Marin's Urban Forest

A GUIDE FOR STAKEHOLDERS

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GROWING TREES MAKE GREAT NEIGHBORHOODS

Kristin Brinner, flickr.com

Marin's Urban Forest: A valuable asset for the present and future

"The trees of our urban forest provide many intangible benefits—from creating the sense of place that makes Marin so beloved to providing a place to hang a hammock on a warm April day to offering habitat and food for the wildlife that share the land with us.

But beyond these gifts, our trees also perform valuable, measurable ecological services. By shading buildings and other heat-absorbing surfaces and by blocking cold winter winds, they help reduce our energy use. By removing greenhouse gases from the atmosphere and transforming them into trunks and roots and branches, trees help in the fight against climate change. Trees filter pollutants out of the air, reducing cases of asthma and other respiratory illnesses and improving the health of everyone. And our urban forest helps clean and slow the flow of stormwater before it reach es the Bay or the ocean."[1]

Marin Analysis

In 2011, an analysis of Marin's urban forest was undertaken by scientists at UC Davis, the US Forest Service, and San Francisco State University.[2] The goal was to understand *the structure, function, and present and future needs of the trees in urban areas of Marin County.* In other words, we asked:

- How many trees are there in Marin County's urban areas and how are they distributed?
- How much room is there for more trees?
- What environmental benefits are our trees providing?
  - When trees shade buildings and other heat-absorbing surfaces, how many kilowatt-hours of electricity are they helping conserve?
  - When they block winter winds, how many therms of natural gas for heating are they helping conserve?
  - How many tons of greenhouse gases are they absorbing from the atmosphere?
  - How many pounds of air pollutants are they filtering out of the air?
  - How many gallons of stormwater are they helping to filter and slow before the runoff reaches the Bay or the ocean?
- If we plant more trees, how much will the environmental benefits increase?
- Where should we concentrate our planting efforts?
- What else can we do to get the most out of our urban forest, now and in future years?

The analysis was part of a larger project to design shade tree planting programs for utility companies and other organizations throughout California and in Marin County specifically. For this reason, our research focused heavily on the contributions trees make to conserving energy and reducing greenhouse gas levels in the atmosphere.

The Research[3]—Phase I

We began the study by using aerial imagery and GIS data to map and measure land cover (how much of the urban areas of Marin County are covered by buildings, other impervious surfaces, trees, shrubs, irrigated grass, unirrigated grass or dry soil, and water). This information was used to determine the existing tree cover and to determine where it will be possible to plant trees.

We used zoning maps from Marin County to determine land use (e.g., single family residential, commercial, institutional, etc.). Land use information was used to determine environmental benefits data, in particular for energy conservation.

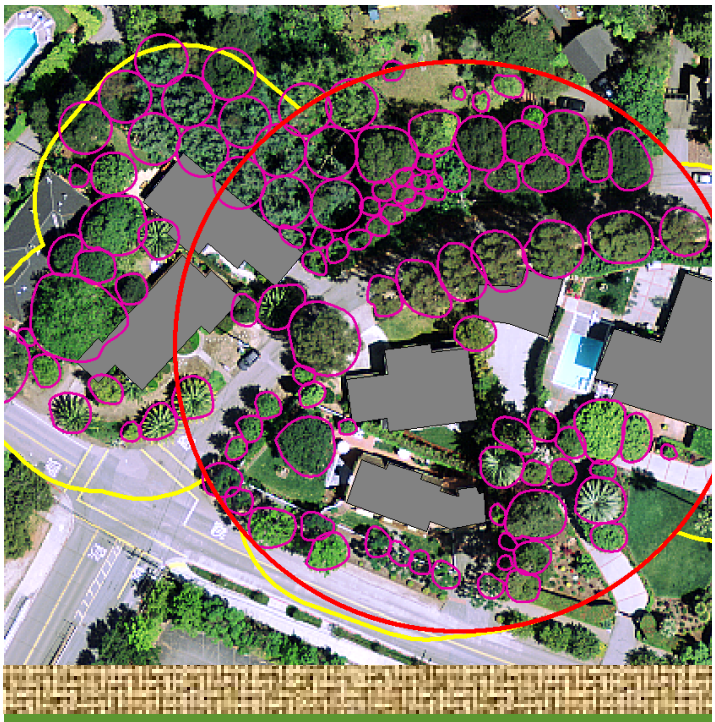
Marin's urban forest by the numbers	Urban tree canopy cover:	Number of trees:	Number of trees per person:	Stocking level:
	36%	1.9 million	8.8	82%

Marin's Urban Forest: What Does It Look Like?

The residents of Marin County can take pride in their urban forest—it's a vast and thriving resource. Approximately 1.9 million trees cover more than one-third of the urban area (tree canopy cover: 36.3%). That's an average of 8.8 trees per person, much higher than other urban areas in California, such as San Jose (3.2 trees per person), Sacramento (2.8) or Los Angeles (1.6). Canopy cover levels vary by city from 29% in San Rafael to 68% in Ross.

Stocking level is a helpful measure for understanding how much of the actual available planting area is covered by trees. It accounts for the fact that very densely developed areas will clearly have lower levels of tree canopy cover because buildings cover more of the land. A very urban area, such as downtown San Francisco, might have only 10% canopy cover but 90% stocking if trees are planted everywhere they can grow. In the urban areas of Marin County, the stocking level was an admirable 82%, with several jurisdictions over 90%.

The lowest levels of stocking were found in industrial (61%), commercial (58%), and mixed use areas (58%) and the highest in residential areas (86%). The town of Tiburon had the lowest stocking level (70%) and Ross the highest (96%).



The Research[3]—Phase II

The second research phase consisted of an analysis of the structure of the urban forest to determine its current extent and to assess where trees could potentially be planted in the future. The area currently covered by tree canopy was determined from the land cover analysis and aerial imagery. This was translated into an estimated number of trees based on typical growth patterns.

The number of potential available planting spaces for trees was determined in 125 sample sites by applying a computer algorithm that "searched" for empty spaces. The results were extrapolated to the rest of the study area.

Environmental and other benefits of the urban forest

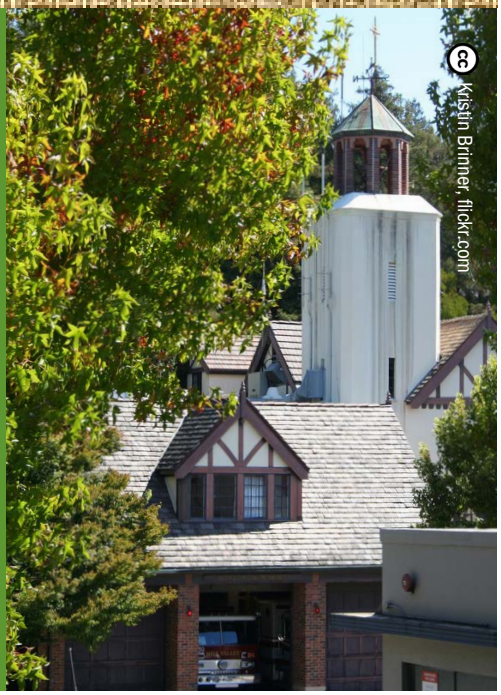
Marin's urban forest reduces energy use by $64 million every year and captures nearly 60,000 tons of greenhouse gases

Each year, Marin's urban trees provide residents with $273 million in ecosystem services and property value increases. The greatest monetary contribution ($198 million) comes in the form of increased property values, which benefit the homeowner directly and other county residents indirectly as higher property values translate into greater amounts of property tax collected. The largest environmental benefit comes from energy conserved due to shading of the summer sun and blocking of cold winter winds, a total of $64 million per year.

BENEFIT	UNITS	DOLLARS
Heating conserved	4.8 million therms	$4.6 million
Electricity conserved	319 million kWh	$59.4 million
Greenhouse gases reduced	59,800 tons	$1.2 million
Air pollutants reduced	390 tons	$986,000
Stormwater intercepted	1.5 million gallons	$8.5 million
Property value increase		$198 million
TOTAL		**$273 million**

The Research[3]—Phase III

In the third research phase, the annual ecosystem services and property value increases provided by the existing urban forest were determined on a per-acre-of-canopy-cover basis, and they varied with land use type. For example, it is known that trees planted to shade buildings help conserve energy, but the effects are greater for smaller buildings. So an energy conservation value (kWh of energy saved) can be attributed to an acre of trees in a single-family residential area and a different value to an acre of trees in an industrial area. This process was carried out for energy conservation, greenhouse gas reduction, air quality improvement, stormwater management, and property value increases. In the second half of this phase, environmental benefits were projected for the available planting spaces.



Is there room for more trees?

Absolutely! To find places for new trees, we looked at all areas that were classified as either irrigated grass or dry grass/bare soil. Of course, not all of this land is actually suitable for trees (owing to the presence of powerlines, ball fields, nearby intersections, etc.), so we reduced the total number to account for this.

In total, we found more than 425,000 potential spots for trees throughout the urban areas of Marin County. Most were in residential areas (56%) or in open space (16%). Belvedere had the fewest potential planting spaces with 1,473. Unsurprisingly, the two largest and most urban cities, San Rafael and Novato, had the most potential planting spaces at 67,851 and 106,060, respectively.

Potential planting spaces for new trees

JURISDICTION	TOTAL
Belvedere	1,473
Ross	2,312
Fairfax	3,276
Sausalito	4,195
San Anselmo	6,486
Larkspur	12,300
Corte Madera	14,378
Mill Valley	14,484
Tiburon	29,117
San Rafael	67,851
Novato	106,060
Other areas	163,556

Parking lot case study

One of the most underutilized opportunities for planting trees is in parking lots, which are sources of contaminated stormwater runoff, contributors to the urban heat island effect, and unexpectedly high sources of air pollutants (as much as 16% of vehicular air pollutants are emitted from cars that are not running).[4] Shading parking lots also reduces wear and tear on the asphalt, lowering maintenance costs by as much as 58% over 30 years.[5] To demonstrate the feasibility of achieving nearly 50% canopy cover over a parking lot without reducing the number of spaces,6 we selected a local tree-less example that holds about 250 cars and is about 2 acres in size. We were able to find space for 24 large trees, which would result in nearly 50% canopy cover at maturity. Each year those trees would capture about 5 tons of greenhouse gases, about 14 lbs of air pollutants, and intercept about 83,000 gallons of stormwater, all while protecting the asphalt from sun damage and reducing the urban heat island effect.

Planting for the future

To get a better understanding of the future opportunities for Marin's urban forest, we used the data from the existing trees to extrapolate how the benefits would increase if we planted trees in half of all the available spaces in irrigated grass areas (172,500 new trees) and half of all the available spaces in dry grass/bare soil areas (40,200 new trees). Most of the dry grass planting spaces were in open space areas so we assumed that larger trees, specifically the native coast live oak, could be planted there. In the irrigated areas, we used a smaller species for the calculations.

If these 213,000 trees were planted, the total urban tree canopy cover would increase to 46% and the stocking level to 91%. Once they reached maturity, the trees would increase the value of the annual ecosystem services by $56 million, including $41 million in property value increases and $12 million in energy savings.

Planting trees in half of the available spaces would increase the ecosystem services by $56 million a year.

Tree planting demonstration project

Schools and other public institutions can be valuable places for larger tree planting projects. They often have significant amounts of open space and the existing infrastructure and support to care for the trees. Their educational mission also offers opportunities to help the public understand the value of the urban forest. As a part of our project to design and promote shade tree programs throughout California, we undertook a demonstration planting project in collaboration with San Jose Middle School in Novato.

After visiting the site in person (we noted that even in early December, the sun was hot and bright enough that all south-facing classrooms had their shades drawn; clearly shade would be of benefit to them), we found strategic locations for 20 trees, including two native species, the coast live oak and California sycamore, and the non-native Hungarian oak, chosen for its hardiness, drought-tolerance, and appearance. The trees were planted in one day by a team that included a local nonprofit tree advocacy group, Friends of the Urban Forest; local landscape professionals who volunteered some of their time and equipment to dig the holes and lay the additional irrigation; and students of San Jose Middle School.

We used the Northern California Coast Community Tree Guide to estimate the benefits the trees will provide and presented the results to the students in a flyer.

Over the next 40 years, the trees will:

Shade buildings & block cold winter winds, reducing energy use by

181,000 kWh

or $29,000

worth of energy, and making classroom time more comfortable for all.

Capture 117 tons of greenhouse gases from the atmosphere,

$3,800

worth and transform them into branches, trunks, roots and leaves.

Remove 700 lbs of pollutants from the air, a contribution of

$1,400

to better breathing, helping fight asthma and other respiratory diseases.

Filter the impurities from

540,000

gallons of stormwater before it reaches the groundwater or into the Bay, resulting in

$3,000

worth of cleaner water!

How can we protect and grow the urban forest for the future?

1 Protect and care for the existing trees. The urban forest of Marin County is already an incredibly valuable resource for the residents of the region, providing $273 million in ecosystem services each year. For trees on public property in particular, adequate funding for tree care in the form of inspections, pruning and pest and disease treatments is critical. Educational campaigns targeted at private property owners can emphasize the value of trees and encourage proper care.

2 Plan to replace trees over time. Marin's urban communities and the urban trees that go along with them are well-established and most have been in place for decades. This suggests that many of the trees may be older and nearing the end of their lifespans.[7] Dying and dead trees should be replaced as quickly as possible to enable benefits to continue.

3 When trees do need to be removed, make use of their wood. When trees die and decompose, the greenhouse gases that they have sequestered in their wood are returned to the atmosphere. If this wood can instead be given new life, as timber for specialty products; recycled into benches, railings and other public structures; or even used as mulch, the climate change benefits of the trees will last even longer.

4 Plant new trees in the neediest areas first, where stocking levels are lowest. Generally speaking, these would be in the industrial, commercial and mixed use areas. In all of these cases, stocking levels were around 60%, leaving ample room for trees.

5 Plant species that will be large at maturity. These provide by far the greatest benefits, as much as four times higher than the benefits of small trees.[8]

6 Plant trees strategically around buildings to help conserve energy. Plant trees on the west and east sides of buildings—the sides the sun warms most strongly. Shading paved surfaces—streets and parking lots—will reduce heat absorption. In colder, windy areas, trees can be used to block prevailing winter winds.[9]

References

1. Hughes N, Ravdin K (2013) Marin voice: Protecting Marin's urban forests. *Marin Independent Journal.* 4/26/2013
2. Xiao Q, Bartens J, McPherson G, Simpson J, Hines E (2013) Marin County Urban Forest Canopy Cover Assessment. Technical Report to California Urban Forests Council. Available at: *http://www.caufc.org/documents/MarinCountyCanopyCoverReport.pdf*
3. For a more in-depth summary of the research methods and results, see Appendix I: Canopy and land cover analyses in the California EnerTrees final report, available at: *http://www.caufc.org/documents/CA_EnerTrees_final_report.pdf.* For the complete study report, see footnote 1.
4. Scott KI, Simpson JR, McPherson EG (1999) Effects of tree cover on parking lot microclimate and vehicle emissions. *Journal of Arboriculture* 25: 129–142
5. Why shade streets? The unexpected benefit. Center for Urban Forest Research, US Forest Service, Davis, CA. Available at: *http://www.fs.fed.us/psw/programs/cufr/products/cufr_673_WhyShadeStreets_10-06.pdf*
6. For more information on fitting trees into parking lots, see: Where are all the cool parking lots? Center for Urban Forest Research, US Forest Service, Davis, CA. Available at: *http://sactree.com/assets/files/greenprint/toolkit/b/CoolParkingLots.pdf*
7. Simpson JR, McPherson EG (2007) San Francisco Bay Area State of the Urban Forest. Center for Urban Forest Research, US Forest Service, Davis, CA. Available at: *http://www.fs.fed.us/psw/programs/cufr/products/2/psw_cufr719_SFBay.pdf*
8. The large tree argument: The case for large-stature trees over small-stature trees. Center for Urban Forest Research, US Forest Service, Davis, CA. Available at: *http://www.fs.fed.us/psw/programs/cufr/products/cufr_511_large_tree_argument.pdf*
9. For more information on planting trees strategically, see McPherson EG, Simpson JR, Peper PJ, Crowell AMN, Xiao Q (2010) Northern California coast community tree guide. Benefits, costs and strategic planting. USDA Forest Service General Technical Report. Pacific Southwest Research Station. Davis, CA. Available at: *http://www.fs.fed.us/psw/publications/documents/psw_gtr228/psw_gtr228.pdf*