The Value of Greenspace:

Tree Planting Strategies for Stormwater Management

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Proven Solutions for a Growing World

Aesthetics:

"Cutting down trees spoils the beauty of the landscape…"

Wildlife habitat:

"There are few birds where there are no trees…"

Flood control:

"We might have dangerous floods if we did not have trees…"

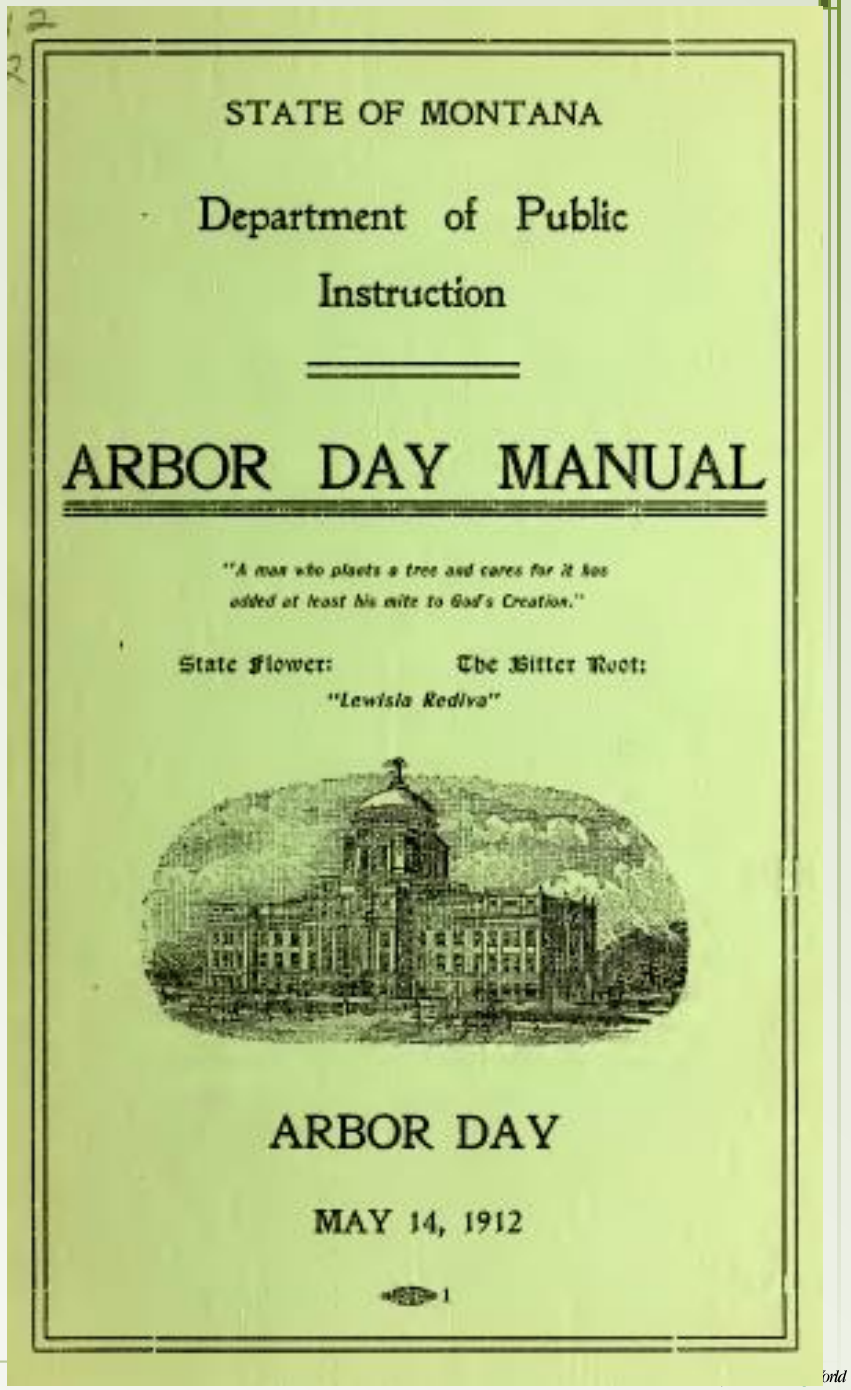
"The leaves of trees catch the rain and hold it..."

"…the moisture that should sink into the soil is carried away in the floods."

Climate change:

Without forests…"we have severe droughts every year."

"We should have greater extremes of heat and cold if it were not for the trees and forests. "


STATE OF MONTANA

Department of Public Instruction

ARBOR DAY MANUAL

"A man who plants a tree and cares for it has added at least his mite to God's Creation."

State Flower: The Bitter Root: *"Lewisia Rediva"*

ARBOR DAY

MAY 14, 1912

1

The future of urban forestry "will rely less upon new knowledge of how to care for trees than it will upon new knowledge of **how trees help to care for people.**"

- Fred Bartenstein, 1981

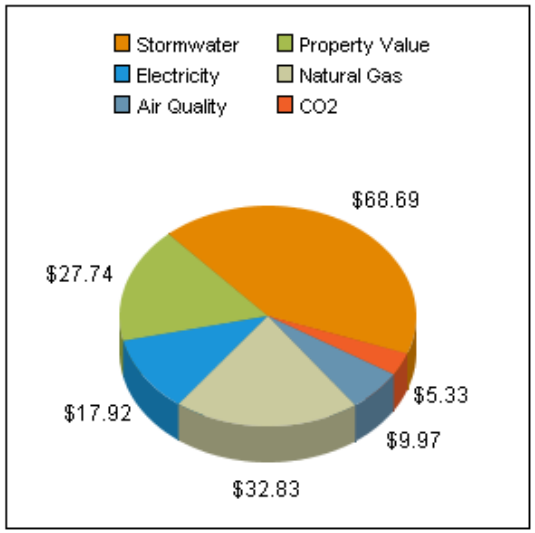
TreeBenefits.org

Home Calculate another tree

National Tree Benefit Calculator

Beta

Overal Benefits | Storm Water | Property Value | Energy | Air Quality | CO2 | About the Model



Breakdown of your tree's benefits
Click on one of the tabs above for more detail

This **24 inch Northern red oak** provides overall benefits of: $162 every year.

While some functional benefits of trees are well documented, others are difficult to quantify (e.g., human social and communal health). Trees' specific geography, climate, and interactions with humans and infrastructure is highly variable and makes precise calculations that much more difficult. Given these complexities, the results presented here should be considered initial approximations—a general accounting of the benefits produced by urban street-side plantings.

Benefits of trees do not account for the costs associated with trees' long-term care and maintenance.

If this tree is cared for and grows to 29 inches, it will provide $170 in annual benefits.

Northern red oak
Quercus rubra

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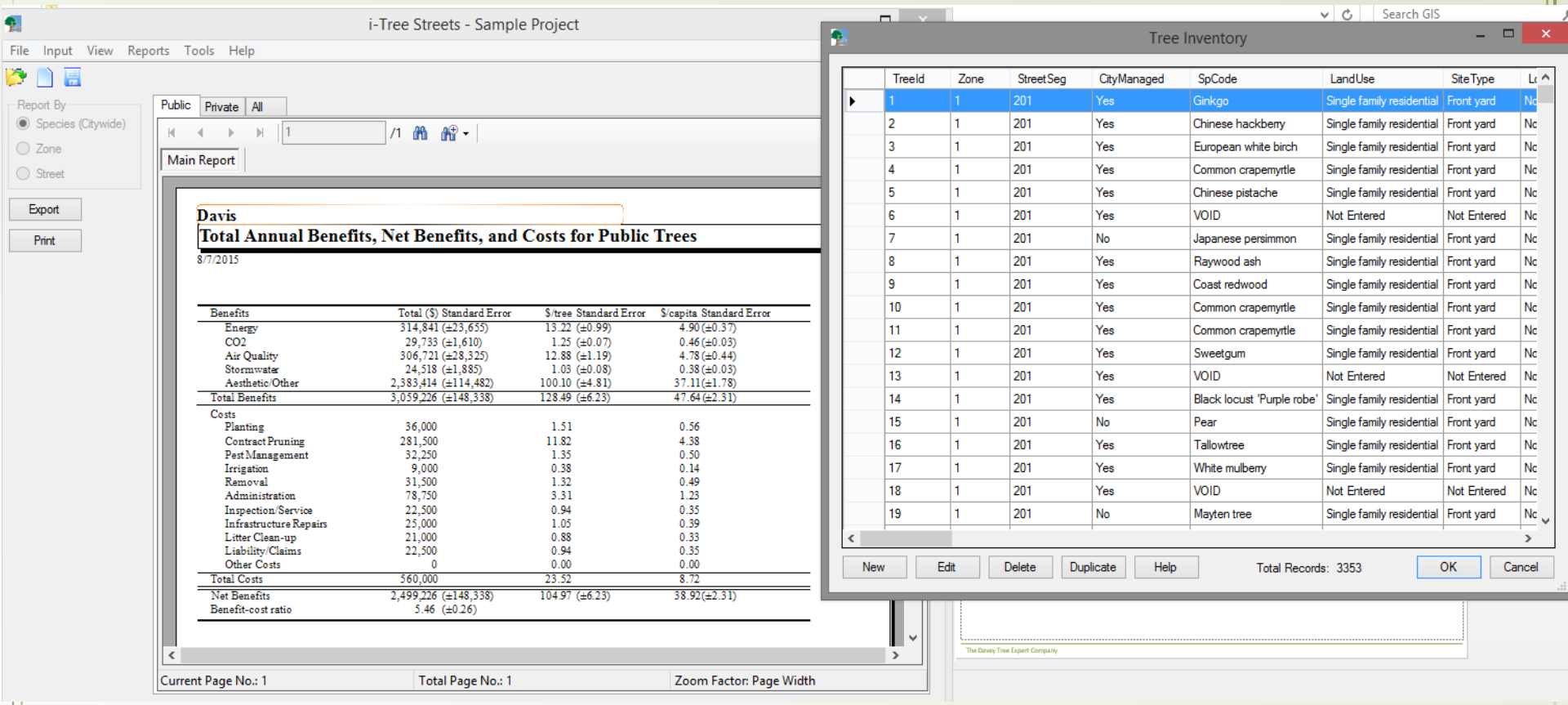
i-Tree Streets



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i-Tree Canopy

Id	Cover Class	Latitude	Longitude
1	Tree	44.01722	-92.48100
2	Tree	44.01749	-92.47942
3	Tree	44.01927	-92.47934
4	Non-Tree	44.02057	-92.46959
5	Tree	44.02531	-92.47215
6	Tree	44.01732	-92.47951
7	Tree	44.01836	-92.48373
8	Non-Tree	44.01816	-92.48194
9	Non-Tree	44.01850	-92.46749
10	Non-Tree	44.02010	-92.46582

Page 1 of 31 View 1 - 10 of 30

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i-Tree Canopy

Tree Benefit Estimates

Abbr.	Benefit Description	Value	±SE	Amount	±SE
CO	Carbon Monoxide removed annually	$13.50	±1.35	20.33 lb	±2.03
NO2	Nitrogen Dioxide removed annually	$47.46	±4.74	193.88 lb	±19.38
O3	Ozone removed annually	$1,461.49	±146.07	1,279.75 lb	±127.90
PM2.5	Particulate Matter less than 2.5 microns removed annually	$2,518.92	±251.75	59.72 lb	±5.97
SO2	Sulfur Dioxide removed annually	$1.10	±0.11	22.71 lb	±2.27
PM10*	Particulate Matter greater than 2.5 microns and less than 10 microns removed annually	$2,046.93	±204.58	655.40 lb	±65.50
CO2seq	Carbon Dioxide sequestered annually in trees	$2,948.42	±294.68	152.27 T	±15.22
CO2stor	Carbon Dioxide stored in trees (Note: this benefit is not an annual rate)	$99,010.25	±9,895.50	5,113.28 T	±511.04

i-Tree Canopy Annual Tree Benefit Estimates based on these values in lbs/acre/yr and $/T/yr: CO 0.500 @ $1,333.50 | NO2 4.766 @ $491.34 | O3 31.460 @ $2,292.12 | PM2.5 1.468 @ $84,658.02 | SO2 0.558 @ $96.84 | PM10 16.112 @ $6,268.44 | CO2seq 7,486.286 @ $19.43 | CO2stor is a total biomass amount of 251,395.359 @ $19.43*

Note: Standard errors of removal amounts and benefits were calculated based on standard errors of sampled and classified points.

About i-Tree Canopy

The concept and prototype of this program were developed by David J. Nowak, Jeffery T. Walton and Eric J. Greenfield (USDA Forest Service). The current version of this program was developed and adapted to i-Tree by David Ellingsworth, Mike Binkley, and Scott Maco (The Davey Tree Expert Company).

Limitations of i-Tree Canopy

The accuracy of the analysis depends upon the ability of the user to correctly classify each point into its correct class. As the number of points increase, the precision of the estimate will increase as the standard error of the estimate will decrease. If too few points are classified, the standard error will be too high to have any real certainty of the estimate.

A Cooperative Initiative Between:

DAVEY Arbor Day Foundation sma ISA Casey Trees

www.itreetools.org

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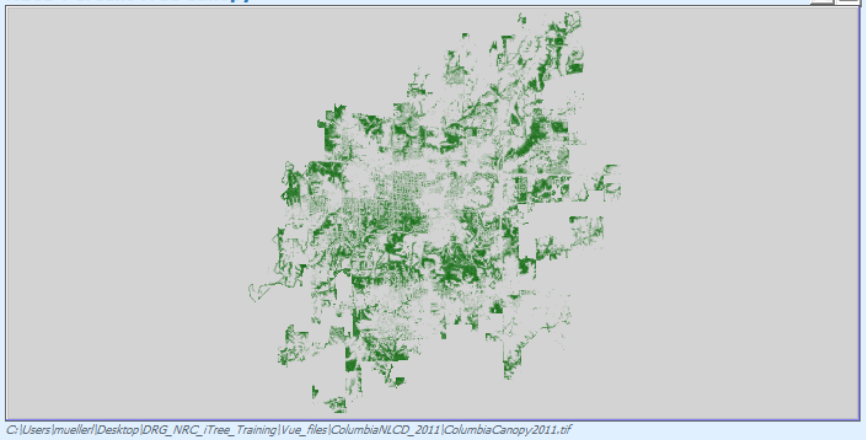
i-Tree VUE

NLCD Land Cover

C:\Users\mueller\Desktop\DRG_NRC_iTree_Training\Vue_files\ColumbiaNLCD_2011\ColumbiaTreeCov2011.tif

NLCD Percent Tree Canopy



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NLCD Statistics

NLCD Image Area:
40,608.0 acres

Tree Canopy (TC):
8,529.5 acres
21.2 %

Impervious Cover (IC):
8,950.5 acres
22.2%

Developed (all):
21,863.6 acres
53.8 %
TC: 11.2% IC: 40.9%

Forest (all):
10,176.6 acres
25.1 %
TC: 53% IC: 0%

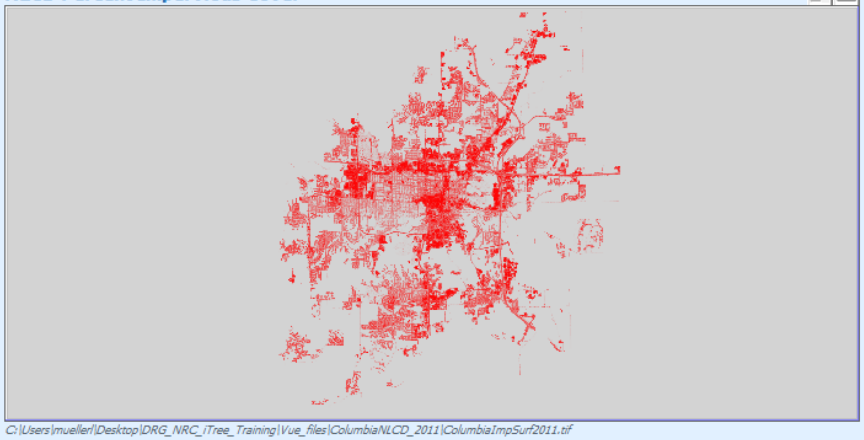
Wetlands (all - wet1 & 2 tabs):
559.8 acres
1.4 %
TC: 41.6% IC: 0%

Agriculture (all):
7,117.5 acres
17.5 %
TC: 5.5% IC: 0%

Miscellaneous (all):
610.0 acres
1.5 %
TC: 10.5% IC: 0.2%

Water:
280.4 acres
0.7 %

NLCD Percent Impervious Cover



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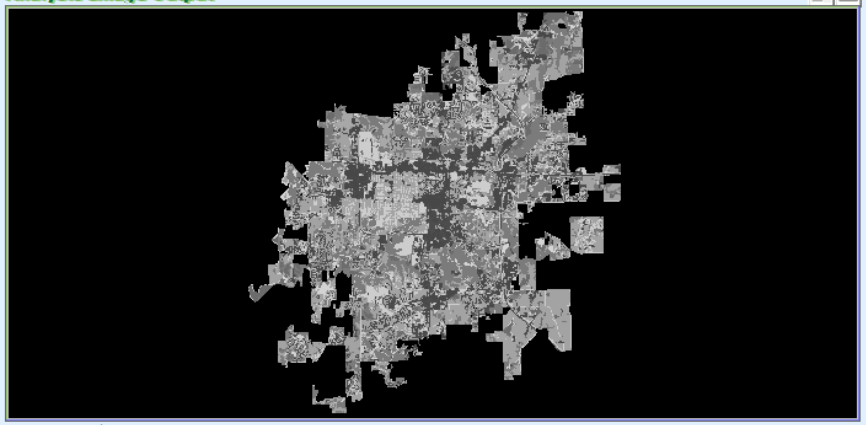
Analysis Image Output



Output Not Saved Yet.

GoogleFind | GoogleVue | Units: U.S.

Save Output | Reset Output | Analysis Optio

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i-Tree Hydro

i-Tree Hydro Executive Summary

Project Location: Holland, Michigan
Project Time Span: 01/01/2005 - 12/30/2005

Model Parameters

Watershed Area	Rainfall	Total Runoff	Stream Gage	Weather Station
square kilometers	*millimeters*	*cubic meters*		
171.28	599.69	25,699,407.15	04108801	725394-99999

Land Cover	Base	Alternative		Base	Alternative	LC beneath Tree Cover	Base	Alternative
Tree Cover %	23.0		Tree LAI	5.0		Soil Cover %	61.0	
Shrub Cover %	0.0		Shrub LAI	2.2		Impervious Cover %	39.0	
Herbaceous Cover %	35.0		Herbaceous LAI	1.6				
Water Cover %	3.0							
Impervious Cover %	39.0		Directly Connected Impervious Cover (%)	40.0				
Soil Cover %	0.0							

Streamflow Predictions

	Total Runoff		Baseflow		Pervious Flow	
	Base	Alternative	Base	Alternative	Base	Alternative
Total Flow (cubic meters)	25,699,407.2		2,916,787.2		7,189,472.4	
Highest Flow (cubic meters / hour)	1,231,611.1		1,343.7		794,562.8	
Lowest Flow (cubic meters / hour)	280.2		280.2		0.0	
Highest Flow Date	11/06/05		01/01/05		11/06/05	
Lowest Flow Date	09/28/05		09/28/05		01/01/05	
Median Flow (cubic meters / hour)	340.2		338.2		0.0	
Number of flow events ABOVE median flow	37.0		10.0		17.0	
Average length of flow events with flow ABOVE median (hours)	117.1		464.6		170.6	
High Flow: Number of flow events ABOVE 1 standard deviation	27.0		1.0		11.0	
Average length of flow events ABOVE 1 standard deviation (hours)	155.1		655.0		201.7	
Number of flow events BELOW median flow	36.0		9.0		0.0	
Average length of events BELOW median (hours)	121.3		484.9		0.0	

Step 3) i-Tree Hydro Hydrological Parameters

These parameters define study area soil, vegetation, and water conditions.
The goal is to adjust them until modeled streamflow resembles observed streamflow.

Project Location: Holland, Michigan

You may create and compare multiple parameter sets. Start by Auto-Calibrating with the Suggested Default Values, and then Compare the Parameter Set Calibration Results. You modify these parameter sets by FIRST Retaining and Editing a NEW Parameter Set. At any time, run the Auto-Calibration routine with any Current Parameter set to create new Auto-Calibrated Parameters which may then be further adjusted.

Note: Auto-calibration is available only when modeling a watershed.

Current parameter set: Suggested Default Values

Retain and Edit as NEW parameter set | Delete this parameter set | Auto-Calibrate this Parameter Set | Compare Parameter Set Calibration Results

Parameters:

We start with a preliminary value for the amount of water coming through the gauge.

Annual Average Flow at Gauging Station (cms): 0.7612444444

Then we select a soil type to account for the way water moves into and through the ground.

Soil Type: Sandy Clay Loam

Wetting Front Suction (m): 0.12
Wetted Moisture Content (m): 0.48
Surface Hydraulic Conductivity (cm/h): 0.2700

Condition of the soil in terms of root penetration and water content is set next.

Depth of Root Zone (m): 0.05
Initial Soil Saturation Condition (%): 50

Advanced Settings

Leaf Transition Period (days)	28
Leaf On Day (Day of year 1-365)	127
Leaf Off Day (Day of year 1-365)	280
Tree Bark Area Index	1.7
Shrub Bark Area Index	0.5
Leaf Storage (mm)	0.2
Pervious Depression Storage (mm)	1.0
Impervious Depression Storage (mm)	2.5
Scale Parameter of Power Function	2
Scale Parameter of Soil Transmissivity	0.023
Transmissivity at Saturation (m²/h)	0.13
Unsaturated Zone Time Delay (h)	10
Time Constant for Surface Flow: Alpha (h)	1.0
Time Constant for Surface Flow: Beta (h)	2.0
Watershed area where rainfall rate can exceed infiltration rate (%)	65.0

Next: Step 4) i-Tree Hydro Alternative Ca

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Sewer overflows during storm hit 10 billion gallons

By Eric D. Lawrence, Detroit Free Press *9:50 a.m. EDT October 26, 2014*

(Photo: Jessica J. Trevino Detroit Free Press)

Almost 10 billion gallons of sewer overflows poured into southeast Michigan's waters in the historic August flooding, according to a Free Press review of data from the Michigan Department of Environmental Quality.

That number includes more than 44 million gallons of raw sewage from sanitary sewers and almost 3 billion gallons from combined sewer and storm water systems, all untreated, raising concerns about deteriorating water quality in the Great Lakes system.

A full accounting of the total was not available immediately, but the Macomb County Health Department had posted information after the storm indicating 1 billion gallons of overflows had poured into Lake St. Clair or its tributaries, according to an earlier Free Press report. The volume affecting the whole region was 10 times that total, and the number now reported by Macomb County is more than twice the initial estimate.

13 comments

Sewage overflows into Grand River a thing of the past for Grand Rapids

The last time Grand Rapids had a combined-sewer overflow was during April 2013 flooding, when 436 million gallons of wastewater flowed into the Grand River. *(MLive.com File)*

By Matt Vande Bunte | mvandebu@mlive.com
Follow on Twitter
on August 06, 2015 at 12:59 PM, updated August 06, 2015 at 1:50 PM

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Email

GRAND RAPIDS, MI – A project more than 20 years in the making, the separation of the city's combined sewer pipes, is virtually complete.

Cleaning up Grand River may cost billions

Joe LaFurgey
Published: June 16, 2015, 4:24 pm | Updated: June 16, 2015, 5:17 pm

Related Coverage

Study: River rapids could draw $20M to GR

GR may seek grant to put in

GRAND RAPIDS, Mich. (WOOD) — Restore the rapids, open up the banks to the public and clean up the water: That's the general plan for the Grand River in Grand

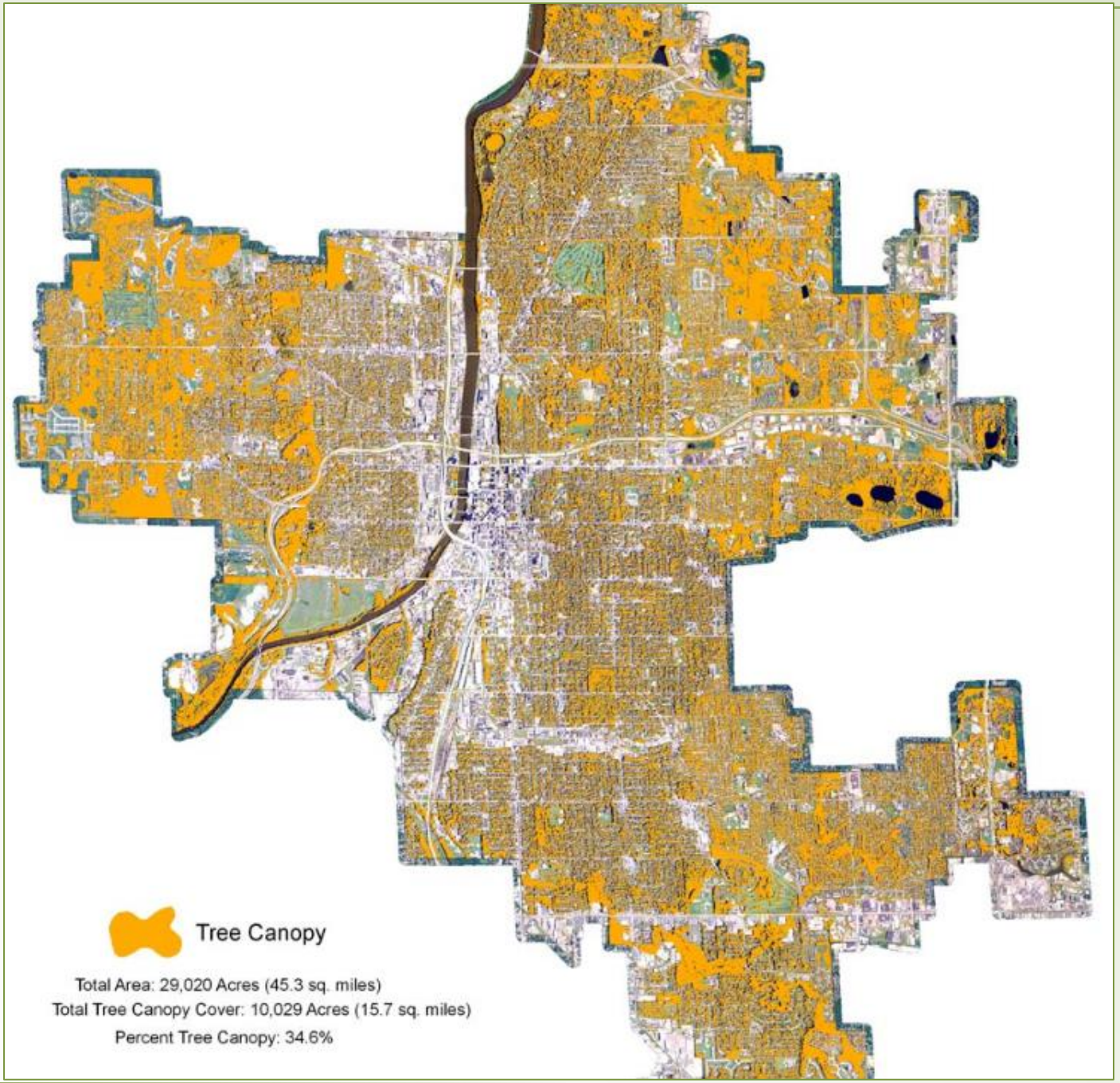

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Table 3.

Runoff	
2-year, 24-hour Rainfall event:	2.37 inches
Curve Number of existing conditions:	78
Curve Number if the trees were replace with new impervious surfaces:	89
Additional Stormwater storage volume needed if the trees were replaced with impervious surfaces:	67,075,658 ft^3
Construction cost per ft^3*	$5.50
Total Stormwater Savings:	**$368,916,122**
Annual costs based on payments over 20 years at 6% interest	**$32,163,789 per year**

* Construction costs based on the cost to build an ADS Storm Tech underground pipe detention system to handle the additional stormwater.

TOTAL VALUE OF SERVICES: $368,916,122

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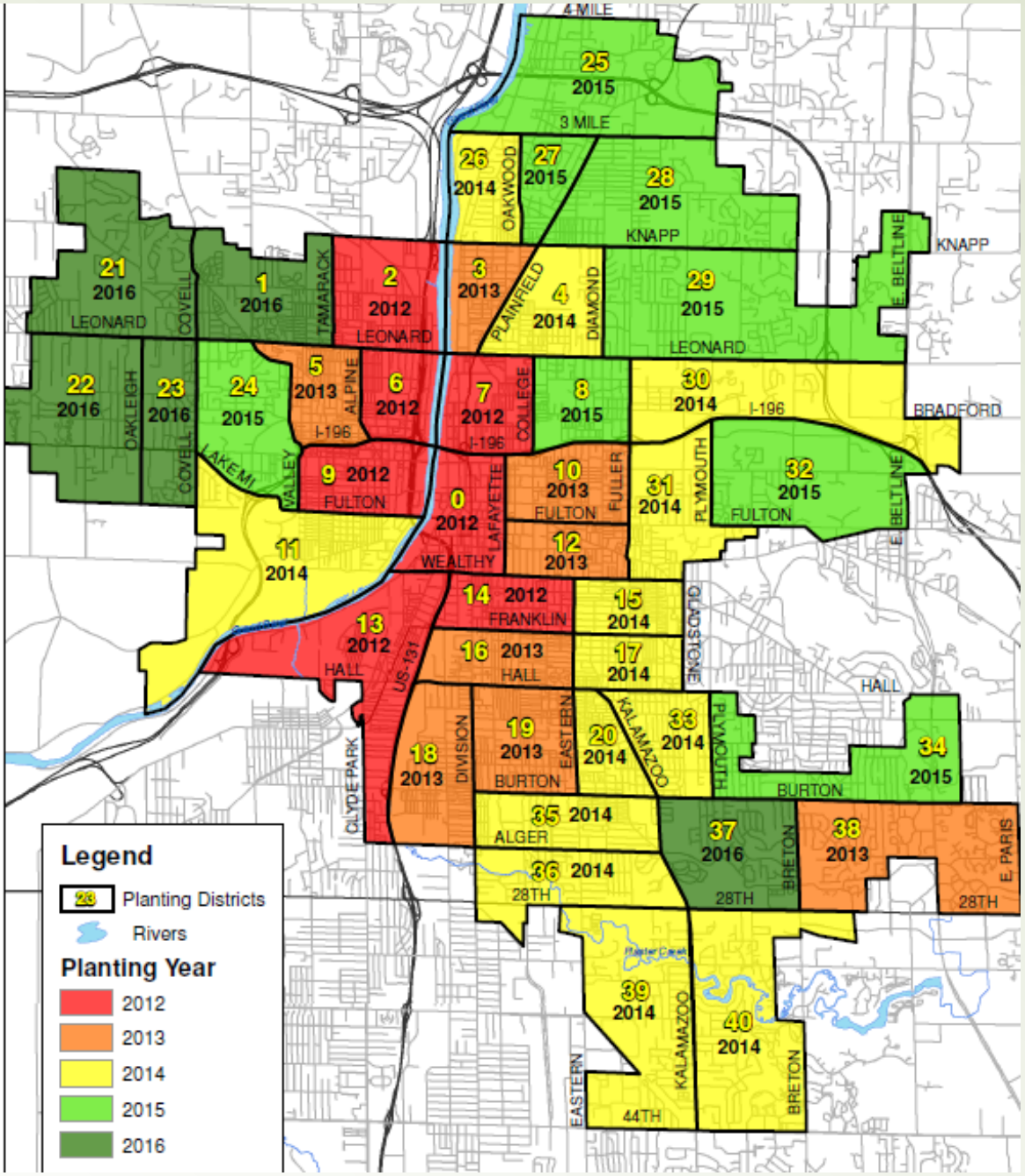
Adopt a goal of 40% urban forest canopy	• Incorporate 40% urban forest canopy goal in Green Grand Rapids • Identify canopy goals for specific land uses
Develop a data base on the city's urban forest to develop prioritized planting and management plans	• Short term: Develop a sample-based inventory profiling several areas of the city and identify maintenance and planting priorities for each • Long term: Develop a complete inventory of the city's public trees as the basis for citywide maintenance and planting plans
Enact public policy changes to maximize tree preservation and planting incentives	• Update the tree ordinance, planning and zoning policies and other tree-related City policies based on a review of existing ordinances and policies and promising practices from other communities
Provide adequate personnel and budget resources to ensure effective, proactive functioning of the Forestry Division	• Devote 100% of the forestry supervisor position to forestry-related duties • Develop an urban forest management plan • Provide adequate funding to implement the management plan, including resources to support outside fund development and community/ volunteer involvement
Increase public awareness and involvement as the foundation for developing broad public support for urban forest issues	• Create opportunities for public education and volunteer involvement, including tree tours, workshops, planting and maintenance projects • Create opportunities for public and private sector financial support



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5 comments

Grand Rapids tree planting effort gets $70,000 federal grant from U.S. Forest Service

By Garret Ellison | gellison@mlive.com
Follow on Twitter
on October 12, 2012 at 7:33 PM, updated October 12, 2012 at 7:52 PM

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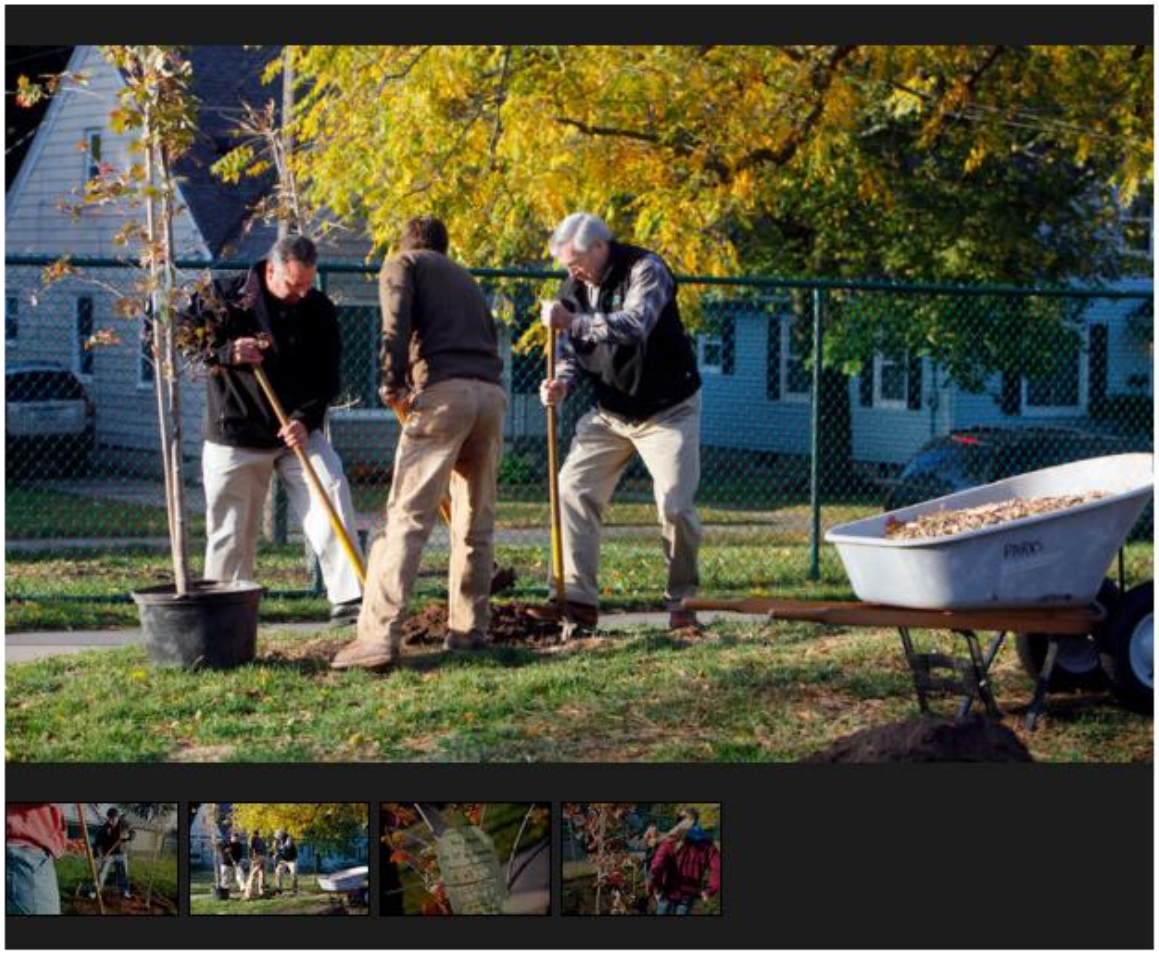


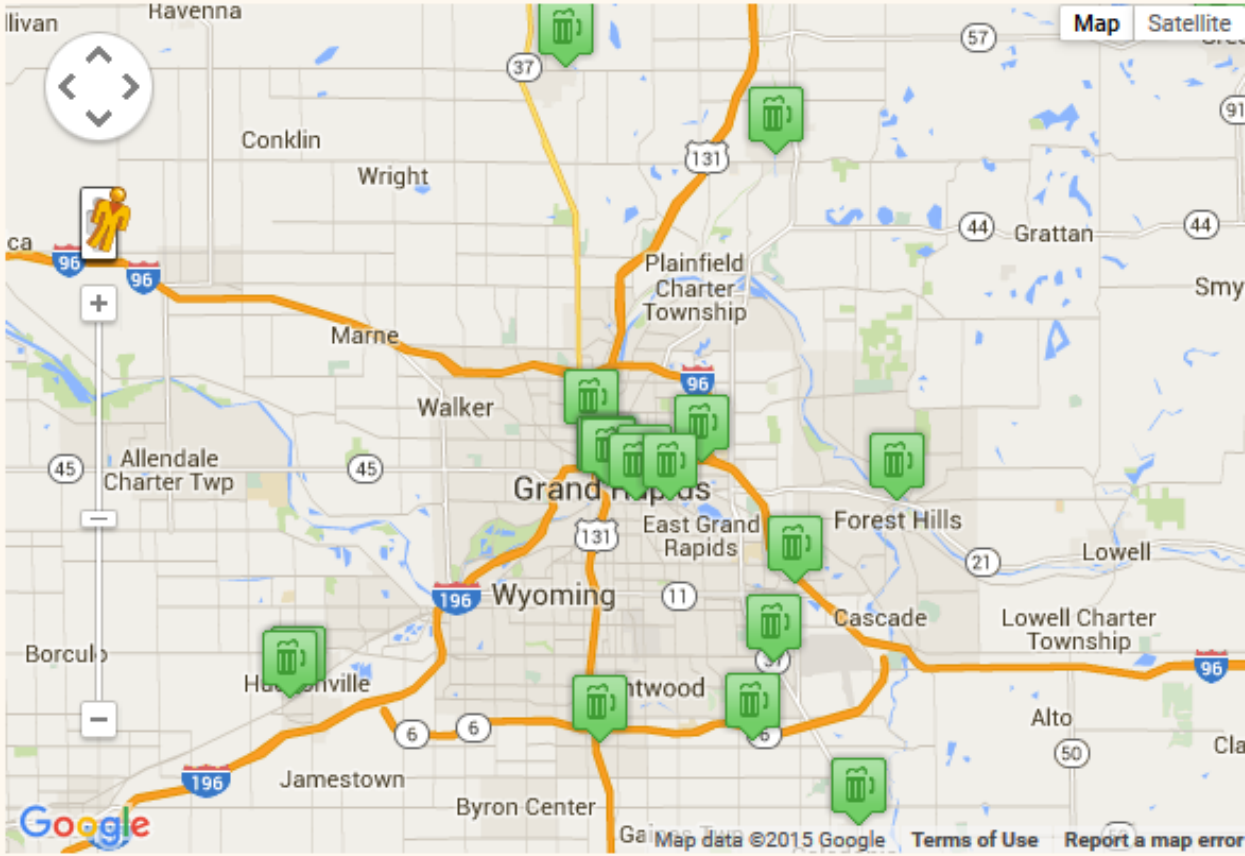
From left, Grand Rapids Public Services Manager Jim Arsulowicz, Friends of Grand Rapids Parks' Lee Mueller, and Grand Rapids Mayor George Heartwell, plant a tree at Cheseboro Park on Thursday, Oct. 11. Cheseboro lost all of its trees due to Emerald Ash Borer, and Heartwell's Climate Change Award is

about the brewers grove

The Brewers Grove project started in 2013 when local brewers asked Friends of GR Parks (FGRP) how they could celebrate being named Beer City USA by give back to our parks and public spaces. And the idea was seeded to create tree-themed beers that would be offered for a limited time with proceeds going directly to FGRP's Urban Forest Project and tree

SEARCH THIS MAP FOR TREE-THEMED BEERS – TREE BEER KICKS OFF ON MONDAY AUGUST 31ST, 2015

Filter by All



Show 10 entries

Search

TITLE	CATEGORY	ADDRESS	DESCRIPTION
57 Brew Pub		1310 W Washington St, Greenville, MI 48838	**TREE THEMED BEER:** Cherry Houdini **STYLE:** Cherry Vanilla Porter
B.O.B.'s Brewery		20 Monroe Ave NW Grand Rapids, MI 49503	**TREE-THEMED BEER:** Tangerine Trees

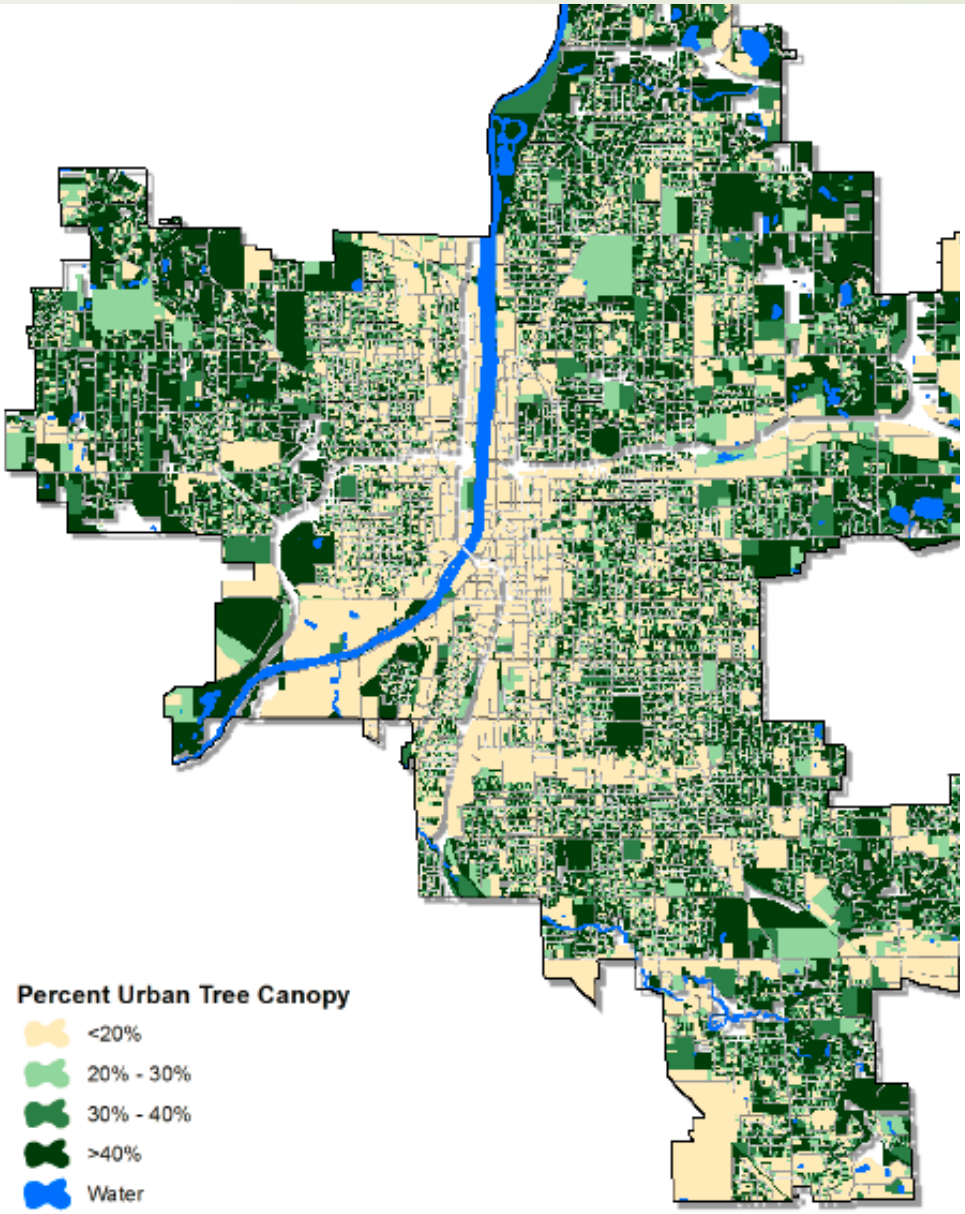


Figure 6: Urban Tree Canopy (%) by parcel in Grand Rapids, MI.

Zoning Code	Zoning Class	% Urban Tree Canopy within Zoning Class	% Possible Planting Area in Zoning Class	Acres Possible Planting Area in Zoning Class
CC	City Center	4%	6%	33
C and C-A	Commercial	10%	13%	92
SD-IC	Industrial Campus	30%	28%	141
SD-IT	Industrial transportation	11%	16%	329
LDR	Low Density Residential	42%	26%	4,330
MDR	Mixed Density Residential	36%	25%	544
SD-NOS	Neighborhood Office Service	21%	25%	107
SD-OS	Open Space	42%	36%	722
SD-PRD	Planned Redevelopment District	30%	29%	226
TBA and TBA-A	Traditional Business Area	9%	9%	61
TOD	Transit Oriented Development	8%	6%	0.1
TCC	Transitional City Center	8%	11%	89

*See page 41 in the Appendix for more information

Section 1. That Table 5.5.06.A. "Site Layout and Building Placement: Residential Zone Districts" of Section 5.5.06. "Residential Zone Districts" of Title V, Chapter 61 of the Code of the City of Grand Rapids be amended to read as follows:

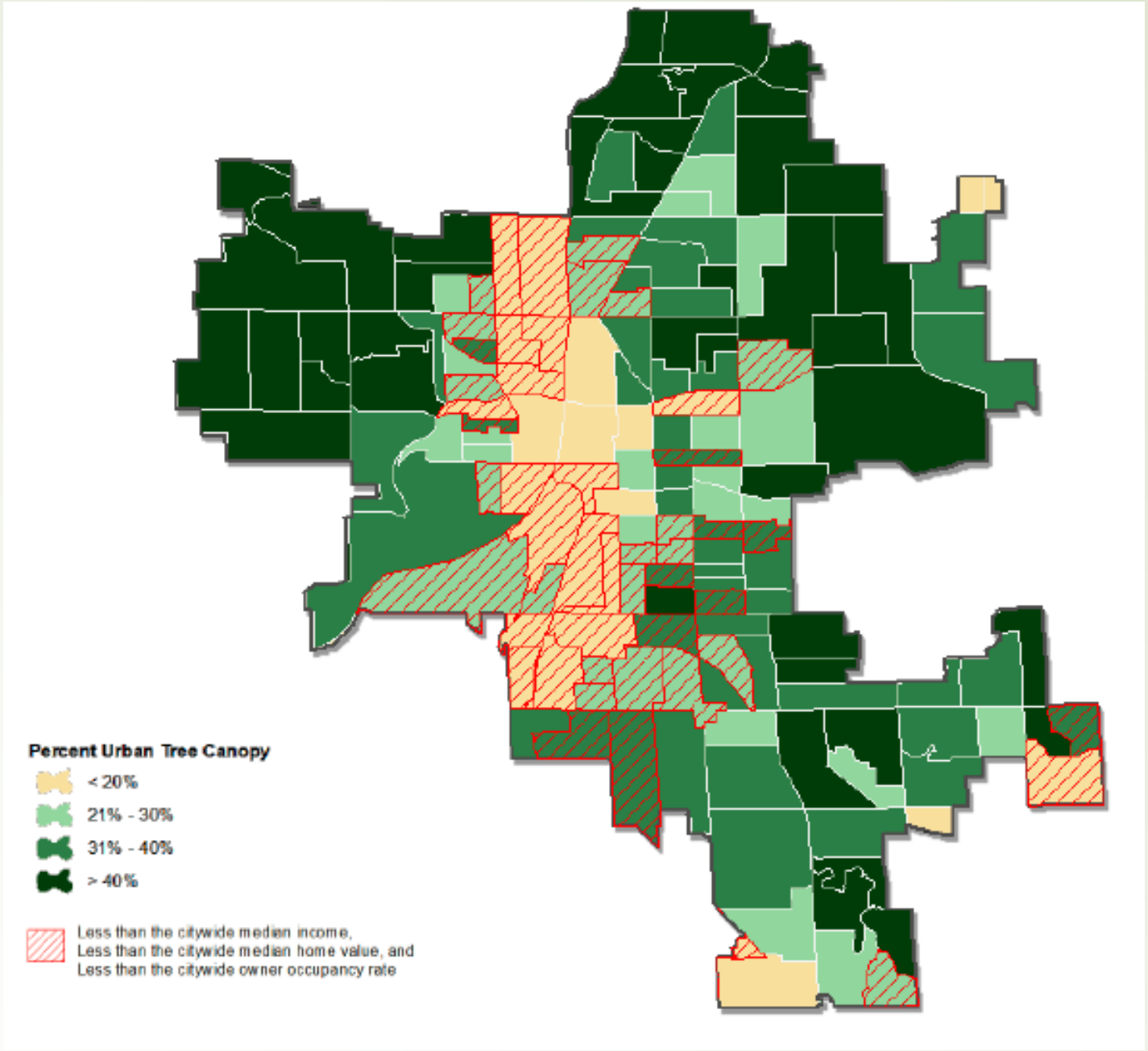
Section 5.5.06. Site Layout and Building Placement Requirements.

Table 5.5.06.A. Site Layout and Building Placement: Residential Zone Districts							
Neighborhood Classification	TN		MCN		MON		Other Regulations
Zone District	LDR	MDR	LDR	MDR	LDR	MDR	
"**Minimum Tree Canopy** (% of lot area)"							
"Multiple-Family / Group Living	37%	34%	48%	41%	51%	35%"	
"Non-Residential Uses	37%	34%	48%	41%	51%	35%"	

Section 2. That Table 5.6.07.A. "Site Layout and Building Placement: Mixed-Use Commercial Zone Districts" of Section 5.6.07. "Mixed-Use Commercial Zone Districts" of Title V, Chapter 61 of the Code of the City of Grand Rapids be amended to read as follows:

Section 5.6.07. Site Layout and Building Placement Requirements.

Table 5.6.07.A. Site Layout and Building Placement: Mixed-Use Commercial Zone Districts										
Neighborhood Classification	TN				MCN		MON		SD	Other Regulations
Zone District	CC	TCC	TBA	TOD	C	TOD	C	TOD	NOS	
"**Minimum Tree Canopy** (% of land area when viewed from above)"										
"Residential	5%	10%	12%	5%	18%	10%	20%	12%	26%"	
"Mixed-use and non-residential	5%	10%	12%	5%	18%	10%	20%	12%	26%"	



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