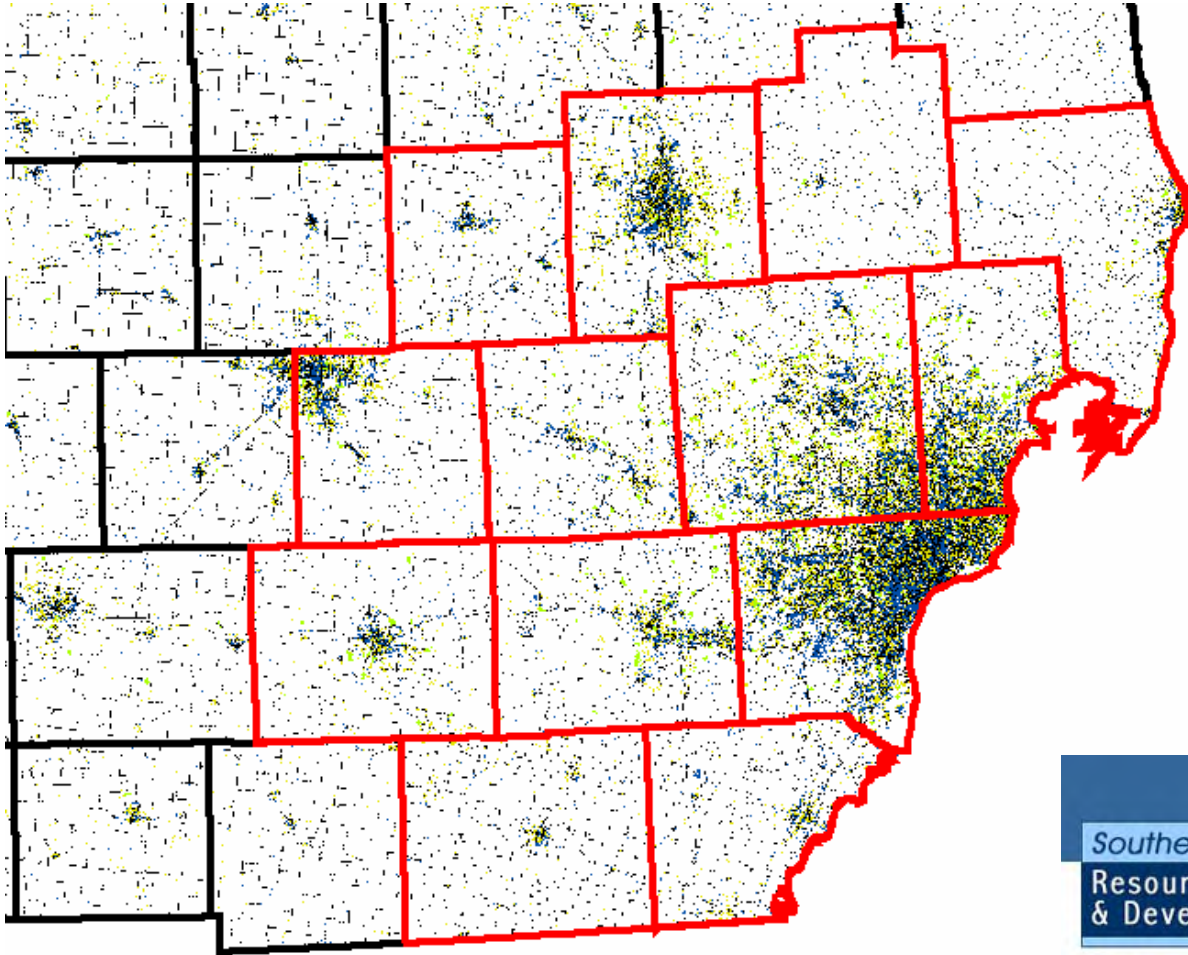
= 26.3 Bd.ft.  
= \$8.77 CD Bd. Ft  
= \$7 U.S. per Bd. Ft

<http://www.urbantreesalvage.com/slabs.html>

# Urban wood: Is it worth the trouble?

- What is the quantity?
- What is the quality?
- How accessible is it?
- Who will buy it?
- How much will they pay for it?
- How does it compare with wood from forests and woodlands?

# Study Area: Urban areas of 13 original EAB quarantine counties in Southeastern Lower MI



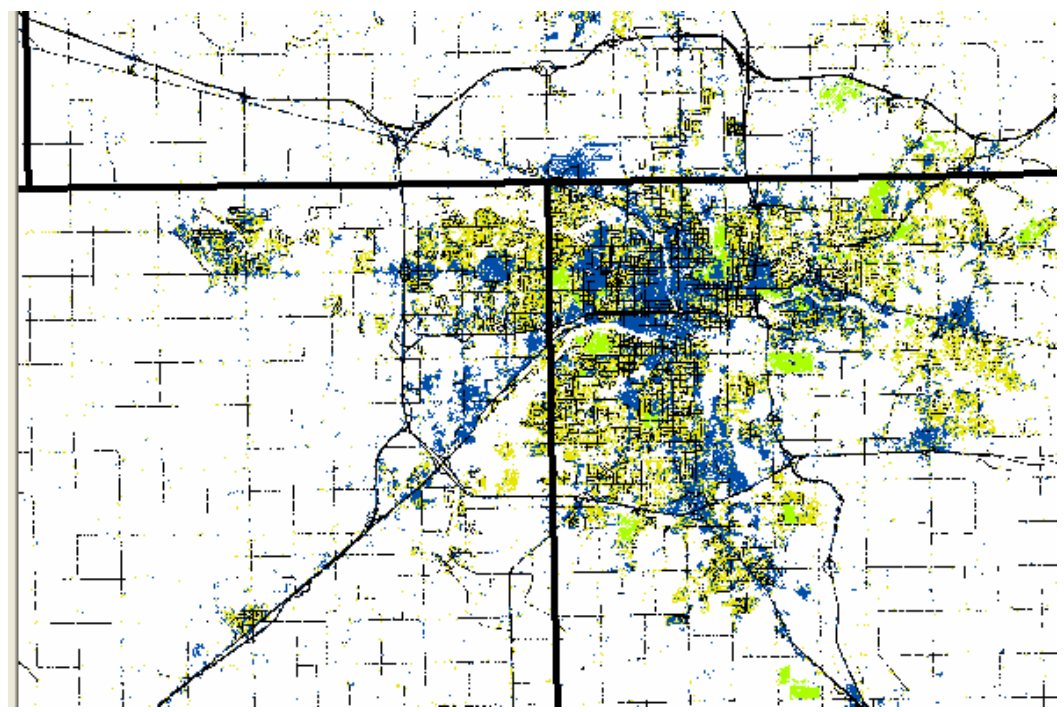
*Southeast Michigan*  
Resource Conservation  
& Development Council







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- Ash Utilization Options

# Defining “Urban” Areas

IFMAP: A Land Use Land Cover Classification  
(LULC) for MI (from 30m Landsat)



Urban LULC classes

-  High Intensity Urban
-  Low Intensity Urban
-  Parks & Golf Courses
-  Roads and parking lots

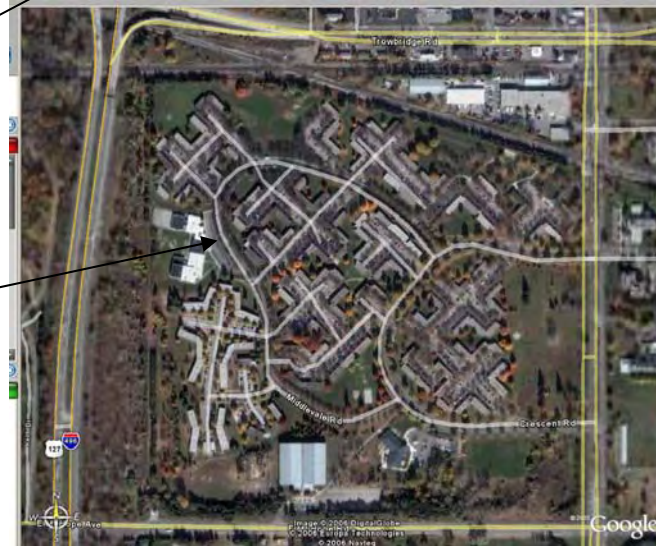
Ex. Lansing, MI



Low Intensity Urban



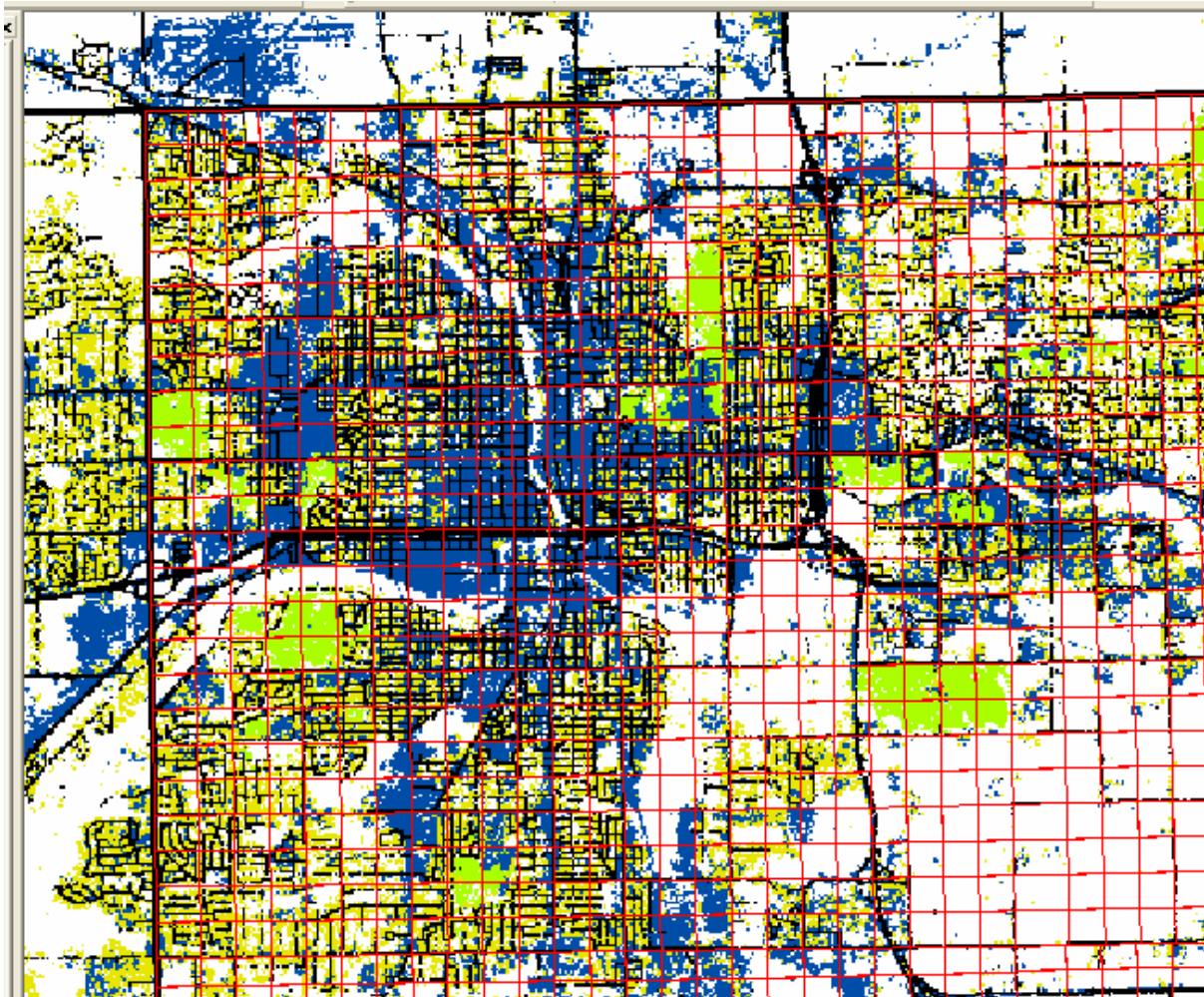
Parks & Golf Courses



High Intensity Urban

Roads and parking lots

# Survey Units (Neighborhoods) were defined as Public land Survey Quarter-Quarter (QQ) sections



- LULC classes
- High Intensity Urban
  - Low Intensity Urban
  - Parks & Golf Courses
  - Roads and parking lots
  - Quarter-Quarter Section

Ex. QQ sections (red grid) over LULC types in NW Ingham Co.

# Sampling Methods

- Randomly selected relatively homogenous urban QQ sections were visited by field crews.
- Field crews systematically laid out variable area rectangles and attempted to measure every tree in the QQ, if possible, over one day.
- Permission to measure trees was obtained on site, to measure all but street trees

# Field Measurements

- Within sample plots within the QQ, sample trees were selected  $\geq 20$  cm (8 in.) stem diameter at breast height (1.37 m (4.5 ft.)).
- Live, dying and standing dead trees were all measured; stumps were measured at stump height (typically about 10 to 20 cm (4 to 8 in.)) above ground level.
- On each tree selected, the following was recorded for estimating saw timber quantity, quality and accessibility:
  - species (if identifiable, e.g., on stumps and dead trees),
  - stem diameter (at breast or stump height as above),
  - total tree height
  - total saw timber log length in the main stem to an approximately 20 cm top diameter outside bark (DOB) (measured with a Wheeler® pentaprism).
  - If the main stem forked, the largest of the forks was followed to assess merchantable height, the other forks were considered part of the crown's branches.
    - The number of 2.4 m (8 ft.) “crown logs” in a tree’s crown with a minimum 20 cm small end diameter DOB in the tree’s crown were tallied .



# Assessing Quality

Used grading system compatible with standards for grading trees in the forest:

\*Hardwoods (Rast et al 1973).

\*Softwoods (Avery and Burkhart, 1994).

And compatible with USDA Forest Inventory and Analysis (FIA).

grade code	hardwood grade	softwood grade	FIA grade
0	no saw value	no saw value	0
1	factory 1	grade 1	1
2	factory 2	grade 2	2
3	factory 3	grade 3	3
4	construction		4
5	local		5

Figure 6.—Selecting the grading face.



From Rast et al. 1973

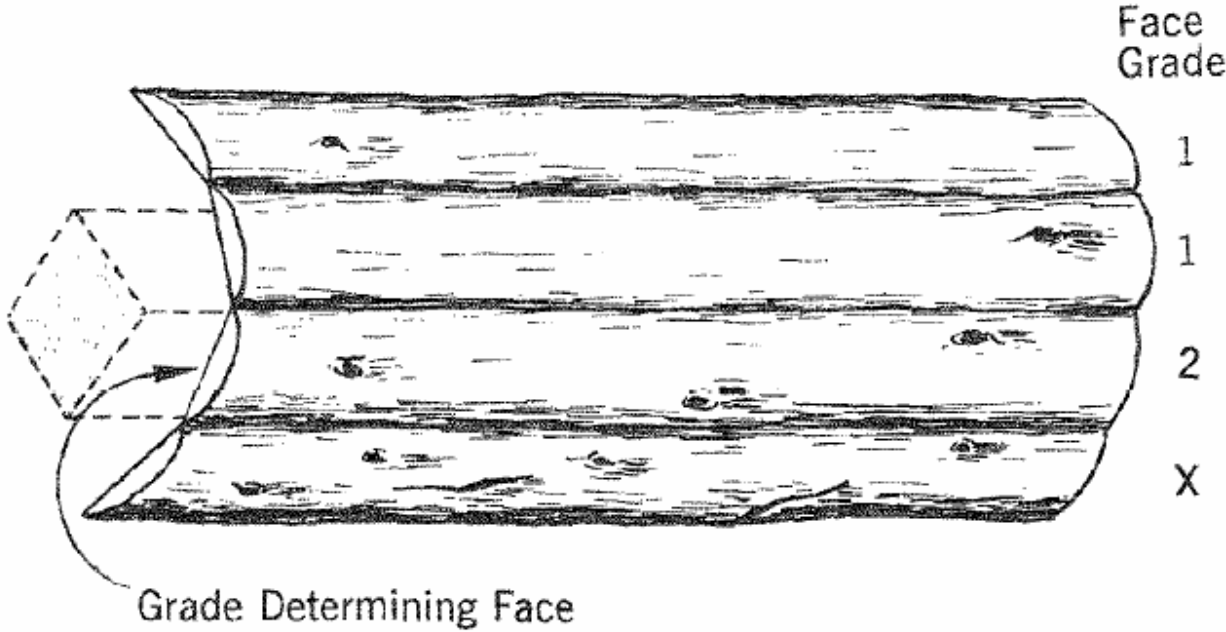


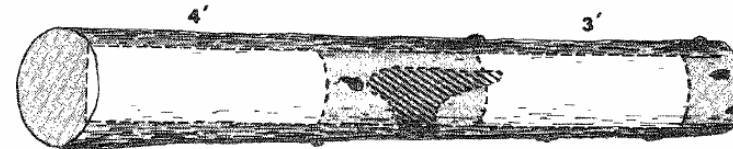
Figure 7.—Examples of hardwood factory grade 1 logs.

Factory grade 1 (code = 1)



Position ..... Butt log  
 Size ..... Length 16', diameter 13" at small end  
 Straightness ..... Straight  
 Soundness ..... Sound  
 Cuttings ..... More than 5/6 of its grading-face length is clear  
 in two sections 7 and 8 feet long

Factory grade 3 (code = 3)



Position ..... Upper log  
 Size ..... Length 12', diameter 14" at small end  
 Straightness ..... Straight  
 Soundness ..... 15 percent rot deduction (less than 50 percent  
 maximum permitted)  
 Cuttings ..... More than 1/2 of its grading-face length is clear in  
 two sections, 4 and 3 feet long  
 Comments ..... Interior rot outside the rot zone limits cuttings

From Rast et al. 1973

Local use class (code = 5)



A 16-foot log 18 inches in diameter at the small end. It does not have the cuttings required for a factory log. Although it is sound, several knots are too large for the construction class.

# Grading Trees



Looking for defects



# Species-Product group assignments

For analysis:

- Trees were assigned to coarse and fine species-product groups consistent with those used by USDA Forest Service
- Species not listed by USDA were assigned to classes based on wood characteristics with assistance from Dr. Pascal Kamdem, MSU Dept. of Forestry

Exs.

non-commercial

apple	Malus spp.
ornamental cherry / plum	Prunus spp.
gingko	Ginkgo biloba
hawthorn	Crataegus spp.
mountain ash, American	Sorbus americana
pear, callery	Pyrus calleryana
olive-tree, Russian	Elaeagnus angustifolia
Tree-of-heaven	Ailanthus altissima
willow	Salix spp.
willow, black	Salix nigra

other soft hardwoods

buckeye	Aesculus spp.
catalpa, Northern	Catalpa speciosa
cherry, black	Prunus serotina
elm, American	Ulmus americana
elm, Siberian	Ulmus pumila
hackberry	Celtis occidentalis
horsechestnut	Aesculus hippocastanum
planetree, London	Platanus acerifolia
mulberry, red	Morus rubra
sassafras	Sassafras albidum
sweetgum	Liquidambar styraciflua
sycamore	Platanus occidentalis

# Accessibility

- Easily accessible = tree could be cut into relatively long sections and could be felled with minimal risk of property damage; cut sections could be loaded readily onto a vehicle for transport.
- Moderately accessible = tree could be cut into merchantable-length sections, but would require additional effort to access, with enhanced risk of property damage; cut sections would have to be transported a modest distance to be loaded onto a vehicle for transport (a truck could not drive up near the tree).
- Difficult to access = much of the tree would have to be cut into sub-merchantable lengths to remove and/or trees could not be accessed without major effort (e.g., a large tree build into a deck) or a high likelihood of property damage.

# Hazards

- The distance to the nearest hazard was measured from each tree
- The type of hazard was noted.



# Scaling up individual tree estimates to the 13-county region

Expansion factors were estimated for sample tree to scale that trees value up to the landscape, based on:

- The size of the sample plot it occurred in.

- The abundance of the urban land cover type it occurred in.

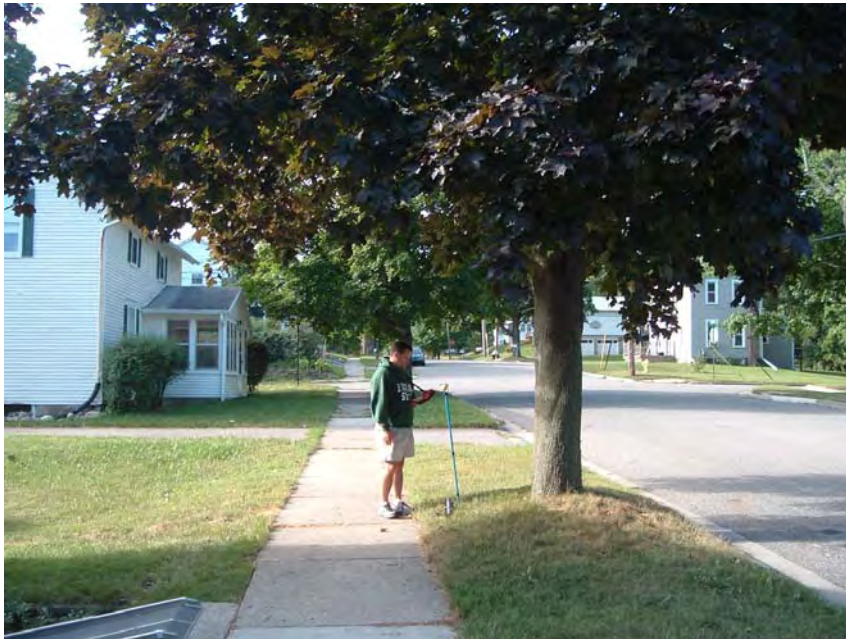




<i>County</i>	Area (acres)	Parks & Golf Courses	High Intensity Urban	Low Intensity Urban	Roads and Paved Areas		% Urban	% Non-urban
					urban	other		
Wayne	411,211	2.24%	15.29%	13.17%	5.72%	14.37%	36.42%	63.58%
Macomb	309,636	1.99%	8.62%	10.53%	2.13%	9.01%	23.27%	76.73%
Oakland	580,232	1.89%	5.93%	8.72%	1.33%	7.72%	17.87%	82.13%
Genessee	415,461	0.60%	4.06%	6.69%	0.69%	5.75%	12.04%	87.96%
Ingham	358,567	0.54%	3.16%	3.32%	0.33%	4.70%	7.34%	92.66%
Washtenaw	461,991	0.93%	2.14%	2.65%	0.22%	4.38%	5.94%	94.06%
Livingston	374,406	0.55%	1.77%	2.26%	0.16%	3.88%	4.74%	95.26%
Monroe	356,832	0.07%	2.12%	2.08%	0.20%	4.60%	4.47%	95.53%
Jackson	462,664	0.55%	1.08%	2.31%	0.12%	3.49%	4.05%	95.95%
St. Clair	470,307	0.22%	1.20%	2.02%	0.12%	3.61%	3.56%	96.44%
Shiawasee	345,939	0.05%	1.18%	1.18%	0.09%	3.90%	2.51%	97.49%
Lenawee	486,910	0.00%	0.71%	1.29%	0.07%	3.66%	2.08%	97.92%
Lapeer	424,015	0.05%	0.40%	1.18%	0.04%	2.40%	1.66%	98.34%
13-county area	5,458,172	0.77%	3.61%	4.44%	0.51%	5.82%	9.32%	90.68%

Spatial weights for extrapolating to the LULC Map

# Results



# Wood Quality?

	Saw timber grade	
	Grade 0	Grades 1-5
<u>Softwoods</u>	56%	44%
<u>Hardwoods</u>	35%	65%
<u>Non-commercial</u>	73%	27%
All	31%	69%

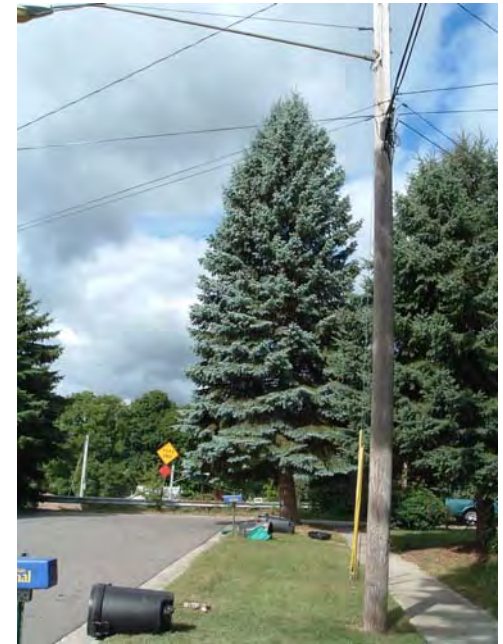
“Non-commercial” species were not automatically assigned no saw timber value

# Softwood quality

- Grading rules focus on size and integrity of branch knots
- Softwood quality was low in urban trees due to large lower branches from open growth form



Knotty Scot's Pine on a golf course near Jackson, MI



*Picea pungens* as a street tree in Mason, MI.

# Hardwood Quality

- Mainly reduced due to defects in the main stem
- The majority of large urban trees had at least one gradable log in the main stem



# Urban Stock Table by Grade



Spp-product group	Grade					All grades	% of total
	1	2	3	4	5		
	(board feet per acre)						
<u>Softwoods</u>							
spruce fir		0.23	29.87	na	na	30.09	57.10%
white-red pine		0.41	12.64	na	na	13.05	24.77%
other pine	0.94	2.20	1.89	na	na	5.02	9.52%
other soft			4.08	na	na	4.08	7.75%
Doug-fir			0.45	na	na	0.45	0.86%
All softwoods	0.94	2.83	48.93	na	na	52.70	9.54%
<u>Hardwoods</u>							
soft maple	0.40	8.41	11.49	0.92	93.44	114.66	23.09%
poplar	27.79	16.33	30.61	0.40	4.48	79.61	16.03%
red oak	4.25	12.24	28.48	2.32	27.44	74.73	15.05%
ash	11.55	10.17	2.68	2.08	30.14	56.62	11.40%
other soft hard	1.90		11.85	2.50	25.89	42.15	8.49%
white oak	2.41	1.71	16.70	4.44	14.15	39.41	7.94%
hickory		0.18	12.08	4.11	3.27	19.65	3.96%
walnut	2.99	8.42	2.78		3.59	17.78	3.58%
other hard hard	0.72	1.27	3.60	1.31	10.22	17.12	3.45%
hard maple	0.17	1.84	4.37	2.05	7.44	15.87	3.20%
basswood	1.84	2.28	0.27		7.68	12.07	2.43%
birch					6.97	6.97	1.40%
yellow poplar			0.01			0.01	0.00%
All hardwoods	54.03	62.85	124.92	20.15	234.72	496.67	89.94%
<u>Non-commercial</u>	0.00	1.03	0.81		0.99	2.83	0.51%
All spp-product classes	54.97	66.72	174.67	20.15	235.70	552.20	100.00%
% of total	9.95%	12.08%	31.63%	3.65%	42.68%	100.00%	

Ash ~10%  
of all urban  
saw timber  
in study  
area.

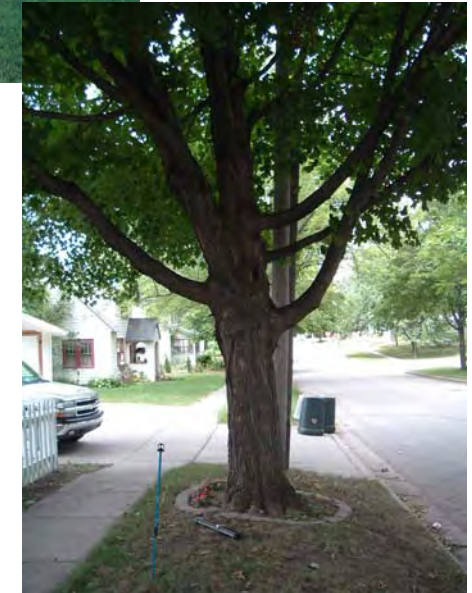
spp-product group	Bole wood	Crown wood	All saw timber	% bole	% branches
	(board feet per acre)				
<u>Softwoods</u>					
spruce fir	30.09	0.00	30.09	100.00%	0.00%
white-red pine	13.05	0.32	13.37	97.63%	2.37%
other pine	5.02	0.12	5.14	97.58%	2.42%
other soft	4.08	0.02	4.10	99.53%	0.47%
Doug-fir	0.45	0.00	0.45	100.00%	0.00%
All softwoods	52.70	0.46	53.16	99.13%	0.87%
<u>Hardwoods</u>					
soft maple	114.66	41.35	156.01	73.50%	26.50%
poplar	79.61	5.86	85.47	93.14%	6.86%
red oak	74.73	0.00	74.73	100.00%	0.00%
ash	56.62	1.62	58.24	97.21%	2.79%
other soft hard	42.15	5.06	47.21	89.29%	10.71%
white oak	39.41	5.97	45.38	86.84%	13.16%
other hard hard	17.12	4.25	21.37	80.12%	19.88%
hickory	19.65	1.52	21.17	92.82%	7.18%
walnut	17.78	0.37	18.15	97.96%	2.04%
hard maple	15.87	1.42	17.30	91.77%	8.23%
basswood	12.07	2.09	14.17	85.22%	14.78%
birch	6.97	0.24	7.21	96.70%	3.30%
yellow poplar	0.01	0.00	0.01	100.00%	0.00%
All hardwoods	496.67	69.76	566.43	87.68%	12.32%
<u>Non-commercial</u>	2.83	1.16	3.99	70.90%	29.10%
All spp-product classes	552.20	71.38	623.59	88.55%	11.45%

Urban trees had  
“crown logs”  
which were not  
graded



Silver maple with crown  
logs

# Accessibility?



LULC	accessibility class		
	easy	moderate	difficult
High Intensity Urban	68.9%	27.8%	3.3%
Low Intensity Urban	35.1%	15.0%	49.9%
Parks & Golf Courses	93.5%	6.0%	0.5%
Roads and Paved Areas	89.8%	8.1%	2.1%
All grades	56.1%	16.2%	27.7%

### Mean distance to hazard

Urban land type	Distance (feet)
High intensity urban	23.5
Low intensity urban	15.9
Parks and golf courses	29.8
Roads and parking lots	22.6
All	23.6



Hazard type	% total	cum. %
building	23.28%	23.28%
fence / wall	21.20%	44.48%
other	12.58%	57.06%
utility pole	9.77%	66.83%
sign	6.08%	72.91%
light pole	4.92%	77.82%
no hazard	4.69%	82.51%
garage/carport	3.91%	86.43%
deck	3.29%	89.72%
fuel tank / utility box	2.51%	92.22%
fire hydrant	2.50%	94.73%
shed	1.67%	96.40%
porch / patio	1.51%	97.91%
mailbox	0.95%	98.86%
playground / athletic equipment	0.83%	99.69%
pool	0.19%	99.88%
garden	0.10%	99.99%
well	0.01%	100.00%
All Hazards	0.00%	

# Availability?

Only random (or sometimes clustered) **dead** trees become available for harvest.

Genus	cum %	% of urban trees per acre (20 cm DBH+)			
		live	ill	stump	dead
Acer	31.1%	93.4%	4.2%	2.2%	0.3%
Pinus	11.5%	90.3%	4.9%	4.8%	0.0%
Picea	11.5%	95.7%	3.7%	0.1%	0.4%
Quercus	9.7%	97.2%	1.8%	0.2%	0.8%
Fraxinus	8.7%	62.8%	33.6%	3.5%	0.2%
Gleditsia	4.6%	96.1%	3.9%	0.0%	0.0%
Populus	3.1%	89.5%	9.8%	0.0%	0.7%
Carya	3.1%	99.5%	0.5%	0.0%	0.0%
Juglans	2.5%	100.0%	0.0%	0.0%	0.0%
Betula	2.4%	100.0%	0.0%	0.0%	0.0%
Ulmus	2.2%	84.0%	11.9%	2.8%	1.3%
Prunus	1.9%	92.9%	0.8%	6.4%	0.0%
Tilia	1.7%	100.0%	0.0%	0.0%	0.0%
Thuja	1.3%	100.0%	0.0%	0.0%	0.0%
Pyrus	0.8%	100.0%	0.0%	0.0%	0.0%
Platanus	0.7%	100.0%	0.0%	0.0%	0.0%
Elaeagnus	0.5%	93.3%	0.0%	0.0%	6.7%
Salix	0.4%	45.1%	54.9%	0.0%	0.0%
Celtis	0.3%	100.0%	0.0%	0.0%	0.0%
Aesculus	0.3%	98.2%	1.8%	0.0%	0.0%
Ailanthus	0.3%	100.0%	0.0%	0.0%	0.0%
Morus	0.2%	60.6%	19.7%	19.7%	0.0%
Ginkgo	0.2%	100.0%	0.0%	0.0%	0.0%
Pseudotsuga	0.2%	100.0%	0.0%	0.0%	0.0%
Liquidambar	0.2%	100.0%	0.0%	0.0%	0.0%
Juniperus	0.2%	59.1%	40.9%	0.0%	0.0%
Castanea	0.1%	100.0%	0.0%	0.0%	0.0%
Catalpa	0.1%	100.0%	0.0%	0.0%	0.0%
Malus	0.1%	82.6%	17.4%	0.0%	0.0%
Sassafras	0.1%	100.0%	0.0%	0.0%	0.0%
Robinia	0.1%	100.0%	0.0%	0.0%	0.0%
Crataegus	0.0%	100.0%	0.0%	0.0%	0.0%
Abies	0.0%	53.8%	0.0%	46.2%	0.0%
Sorbus	0.0%	100.0%	0.0%	0.0%	0.0%
Taxodium	0.0%	100.0%	0.0%	0.0%	0.0%
Liriodendron	0.0%	100.0%	0.0%	0.0%	0.0%
All Genera		91.4%	6.5%	1.8%	0.3%



Dead ash in Ann Arbor, MI

Photo source: <http://www.semircd.org/>

# Regional urban sawtimber quantity

County	saw timber volume (board feet, INT1/4" rule)		
	total standing	accessible	annual yield
Genessee	31,187,412	22,454,937	449,099
Ingham	16,417,831	11,820,838	236,417
Jackson	11,696,327	8,421,356	168,427
Lapeer	4,399,305	3,167,499	63,350
Lenawee	6,301,012	4,536,729	90,735
Livingston	11,068,852	7,969,573	159,391
Macomb	44,923,999	32,345,279	646,906
Monroe	9,934,479	7,152,825	143,057
Oakland	64,661,764	46,556,470	931,129
Shiawasee	5,410,284	3,895,405	77,908
St. Clair	10,436,080	7,513,978	150,280
Washtenaw	17,116,001	12,323,521	246,470
Wayne	93,373,938	67,229,235	1,344,585
13-county area	326,927,283	235,387,644	4,707,753

\*326 million standing board feet

\*72% accessible (not difficult)

\*2% removals standing dead per year (modified from Nowak et al 2004).



# Comparisons with forest-grown trees

- MI DNR Timberlands 641 trees with saw logs (MacFarlane 2004, 2005a and b).
- FIA data, MI 2004, statewide coverage, thousands of plots, hundreds of thousands of trees.

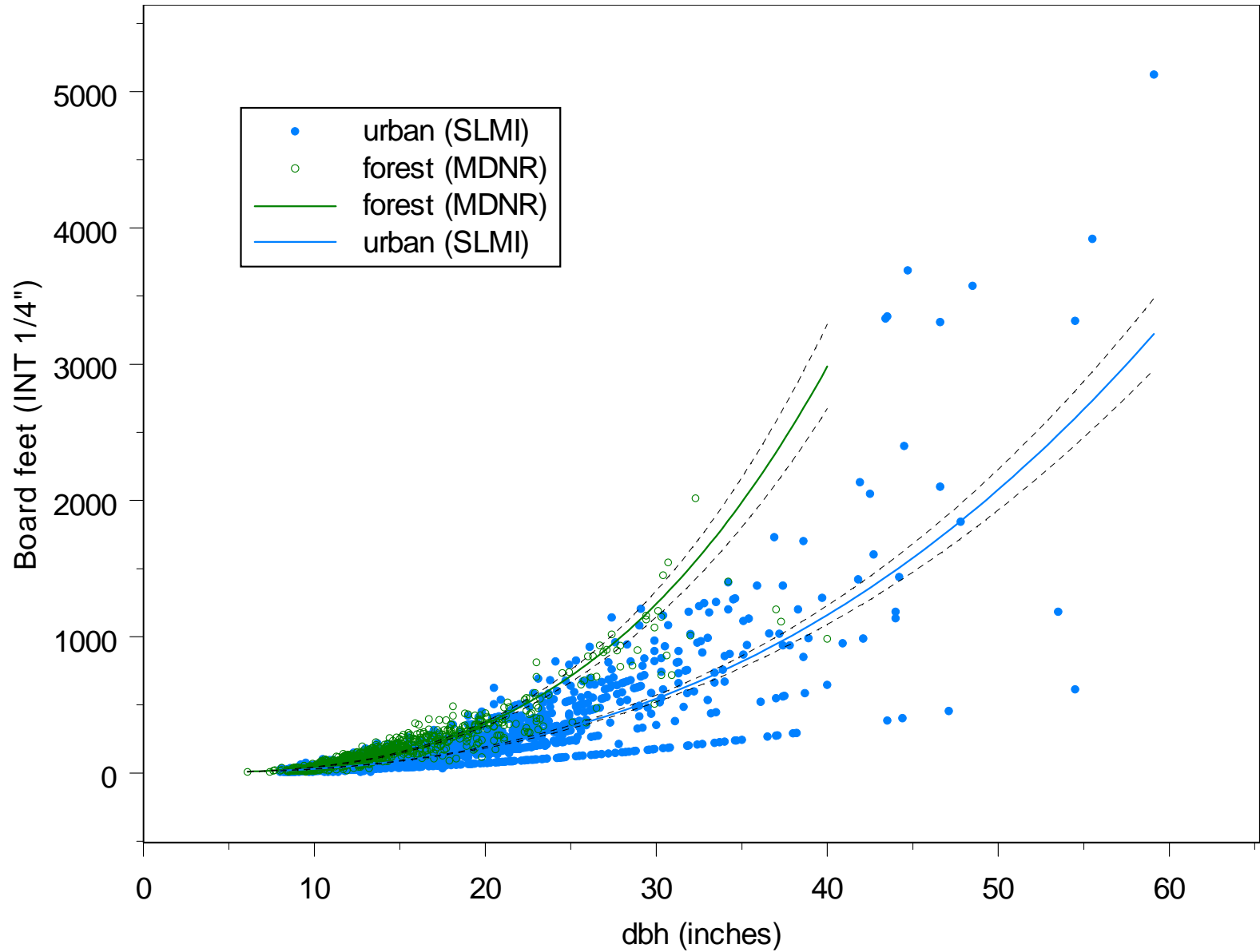


# Anatomy of an urban timber tree

Urban timber trees are shorter, fatter, with shorter log lengths.

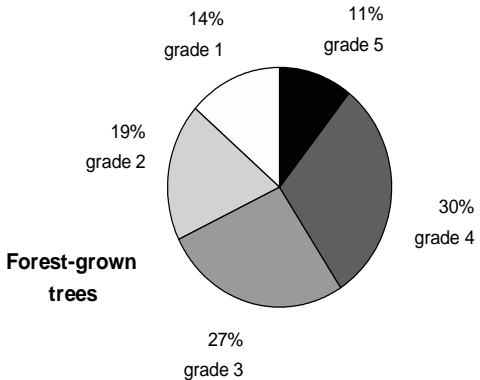
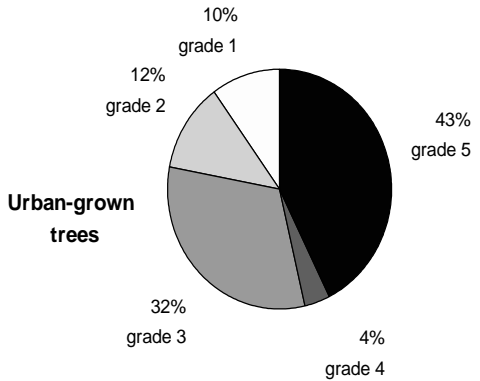
	tree statistics		
	<u>mean</u>	<u>min</u>	<u>max</u>
n	<u>1,793 urban trees (SLMI)</u>		
DBH	16.9	8.0	59.1
Total Height	47.5	14.0	133.5
Height to 8" top diam.	16.6	4.0	89.7
Merchantability ratio	0.35	0.29	0.67
Board feet	150.6	8.4	5,124.9
n	<u>641 forest trees (MDNR)</u>		
DBH	14.8	6.1	40.0
Total Height	77.0	34.9	113.2
Height to 8" top diam.	34.0	4.0	88.3
Merchantability ratio	0.44	0.11	0.78
Board feet	201.8	7.3	2,016.8





# National forest Inventory comparison (FIA data) in Southern Lower MI

	Forest	vs.	Urban
<u>Quantity</u>			
Bd. ft. acre <sup>-1</sup>	5,055		552
<u>Quality</u>			
Factory			
Grades 1-3	53%		59%
Local use			
Grades 4-5	47%		41%



# Conclusions

- Overall about 69% of wood in all urban trees  $\geq 8$ " DBH was saw grade.
- The quality of urban softwoods was generally low.
- Most urban saw timber (~90%) inventoried came from commercially viable hardwood timber species, 60% of which was considered saw grade quality. Comparable in quality to wood from forest-grown trees, except with much lower volumes in a tree.
  - However, urban wood may have potentially lower strength due to open-growth form (a greater quantity of juvenile wood); this needs further research.
- The potentially available wood in the 13 counties studied could support the minimum annual needs of 5 small saw mills.
  - The 4.7 million bd.ft. of lumber annually available is equivalent to the amount of wood used to build 362 average-sized homes.
- If SE Lower Michigan is similar to other regions nationwide, a substantial amount of saw timber is available from trees in urban areas.

# Remember.....



## Own a piece of Toronto's history today

This coffee table was created from a combination of a Douglas Fir top salvaged from the Liberty Market Building in downtown Toronto circa 1930's and the base from the historic Queen's Wharf old growth pine circa 1830's.

Dimensions: 20" x 56" x 16" h

Price: \$490

An additional coffee and 2 end tables available. Please inquire

## “Urban wood has a story”

-Anthony Weatherspoon

# Questions?

