MARK BROWN DIGITAL ARTS

11/15/21

I am writing in response to the Mountain View Forestry Department's decision to grant Henry Tu permission to cut down an old growth redwood tree on a property he recently purchased at 1430 Mercy Street. I have sent you other documents from myself and David Docktor, a certified arborist working with Canopy, regarding your unfortunate decision to let him cut down this huge tree, which you already have in your files.

In August of 2021, Mr. Tu told Jakob Troconoc that he and his family were going to move into the rear structure at 1430 Mercy Street, and needed permission to cut the tree down to make it habitable for his family.

I walk by the house twice a day with my dog and can see the structure and yard clearly from my second story window next door. No one is currently living there and Mr. Tu recently advertised the house for rent. He was clearly lying to Mr. Troconoc when he stated that he and his family were going to live there. I suspect he wants to remove the tree so that he can develop the property without having to design and plan a new house around this giant redwood.

Mark McAfee Brown

Please distribute these documents to the other members of the Parks and Recreation Division.

11/15/21

I have been intimately familiar with the tree that Henry Tu wants to cut down at 1430 Mercy Street for a very long time. I have lived next door to this tree for 40 years and have appreciated it every single day for all of that time. I walk by it twice a day with my dog. It has been the first thing I see every morning from my yard and bedroom window and the last thing I see every night. It is the largest, grandest and most significant and magnificent tree in the entire Shoreline West Neighborhood.

Heritage trees are an institution meant for the well-being of our community. If a tree which is at least 80 years old, over 80' high, and 4' wide at the base and is healthy and beautiful cannot be saved, the City of Mountain View should stop pretending that there is such a thing as a Heritage Tree Ordinance. It would save residents and the city the time and money spent on arborists and appeals and prevent commissions such this from their wasting time in more meetings like this in the future.

If this tree were growing in most cities in America, it would be automatically be preserved as a living treasure, by its sheer size, beauty and its obvious benefit to the community. Coastal redwood trees such as this one reach maturity in 400 - 500 years and can live as long as 2,500 years.

I bought my house from, and knew the previous owner of the house at 1430 Mercy Street, Bob Guthrie, for 40 years, and knew several of the tenants who lived in that house which Mr. Guthrie owned and rented to several families over those years. None of them ever once complained about the tree, indeed they saw it as a property and neighborhood enhancement. None of them complained about the condition of the foundation or the floor of the house that they were living in.

Mr. Tu has stated that the tree is interfering with the cheap and inappropriate slab foundation of the rear structure. As a former builder, in documents I submitted to the Parks and Rec and Forestry Divisions, I clearly outlined many building alternatives for remidiating the structural and foundation problems as well as the alternative of building an ADU, rather than cutting down the tree. Many of these ideas were agreed upon by David Docktor, a certified arborist working with Canopy, an Urban Forest advocacy group that the city of Mountain View has long contracted and worked with. Those certified ideas are on file in your records. I do not have the time to go over them now in this short statement.

No right is unlimited, including property rights. They are restricted by zoning ordinances and, yes, Heritage Tree Ordinances, in spite of Mr. Tu's shameful and profoundly selfish desire to cut this tree down. This tree has far greater value to the community and the ongoing ecology of the Shoreline West Neighborhood than the recently purchased, dilapidated structure he is complaining about, which has no architectural or historical value.

When Mr. Tu purchased the property he knew of the Heritage Tree Ordinance. The ordinance must be disclosed during the sales process. A tree that is 4' wide and over 80' high is very hard to miss or ignore.

I have no problem with Mr. Tu remodeling the existing homes on the lot or building an ADU, providing that the tree is not harmed. I have two very large redwood trees in my front yard. Their roots damaged my sewer drain and my main water line. At a personal cost of several thousand dollars, I had the sewer drain and water lines replaced, mitigating the damage. I did not seek permission to cut down the trees.

You know from the volume of calls, e-mails and letters that you have received since Mr. Tu was granted permission to cut this tree down, that the Shoreline West neighborhood is united in strong opposition to the socially and ecologically barbaric decision of the Forestry Division to grant him permission to remove the tree.

A giant old growth redwood tree is not a "thing" that belongs to one person that he can destroy because he buys the property that the tree is living and growing on. A huge heritage tree such as this is not a bit of decorative landscaping. A property which is fortunate enough to have a giant redwood tree benefits the entire community and also increases property values. The community benefits because redwood trees are the best air filters we have. They improve the air we breathe. They improve our health. This tree enhances the oxygen we breathe and sequesters carbon for the entire neighborhood. It is a magnificent living thing of beauty and grandeur. Please do not give Mr. Tu permission to destroy it.

Mark McAfee Brown •   • Mountain View, CA • 94041 •

Flynn, Allison

From:	Nancy Stuhr
Sent:	Tuesday, November 30, 2021 6:46 PM
To:	stevefilios@gmail.com; jonathan.mountainview@gmail.com; prc@mountainview.gov; jsmhome@comcast.net; sandysommer@dslextreme.com
Subject:	A bid to save the Redwood tree at 1430 Mercy Street (Hearing on December 8th)
Attachments:	Ordinance Guided appeal to preserve the tree at 1430 Mercy Street for email- Google Docs - Google Docs.pdf; Environmental pollution.pdf; Understanding the Benefits and Costs of Urban Forest Ecosystems.pdf; Copy of MVCC Protection of the Urban Forest.pdf; Addendum A Forestry Board Letter M Brown.pdf

Dear Parks and Recreation Commission Member,

Please find attached a letter to you regarding the application to destroy the Redwood tree at 1430 Mercy Street. I know you are very busy and already have plenty to read (!) and so I am sending this package early, and hope that you will find the time to read it.

This application is alarming as the tree in question is quite obviously a true Heritage Tree.

I can tell you as a practicing Realtor in the area that it is standard practice to disclose items like the Heritage Tree Ordinance, both locally and through a Statewide Disclosure form. It is also highly improbable that the applicant purchased this property without a property inspection. This purchaser should have been advised to look into the details of the Ordinance before buying the property. In other words, the applicant knew what they were purchasing and must have been aware of the Ordinance since he quickly applied for Tree Removal.

Staff tells me that the applicant wants to "move in with their family" but the "house is damaged". If the house is damaged then repairs are needed, and can be applied without removing this tree. Staff also says that they "have to believe the applicant's statement". But what if the applicant is not telling the truth? Once the tree is gone it cannot be replaced.

Many neighbors are watching and wondering why the new owner has not moved in (even into the front house, which is up for rent on Zillow) and are worried that the new owner only wants to destroy the tree for other purposes, i.e. development. Development could also happen around the tree without removing it. There are many examples of this nearby in the neighborhood. It doesn't seem that any other options other than removing the tree have even been considered. Keeping this tree also statistically improves the value of the property.

If this application is approved, this tree is lost forever, a waste and a failure of the Ordinance itself. This is exactly the kind of Tree that deserves protection. The other zoning laws are expected to be upheld, so why not this ordinance? My argument attached will address how the Ordinance should be able perform as intended to protect this tree.

I do not know how your committee works, but it might be useful to know what the intended plans for the property are, where the owner lives now, what other professionals, if any, he has contacted to look into keeping this tree. Has he even tried?

Myself and many other folks are hoping that this tree can remain as a resident - a very helpful and valuable resident of Mountain View for many years to come. It is an issue of community health and pride in our City and its assets.

I thank you for your service to the community. I thank you for taking the time to read the attachment(s).

(Please note: The first attachment is my letter to you. The 2nd and 3rd attachments are included as expert opinions to back-up statements made in my appeal to you. These are long articles, and so I don't expect that they will be read in their entirety! The last two are items you have probably already seen, included for convenience of reference)

Thanks again,

Nancy Adele Stuhr
Broker Associate

I look forward to being of service to you.

t.

DRE 00963170

sereno—

Serving Mountain View & surrounding areas for over 20 years

MBDA
MARK BROWN DIGITAL ARTS

• Mountain View, CA 94041 •

9/3/21

Hello Mr. Troconic, and members of the Mountain View Forestry Division,
I am writing to supplement materials that I submitted in on August 4th, 2021, opposing the Mountain View Forestry Division's decision to allow Henry Tu to cut down a large redwood tree on the property he recently purchased at 1430 Mercy Street in Mountain View.

I have been in touch with Canopy, a group that advocates for preservation of the urban forest. Through Canopy I was put in touch with David Docktor, ISA Tree Risk Assessor Qualified & Certified Arborist WE-0351-A. His letter of support for saving the tree and allowing for ecologically sound development of the property follows this introductory letter.

In his letter Mr. Docktor states; "I find that a compelling argument by Mr. Brown exists, which the City of Mountain View should consider for further evaluation. Specifically, explore alternatives #4, #5 and #6.

Alternatives # 4, 5, and 6, which I suggested and detailed to the Forestry Division in my letter of August 4th, 2021 are as follows:

4) Move the Rear Structure Away from the Tree Further Back Into the Lot:
A) Form a new perimeter foundation further back on the lot and move the rear structure onto the new foundation away from the tree.

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5) New Construction Idea # 1:
A) Demolish the rear structure and slab foundation and build an environmentally friendly ADU on a perimeter foundation further back on the lot away from the tree.

6) New Construction Idea # 2:
A) Demolish both the front and rear structures and build whatever is legally permissible under current Mountain View building codes, but maintain the tree.

As a former builder, I also suggested several other alternatives to cutting down the tree and maintaining the existing structures which included:

1) To Resolve the Drainage Issues:
A) Install a French Drain around the perimeter of the rear structure.
B) Install gutters on the rear structure with underground downspout extensions which will carrying the water away from the house. The existing structure does not have any gutters at all which is the primary cause of the drainage issues. Doing both of these would easily mitigate the drainage issues.

2) To Resolve Foundation and Floor Level Issues:
A) Fill whatever floor cracks there are with flexible concrete crack filler and level out the floors with concrete. There are contractors that specialize in this type of work on slab foundations.

3) To Better Resolve the Foundation and Floor Level Issues:
Slab foundations such as this structure has are a cheap and inherently problematic way to secure a structure to the ground, especially in California where winter periods of wet weather and a subsequent six to nine months of very dry weather cause the ground to expand and contract, causing upheaval and subsidence in the soil under the house and creating cracks

in the thin slab foundations. Seismic disturbances like small and large earthquakes also exacerbate these problems. A solution to this problem would be:
A) Jack up the rear structure and install a solid concrete perimeter foundation and bolt the structure to the new, solid foundation and install a framed wood and plywood sub floor with the finish floor of Mr. Tu's choosing.
Having a crawl space under the house and proper roof drainage would permanently solve these level and drainage issues without killing the tree.

7) New Construction Idea # 3:
A) Add on to the existing Craftsman style house at the front of the lot, incorporating the tree into the overall design of the new, larger remodeled structure.

Please enter these documents into the public record.

Thank You

Mark McAfee Brown

Mountain View, CA
94041

David Dockter • Arborist’s Statement

Mr. Brown has sent a statement to the Canopy Advocacy Committee for a tree-related opinion on a matter appealing a tree removal permit. As part of his appeal material provided, the statement serves as the basis or findings that support his appeal.

I reviewed this document. I find that a compelling argument by Mr. Brown exists, which the City of Mountain View should consider for further evaluation. Specifically, explore alternatives #4, #5 and #6.

These alternatives reasonably envision future or likely site planning potential (redevelopment), and may serve as a Planning incentive to rebuild with nature.
One of these alternatives would benefit the property owner with a new permanent site & building configuration in the proximity of the canopy of a mature tree, and retain consistency with the City’s adopted tree ordinance intent, policy and protections.

Prior to any final City determination, Urban Forestry and Planning could vet the alternative site plans (ADUs, secondary buildings) with the applicant.

You may forward to Mr. Brown the above comments on behalf of the Canopy Advisory Committee if you deem appropriate and timely.

Respectfully submitted,

David Dockter, the Arbor Advisor
ISA Tree Risk Assessor Qualified & Certified Arborist WE-0351-A
American Planning Association

Contact me at Linkedin.com or 408.318.7316

Condemned Redwood tree from 468 Palo Alto Avenue, Mountain View • Shoreline West neighborhood.

Condemned Redwood tree from 1430 Mercy Street, Mountain View • Shoreline West neighborhood.

ORDINANCE NO. 01.03

AN ORDINANCE AMENDING ARTICLE II OF CHAPTER 32 OF THE MOUNTAIN VIEW CITY CODE, RELATING TO PROTECTION OF THE URBAN FOREST

Section 1. Chapter 32, Article II, consisting of Sections 32.22 through 32.39, relating to PROTECTION OF THE URBAN FOREST, is hereby amended to read as follows:

"ARTICLE II. PROTECTION OF THE URBAN FOREST.

SEC. 32.22. Findings and purpose.

The City of Mountain View lies between the foothills of the Santa Cruz Mountains and the San Francisco Bay and the beauty and health of this area has been greatly enhanced by the presence of large numbers of majestic trees. Development of the city and the surrounding urban sprawl have resulted in the removal of a great number of these trees. Further uncontrolled and indiscriminate destruction of mature trees would detrimentally affect the health, safety and welfare of the City of Mountain View. The preservation program outlined in this article contributes to the welfare and aesthetics of the community and retains the great historical and environmental value of these trees.

This article sets forth the policy of the city to require the preservation of all healthy heritage trees unless reasonable and conforming use of the property justifies the removal, cutting, pruning, and/or encroachment into the drip line of a heritage tree. (Ord. No. 10.96, 9/24/96.)

SEC. 32.23. Definitions.

For the purposes of this chapter, the following terms shall have the meaning set forth in this section:

a. "Director" shall mean the director of the city's community services department or his/her designee.

b. "Drip line" shall mean the outermost edge of the tree's canopy. When depicted on a map, the drip line will appear as an irregular-shaped circle that follows the contour of the tree's branches as seen from overhead.

c. "Heritage tree" shall mean any one of the following:

1. A tree which has a trunk with a circumference of forty-eight (48) inches or more measured at fifty-four (54) inches above natural grade;

2. A multi-branched tree which has major branches below fifty-four (54) inches above the natural grade with a circumference of forty-eight (48) inches measured just below the first major trunk fork.

3. Any quercus (oak), sequoia (redwood), or cedrus (cedar) tree with a circumference of twelve (12) inches or more when measured at fifty-four (54) inches above natural grade;

4. A tree or grove of trees designated by resolution of the city council to be of special historical value or of significant community benefit.

d. "Owner" shall mean the owner of the real property on which the tree is situated as shown on the most recent county assessor's roll, and includes any successor in interest to the owner.

e. "Permit" or "removal permit" or "heritage tree removal permit" may be used interchangeably and shall mean the permit required by Sec. 32.27 of this article.

f. "Person" shall mean any individual, partnership, firm, association, corporation, and any agent, employee, contractor or representative thereof.

g. "Proposed decision" shall mean the decision of the director in nondevelopment-related removals.

h. "Removal" shall mean the physical removal of a tree or causing the death of a tree through damaging, poisoning, or other direct or indirect action, including excessive trimming, pruning or mutilation that sacrifices the health, destroys or diminishes the aesthetic quality, or diminishes the life expectancy of the tree(s). (Ord. No. 10.96, 9/24/96.)

SEC. 32.24. Council designation of heritage trees.

The council may, by resolution, designate any tree or grove of trees on public or private property as heritage trees. Prior to adoption of a resolution designating a tree or grove of trees on private property to be heritage trees as defined in Sec. 32.23(c)(4), the owner shall receive written notice of the proposal by personal delivery or by certified mail not less than ten (10) days prior to the decision. (Ord. No. 10.96, 9/24/96.)

SEC. 32.25. Heritage tree preservation.

a. Any person who owns, controls, has custody or possession of any real property within the city shall maintain and preserve all heritage trees located thereon in a state of good health. Failure to do so shall constitute a violation of this section.

b. No person shall willfully injure, damage, destroy, move or remove a heritage tree except pursuant to the terms and conditions of a permit granted pursuant to this article.

c. **Construction/grading activity**. Any owner or person who conducts any grading or construction activity on property shall do so in such a manner as to not threaten the health or viability or cause the removal of any heritage tree. The director or the community development director may impose conditions on any city permit to require construction fencing and/or the use of protective grading methods to assure compliance with this section. In addition to said conditions, the following shall apply:

1. Except as otherwise provided in this section, excavation adjacent to any heritage tree shall not be permitted where material damage to the root system may result. When proposed developments encroach into the drip line of any heritage tree, special construction techniques to allow the roots to breathe and obtain water may be required as a condition(s) to the approval of any application for a building, zoning permit or removal permit.

2. The existing ground surface within four (4) feet (measured horizontally) of the base of any heritage tree shall not be cut, filled, compacted or pared except for existing, permitted encroachments such as sidewalks or as otherwise expressly approved by the community development director pursuant to an approved arborist's report. Tree wells may be used where advisable. (Ord. No. 10.96, 9/24/96.)

SEC. 32.26. Urban forestry board.

a. The urban forestry board of the City of Mountain View is hereby created and shall consist of the members of the parks and recreation commission.

b. The urban forestry board shall have the following powers and duties:

1. Act as decision-making body for heritage tree appeals as set forth in Sec. 32.31 of this chapter;

2. Make recommendations to the city council regarding modifications to this article;

3. Assist in the planning of urban forest management for the city; and

4. Make recommendations relative to appropriate mitigation for removals associated with city capital projects pursuant to Section 32.33. (Ord. No. 10.96, 9/24/96.)

SEC. 32.27. Permit required: Exemptions.

a. **Permit required.** No person shall cut down, destroy, remove or relocate any heritage tree growing on public or private property, or on any city-owned property, unless a valid heritage tree removal permit has been granted by the city pursuant to this article. Construction of improvements within the drip line of a heritage tree shall also require a permit issued pursuant to this article.

b. **Exemptions.** A permit is not required to cut, encroach, remove, or relocate a tree(s) under the following circumstances:

1. Trees damaged by thunderstorms, windstorms, floods, earthquakes, fires or natural disasters and determined to be dangerous by a peace officer, firefighter, civil defense official or code enforcement officer acting in their official capacity. The owner shall notify the director within five (5) days of any action taken with respect to the emergency; or

2. When removal is determined necessary by fire department personnel actively engaged in fighting a fire; or

3. Employees of the city, during an emergency, may take such action with regard to trees on city-owned property as may be necessary to maintain the safety of city operations and/or the safe conditions of city property; or

4. Public utilities subject to the jurisdiction of the Public Utilities Commission of the State of California may take such action as may be necessary to comply with the safety regulations of said commission and as may be reasonably necessary to maintain the safe operation of their facilities. No pruning at the direction of any public utility or its agents pursuant to this subsection shall be performed in such a manner as to leave the tree in an unbalanced, unstable or other dangerous condition; or

5. Any heritage tree may be removed from the landfill area, including the Shoreline golf course, when determined by the city's director of public works or the director to be necessary for the proper maintenance and operation of the landfill or golf course; or

6. Any heritage tree which the city's arborist has determined is dead may be removed.

c. **Process.** Permits for development-related removals shall be secured pursuant to Sec. 32.29. Permits for nondevelopment-related removals shall be secured pursuant to Sec. 32.30. Sec. 32.31 shall apply to all removal permits. (Ord. No. 10.96, 9/24/96.)

SEC. 32.28. Application for removal permit; Term of permit.

a. An application for removal of any heritage tree connected with a discretionary development project permit subject to review by the Development Review Committee, Zoning Administrator or the city council shall be filed as a development-related removal pursuant to Sec. 32.29.

b. All other applications for removal of a heritage tree or trees, including construction projects which require a building permit only, shall be filed as a nondevelopment-related permit pursuant to Sec. 32.30.

c. All applications for heritage tree removal permits shall specify the number, species, size, and exact location of the tree or trees involved, a brief statement of the reason for the requested removal, and any other pertinent information as may be required by the city. The applicant may be required to provide a plot plan or survey drawn to scale depicting the tree(s) and any improvements on the property and/or an arborist's report.

d. A heritage tree removal permit shall be valid for a period of two (2) years from the date of issuance. Said permit may be extended by and at the discretion of the Zoning Administrator for development-related permits and by the director for nondevelopment-related permits. Removal permits shall expire when any underlying permit expires and extensions shall not exceed the life of any underlying permit.

SEC. 32.29. Permits: Development-related removals.

a. **Filing an application.**

An application for a development-related heritage tree removal permit shall be filed with the community development department. The application shall be filed and processed concurrently with any other application(s) for development entitlements.

b. **Processing.**

1. The community development department shall review all heritage tree removal permits filed pursuant to this section. The permit application shall be referred to the director for review and comment before action is taken. The application shall be approved, conditionally approved or denied by the official or hearing body that acts on the companion development permits.

2. Five (5) days prior to the hearing on the heritage tree removal application, the applicant shall be required to wrap each heritage tree subject to removal with designated yellow tape as directed by the community development department and shall also be required to post a notice approved by the community development department stating the time, date and place of the development project and heritage tree removal hearing. Said notice shall be posted at or near the public right-of-way and shall be legible from the public right-of-way.

3. In no event shall any heritage tree approved for removal pursuant to this section be removed prior to the expiration of any applicable appeal period or issuance and initiation of the building permit for the companion development project.

4. Notice of the decision on the permit shall be made by personal delivery or certified mail to the owner, the applicants and by first-class mail to any other person who has filed a written request for such notice with the community development department. Notice of the decision shall also be incorporated into any noticing of the accompanying development permit.

SEC. 32.30. Permits: Nondevelopment-related removals.

a. Filing an application.

An application for a nondevelopment-related heritage tree removal permit, including projects requiring a building permit only, shall be filed with the community services department.

b. Processing.

1. The director shall review and approve, conditionally approve or deny the nondevelopment-related removal application.

2. In no event shall any heritage tree approved for removal pursuant to this section be removed prior to the expiration of any applicable appeal period or issuance of a building permit for the companion project when a building permit is required.

3. The community services department staff or, at their discretion, the applicant, shall wrap each heritage tree subject to removal with designated yellow tape within five (5) days of filing the application. The community services department shall post notice of the decision on the application for such permit on the tree or trees or at or near the public right-of-way and by personal delivery or certified mail to the owner and by first class mail to any other person who has filed a written request for such notice with the director. The on-site posting shall be legible from the public right-of-way.

Such notice shall state the director's decision on the application and shall provide information on the appeal process pursuant to this section.

SEC. 32.31. Appeals.

a. Any person aggrieved or affected by a decision on a requested removal, or a member of the urban forestry board, or of the city council if the decision was made by the Development Review Committee or the Zoning Administrator, may appeal the decision by filing a written notice of appeal with the city clerk stating the grounds for the appeal, and paying the requisite appeal fee, as established by council resolution, within ten (10) calendar days after the notice of the decision is posted or mailed. A member of the city council or urban forestry board shall be exempt from payment of the appeal fee.

b. Development-related removal permit appeals shall be heard by the City Council. Nondevelopment-related appeals shall be heard by the urban forestry board.

c. An appeal shall automatically stay issuance or denial of the permit until the appeal has been completed. If no appeal is timely filed, the permit shall issue as indicated in the notice of the decision.

d. Notice of the appeal shall be made by personal delivery or certified mail to the owner, the permit applicant and by first-class mail to any other person who has filed a written request for such notice. Notice shall also be given to the decision-maker. The decisions of the urban forestry board and city council shall be final. Notice of the decision shall be incorporated into the findings report. The denial of a permit shall be with prejudice and neither the owner nor any applicant shall reapply for the removal of the same heritage tree for a period of two (2) years from said denial unless the director of community services or director of community development finds, in writing, prior to the filing of the application for removal, that there has been a material change in circumstances.

SEC. 32.32. Post-removal permits.

a. Any person who removes a heritage tree without a permit issued pursuant to this article shall secure from the city a post-removal permit.

b. **Process.** The post-removal permit shall be processed pursuant to Sec. 32.29 or 32.30, as applicable.

c. **Determination of heritage tree status.** If the removal has reduced the tree below fifty-four (54) inches from the natural grade, the tree will be presumed to be of heritage status and thus subject to this article if the cut portion of the tree meets the applicable measurement threshold, or if the remaining in-ground portion, including the stump, meets the minimum threshold for protection.

d. In granting a post-removal permit, the decision-maker may require the replanting of a tree, including a tree of heritage size, in the exact location where the illegal removal occurred.

SEC. 32.33. City capital improvement projects.

City capital improvement projects which propose the removal of any heritage tree shall be submitted by the city project staff to the city's arborist for review and recommendation of appropriate mitigation measures. The arborist's recommendations shall be forwarded by city project staff to the urban forestry board for their recommendation on the number, size and location of replacement trees. The recommendation of the urban forestry board shall be forwarded by city project staff to the city council for their consideration with the approval of the project.

SEC. 32.34. Other public agency projects.

Unless otherwise exempted by state law, other public agencies which propose to remove any heritage tree within the City of Mountain View for any reason shall comply with the provisions of this article. If the agency is exempt, the agency shall submit any environmental study of the proposed project, if applicable, including any proposed mitigation of the loss of any heritage tree, to the director for review. City staff shall review the project documentation, including any relandscaping plan, and shall work cooperatively and informally with that agency's staff to adequately mitigate the removal of any heritage tree.

SEC. 32.35. Criteria for removal; Conditions; Findings.

a. **Criteria for removal.** The determination on each application shall be based upon a minimum of one of the following criteria; however, the decision-maker shall consider additional criteria, if applicable, in weighing the decision to remove a heritage tree, with an emphasis on the intent to preserve heritage trees.

1. The condition of the tree with respect to age of the tree relative to the life span of that particular species, disease, infestation, general health, damage, public nuisance, danger of falling, proximity to existing or proposed structures, and interference with utility services.

2. The necessity of the removal of the heritage tree in order to construct improvements and/or allow reasonable and conforming use of the property when compared to other similarly situated properties.

3. The nature and qualities of the tree as a heritage tree, including its maturity, its aesthetic qualities such as its canopy, its shape and structure, its majestic stature and its visual impact on the neighborhood.

4. Good forestry practices such as, but not limited to, the number of healthy trees a given parcel of land will support and the planned removal of any tree nearing the end of its life cycle and the replacement of young trees to enhance the overall health of the urban forest.

5. **Balancing criteria**. In addition to the criteria referenced above which may support removal, the decision-maker shall also balance the request for removal against the following which may support or mitigate against removal:

A. The topography of land and effect of the requested removal on erosion, soil retention, water retention, and diversion or increased flow of surface waters.

B. The effect of the requested removal on the remaining number, species, size and location of existing trees on the site and in the area.

C. The effect of the requested removal with regard to shade, noise buffers, protection from wind damage and air pollution and the effect upon the historic value and scenic beauty and the health, safety, prosperity and general welfare of the area and the city as a whole.

b. **Conditions of approval.** Approval of an application for a permit may include reasonable conditions to insure compliance with the content and purpose of this article, including but not limited to:

1. Requiring the replacement or placement of an additional tree or trees on the subject property or off-site to offset the loss of a tree, limbs, or encroachment into the drip line. The number, species, size and location of said replacement tree(s) shall be determined by the director upon recommendation of the city arborist.

2. Requiring construction fencing or barriers to protect adjacent heritage trees or other landscaping.

3. Requiring protective grading requirements to avoid damaging the root structure of the tree or adjacent trees.

4. Requiring posting of a security bond to ensure that replacement trees are planted and become established (one year after planting) and to compensate for the lost trees due to illegal removal.

5. Requiring the relocating of a tree on-site or off-site, or the planting of a new tree on-site or off-site to offset the loss of a tree.

6. Requiring a maintenance and care program be initiated to ensure the continuing health and care of heritage trees on the property.

7. Requiring payment of a fee or donation of a boxed tree(s) to the city or other public agency to be used elsewhere in the community should a suitable replacement location of the tree not be possible on-site. The fee for replacement of a tree or trees shall be, at a minimum, based on the cost of a 24" boxed tree of same species, delivered and installed.

c. **Findings**. If a permit is denied or conditions are attached, the director or decision-maker shall provide the applicant with a written statement of the reasons for said denial or conditions based upon the criteria and conditions set forth in this section.

d. **Off-site replacement option**. An applicant for a preremoval permit may request that any replacement trees be placed off-site or that he/she be permitted to pay a fee in lieu of replacement. The decision-maker shall consider the request in light of the balancing criteria set forth in Section 32.35(a)(5), above."

SEC. 32.36. Nonliability of city.

Nothing in this article shall be deemed to impose any liability for damages or a duty of care of maintenance upon the city or upon any of its officers or employees. The owner of any private property shall have the duty to keep heritage trees upon the property in a safe, healthy condition. Unless subject to an exemption from a permit pursuant to this article, any person who believes that a tree located on property possessed, owned or controlled by them is a danger to the safety of themselves, others or structural improvements on-site or off-site shall secure the area around the tree or support the tree, as appropriate, to safeguard both persons and property from harm pending compliance with this article.

SEC. 32.37. Regulations.

The City Council by resolution may promulgate administrative guidelines and/or regulations as necessary to implement this article. The director or the urban forestry board may promulgate administrative guidelines and/or regulations consistent with this article as needed, subject to council approval.

SEC. 32.38. Penalty; Restitution.

a. **Penalty.**

Any violation of this article shall be deemed a misdemeanor, punishable as set forth in the City Charter.

b. **Restitution for unlawful removal.**

1. It has been determined that heritage trees within the city are valuable assets to the citizens of Mountain View and the neighboring communities. The loss or damage to any of these trees results in a loss to the community and detrimentally affects the health, safety and welfare of the citizens of Mountain View. Therefore, the loss of or damage to any unlawfully removed or damaged heritage tree will require restitution. In addition to any applicable penalties, any person who willfully injures, damages, destroys, removes or relocates any heritage tree in violation of the terms of this article shall be responsible for proper restitution in the form of replacement trees or fees in lieu of replacement.

2. The number, species, size and location of said replacement tree(s) shall be determined by the director or other decision-maker, as applicable. The minimum size of a replacement tree shall be a twenty-four inch (24") box size tree.

3. Any fees collected in lieu of planting replacement trees shall be used for the purpose of enhancing the urban forest.

SEC. 32.39. Tree valuation.

For purposes of replacement for trees removed, the method of valuation shall be the "Standards for Valuation of Amenity Trees" of the International Society of Arboriculture. These standards shall apply to those trees removed without a permit as well as those removed with a permit, which require on-site or off-site replacements of similar value for the trees removed. (Ord. No. 10.96, 9/24/96.)"

Section 2. The provisions of this ordinance shall be effective thirty (30) days from and after the date of its adoption.

Section 3. If any section, subsection, sentence, clause or phrase of this ordinance is for any reason held to be unconstitutional, such decision shall not affect the validity of the other remaining portions of this ordinance. The City Council hereby declares that it would have passed this ordinance and each section, subsection, sentence, clause or phrase thereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses or phrases be declared unconstitutional.

Section 4. Pursuant to Section 522 of the Mountain View City Charter, it is ordered that copies of the foregoing proposed ordinance be posted at least two (2) days prior to its adoption in three (3) prominent places in the City and that a single publication be made to the official newspaper of the City of a notice setting forth the title of the ordinance, the date of its introduction, and a list of the places where copies of the proposed ordinance are posted.

- - - - - - - - - -

The foregoing ordinance was regularly introduced at the Regular Meeting of the City Council of the City of Mountain View, duly held on the 10th day of December, 2002, and thereafter adopted at the Regular Meeting of said Council, duly held on the 14th day of January, 2003, by the following roll call vote:

AYES:	Councilmembers Galiotto, Neely, Pear, Stasek, Zoglin and Mayor Kasperzak
NOES:	Councilmember Perry
ABSENT:	None
NOT VOTING:	None

ATTEST:

APPROVED:

ANGELITA M. SALVADOR
CITY CLERK

R. MICHAEL KASPERZAK, JR.
MAYOR

I do hereby certify that the foregoing ordinance was passed and adopted by the City Council of the City of Mountain View at a Regular Meeting held on the 14th day of January, 2003, by the foregoing vote, and was published in the *San Jose Post Record* by reference on the 10th day of January, 2003, and posted in three prominent places in said City.

City Clerk
City of Mountain View

MDM/5/ORD
014-11-27-02o-1^

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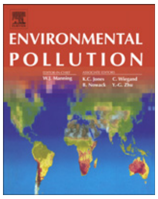

Carbon storage and sequestration by trees in urban and community areas of the United States

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ABSTRACT

Carbon storage and sequestration by urban trees in the United States was quantified to assess the magnitude and role of urban forests in relation to climate change. Urban tree field data from 28 cities and 6 states were used to determine the average carbon density per unit of tree cover. These data were applied to statewide urban tree cover measurements to determine total urban forest carbon storage and annual sequestration by state and nationally. Urban whole tree carbon storage densities average 7.69 kg C m^{-2} of tree cover and sequestration densities average 0.28 kg C m^{-2} of tree cover per year. Total tree carbon storage in U.S. urban areas (c. 2005) is estimated at 643 million tonnes ($50.5 billion value; 95% CI = 597 million and 690 million tonnes) and annual sequestration is estimated at 25.6 million tonnes ($2.0 billion value; 95% CI = 23.7 million to 27.4 million tonnes).

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1. Introduction

Urban trees and forests affect climate change, but are often disregarded because their ecosystem services are not well understood or quantified. Trees act as a sink for carbon dioxide (CO_2) by fixing carbon during photosynthesis and storing carbon as biomass. The net long term CO_2 source/sink dynamics of forests change through time as trees grow, die, and decay. Human influences on forests (e.g., management) can further affect CO_2 source/sink dynamics of forests through such factors as fossil fuel emissions and harvesting/utilization of biomass (Nowak et al., 2002). Trees in urban areas (i.e., urban forests) currently store carbon, which can be emitted back to the atmosphere after tree death, and sequester carbon as they grow. Urban trees also influence air temperatures and building energy use, and consequently alter carbon emissions from numerous urban sources (e.g., power plants) (Nowak, 1993). Thus, urban trees influence local climate, carbon cycles, energy use and climate change (e.g., Abdollahi et al., 2000; Wilby and Perry, 2006; Gill et al., 2007; Nowak, 2010; Lal and Augustine, 2012).

Urban areas in the conterminous United States have increased from 2.5% of the U.S. land area (19.5 million ha) in 1990 to 3.1% (24.0 million ha) in 2000, an increase in area the size of Vermont and New Hampshire combined (Nowak et al., 2005). If the growth patterns of the 1990s continue, urban land is projected to reach 8.1% by 2050, an increase greater than the area of Montana (Nowak and Walton, 2005). Within these urban areas, tree cover (circa 2005) is estimated at 35.0% (Nowak and Greenfield, 2012b).

Given the growing expanse of urban areas, trees within these areas have the potential to store and annually sequester substantial amounts of carbon. Understanding this national carbon effect can aid in preparing annual inventories of greenhouse gas (GHG) emissions and sinks (U.S. EPA, 2010; Heath et al., 2011). Numerous cities in the United States have analyzed carbon storage and sequestration of the trees and forests among various land use types using the i-Tree methodology (www.itreetools.org) (Table 1) or other methods (Hutyra et al., 2011; Raciti et al., 2012). In addition, cities outside the United States have also analyzed carbon storage by urban vegetation (e.g., Brack, 2002; Jo, 2002; Chaparro and Terradas, 2009; Zhao et al., 2010; Davies et al., 2011; Strohbach and Haase, 2012).

In the past, city analyses of carbon storage and sequestration have been extrapolated to national estimates using limited data. The first estimate of national carbon storage by urban trees (between 350 and 750 million tonnes; Nowak, 1993) was based on an extrapolation of carbon data from one city (Oakland, CA) and tree cover data from various U.S. cities (e.g., Nowak et al., 1996). A later assessment, which included data from a second city (Chicago, IL), estimated national carbon storage by urban trees between 600 and

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Table 1
City and state data used for carbon estimates. Plot size 0.04 ha unless noted otherwise.

City/State	Year	No. plots	Data collection group	Reference
Arlington, TX[a]	2009	233	City of Arlington	
Atlanta, GA[a]	1997	205	ACRT, Inc.	
Baltimore, MD[a]	2009	195	US Forest Service (USFS)	
Boston, MA[a]	1996	217	ACRT, Inc.	
Casper, WY	2006	234	City of Casper	Nowak et al., 2006c
Chicago, IL	2007	745	City of Chicago, Chicago Park District, USFS	Nowak et al., 2010b
Freehold, NJ[a]	1998	144	NJ Dept. Env. Protection	
Gainesville, FL	2007	93	Univ. Florida, USFS	Escobedo et al., 2009
Golden, CO[a]	2007	115	Inst. of Environmental Solutions	
Hartford, CT[a]	2007	200	Knox Parks Foundation	
Jersey City, NJ[a]	1998	220	NJ Dept. Env. Protection	
Lincoln, NE[a]	2008/09	178	Nebraska Forest Service	
Los Angeles, CA	2007/08	348	USFS, Univ. Cal., Riverside	Nowak et al., 2011
Milwaukee, WI[a]	2008	216	City of Milwaukee	
Minneapolis, MN	2004	110	Davey Resource Group	Nowak et al., 2006a
Moorestown, NJ[a]	2000	206	NJ Dept. Env. Protection	
Morgantown, WV	2004	136	West Virginia University	Nowak et al., 2012c
New York, NY	1996	206	ACRT, Inc.	Nowak et al., 2007d
Oakland, CA[b]	1989	1350	USFS	Nowak, 1991
Omaha, NE[a]	2008/09	189	Nebraska Forest Service	
Philadelphia, PA	1996	210	ACRT, Inc.	Nowak et al., 2007b
Roanoke, VA[a]	2010	160	Virginia Tech	
Sacramento, CA[a]	2007	300	Sacramento Tree Foundation	
San Francisco, CA	2004	194	San Francisco Dept. of the Environment	Nowak et al., 2007c
Scranton, PA	2006	182	Northeast PA Urban Forestry Program, Keystone College, Penn State Extension, PA Dept. of Conservation and Natural Resources	Nowak et al., 2010a
Syracuse, NY[a]	2009	198	USFS	
Washington, DC	2004	201	Casey Trees, University of Maryland, National Park Service	Nowak et al., 2006b
Woodbridge, NJ[a]	2000	215	NJ Department of Environmental Protection	
Indiana[c]	2002	32	State Forestry personnel, USFS	Nowak et al., 2007a
Kansas[c]	2008/09	188	State Forestry personnel	Nowak et al., 2012b
Nebraska[c]	2008/09	200	State Forestry personnel	Nowak et al., 2012b
North Dakota[c]	2008/09	299	State Forestry personnel	Nowak et al., 2012b
South Dakota[c]	2008/09	200	State Forestry personnel	Nowak et al., 2012b
Tennessee[c]	2005 09	255	State Forestry personnel, USFS	Nowak et al., 2012a

[a] Unpublished data.
[b] Variable plot size.
[c] 0.067 ha plot size.

900 million tonnes (Nowak, 1994). The most recent analysis, which used data from 10 cities and urban tree cover estimates (Nowak et al., 2001) derived from 1991 Advanced Very High Resolution Radiometer (AVHRR) data, estimated national carbon storage by urban forests at 700 million tonnes (range: 335 million–980 million tonnes) (Nowak and Crane, 2002). Above and below ground biomass in all forestland across the United States, which includes forest stands within urban areas, stored approximately 20.2 billion tonnes of carbon in 2008 (Heath et al., 2011).

The purpose of this paper is to update the national urban tree carbon storage and sequestration estimates using urban field data from 28 cities and 6 states and newer estimates of urban land area and urban tree cover. This new assessment produces more refined statistical estimates of the uncertainty of the national estimates and investigates the overlap between urban forest carbon estimates and U.S. forestland carbon estimates. These carbon storage and sequestration estimates provide better, more up to date information for national carbon estimates (e.g., IPCC, 2006) and can be used to help assess the actual and potential role of urban forests in reducing atmospheric CO_2.

2. Materials and methods

The methods of this study used: (a) field data and model analyses from several cities and states to estimate total carbon storage and sequestration in these areas, (b) photo-interpretation of tree cover in these areas to determine carbon densities per unit of tree cover, and (c) photo-interpretation of tree cover in urban and community areas in each U.S. state to estimate statewide urban forest carbon values. As forest values from the national Forest Inventory and Analysis (FIA) program (hereby referred to as "forestland") overlap with urban estimates (because there are forest stands within urban areas), analysis of forestland plots within urban areas was conducted to determine the overlap between national forestland carbon estimates and national urban forest carbon estimates.

The definition of urban is based on population density using the U.S. Census Bureau's (2007) definition: all territory, population, and housing units located within urbanized areas or urban clusters. The definition of community, which includes cities, is based on jurisdictional or political boundaries delimited by U.S. Census Bureau definitions of incorporated or designated places (U.S. Census Bureau, 2007). Community areas may include all, some, or no urban land within their boundaries, but city areas are often dominated by urban land. As urban land encompasses the more heavily populated areas (population density-based definition) and community land has varying amounts of urban land that are recognized by their geopolitical boundaries (political definition), the category of "urban/community" was created to classify the union of these two geographically overlapping definitions where most people live. Urban land in 2000 occupied 3.1% (24.0 million ha) of the conterminous United States (Nowak et al., 2005), while urban/community land occupied 5.3% (40.4 million ha) (Nowak and Greenfield, 2012b).

Forestlands at the national scale, as defined by the U.S. Department of Agriculture (USDA) Forest Service Forest Inventory and Analysis (FIA) program, are areas at least 0.4 ha (1 ac) in size, at least 36.6 m (120 feet) wide, and at least 10% stocked. To be measured as "forestland", plots must also not be affected by a land use that prevents normal tree regeneration and succession such as mowing, intensive grazing, or recreational activities (USDA Forest Service, 2010). Forestlands are estimated to cover 304 million ha in the United States (Smith et al., 2009). These forestlands include some areas that fall within urban and community areas.

2.1. Field data

Field data were used to determine the entire urban forest structure (e.g., tree species composition and number of trees on all land uses) for 28 U.S. cities and urban areas in 6 states (Table 1). These cities were sampled based on methods developed by the USDA Forest Service for various urban forest research projects (e.g., Nowak et al., 2008) and national urban forest monitoring (Cumming et al., 2008). Data collection was based on random sampling of 0.04 ha (1/10 ac) plots (in cities) or 0.067 ha (four 1/24 ac sub-plots) plots (in urban areas of states) and analyzed using the i-Tree Eco (formerly Urban Forest Effects (UFORE)) model (Nowak et al., 2008). The state plots were based on FIA plot design and data were collected as part of pilot projects testing FIA data collection in urban areas (Cumming et al., 2008). The number of plots collected varied by location (Table 1) with data collection including tree species, stem diameter at 1.37 m above the ground (DBH), tree and crown height, crown width, crown light exposure, and canopy condition. For each tree sampled, carbon storage and annual sequestration were estimated using biomass and growth equations. To aid in national estimates of carbon storage and sequestration, the carbon data are standardized per unit of tree cover.

2.2. Biomass equations

Biomass for each measured tree (minimum tree size 2.54 cm dbh) was calculated using allometric equations and conversion factors from the literature to estimate whole tree dry weight biomass and carbon (see Nowak, 1994; Nowak et al., 2008). These equations are based on forest-grown trees, but as open-grown, maintained trees tend to have less above-ground biomass than predicted by forest-derived biomass equations for trees of the same DBH, biomass results for open-grown urban trees were multiplied by a factor 0.8 (Nowak, 1994). No adjustment was made for trees found in more natural stand conditions (e.g., on vacant lands or in forest preserves). If no allometric equation could be found for an individual species, the average of results from equations of the same genus was used. If no genus equations were found, the average of results from all broadleaf or conifer equations was used.

The carbon estimates yield a standard error of the estimate based on sampling error, rather than error of estimation. Estimation error is unknown and likely larger than the reported sampling error. Estimation error includes the uncertainty of using biomass equations and conversion factors, which may be large, as well as measurement error, which is typically small.

To estimate monetary value associated with urban tree carbon storage and sequestration, carbon values are multiplied by $78.5 per tonne of carbon (range $17.2 128.7 tC ^{1}) based on the estimated social costs of carbon for 2010 with a 3% discount rate (Interagency Working Group, 2010).

2.3. Urban Tree growth and carbon sequestration

Measured tree growth rates for street (Frelich, 1992; Fleming, 1988; Nowak, 1994), park (deVries, 1987), and forest (Smith and Shifley, 1984) trees were standardized to length of growing season and adjusted for site competition and tree condition. The measured tree growth rates were standardized to 153 frost free days based on: Standardized growth (SG) measured growth rate × (153 ÷ number of frost free days of measurement) (Nowak et al., 2008). The 153 days was used as the reference length as this was the minimum length of the growing season from the measured data.

Standardized growth rates of trees of the same species or genera were then compared to determine the average difference between standardized street tree growth and standardized park and forest growth rates. Park growth averaged 1.78 times less than street tree growth, and forest growth averaged 2.29 times less than street tree growth. Crown light exposure (CLE) measurements (number of sides and/or top of tree exposed to sunlight) of 0 1 were used to represent forest growth conditions; 2 3 for park conditions; and 4 5 for open-grown (street tree) conditions. Local tree base growth rate (BG) was then calculated as the average standardized growth rate for open-grown trees (0.83 cm year ^{1}) × number of frost free days ÷ 153. CLE adjusted growth rate was: BG ÷ 2.26 for CLE 0 1; BG ÷ 1.78 for CLE 2 3: and BG ÷ 1 for CLE 4 5 (Nowak et al., 2008).

The CLE adjusted growth rate was then adjusted based on tree condition to determine the final growth rate. For trees in fair to excellent condition, base growth rates are multiplied by 1 (no adjustment), for trees in poor condition (26 50% dieback) growth rates are multiplied by 0.62, critical trees (51 75% dieback) by 0.37, dying trees (76 99% dieback) by 0.13 and dead trees (100% dieback) by 0 (Nowak et al., 2008). Adjustment factors are based on percent crown dieback and the assumption that less than 25% crown dieback has a limited effect on growth rates. The difference in estimates of carbon storage between year x and year $(x + 1)$ is the gross amount of carbon sequestered annually.

Tree death leads to the eventual release of stored carbon. To estimate the net amount of carbon sequestered by the urban trees, carbon emissions due to decomposition of dead trees were calculated based on methods detailed in Nowak and Crane (2002). To estimate the net carbon sequestration rate, the amount of carbon sequestered due to tree growth was reduced by the estimated amount of carbon lost due to tree mortality and decay.

2.4. Tree cover estimates

Tree cover within each sample city was assessed using either photo-interpretation or ground plot measurements of tree cover. Tree cover in urban areas and "urban/community" areas in each state was assessed using photo-interpretation of aerial images circa 2005 (Nowak and Greenfield, 2012b).

2.5. State and national level estimates

Carbon and tree cover data for individual cities and states were used to calculate the total carbon storage and sequestration values standardized to per unit tree cover (kg C m ^{2}; Table 2). The carbon storage standardized values were pooled to determine a national average standardized value and associated standard error. The average standardized value was multiplied by tree cover and associated standard error in urban and urban/community areas in each state (Nowak and Greenfield, 2012b) to estimate state and national totals for carbon storage. As tree growth and thus carbon sequestration can vary by length of growing season, the standardized sequestration values for each sampled city/state were divided by its length of growing season (number of days) to determine the average sequestration per day per unit of tree cover. This average value was multiplied by the average length of growing season and tree cover for each state to estimate state and national totals for annual carbon sequestration.

2.6. Overlap with forest estimates

As national forestland (FIA) data contains data from forest stands in urban areas, and the national urban forest data contains data from forest stands in urban areas, there is an overlap between the two estimates. This overlap leads to double-counting carbon when combining the two estimates for national scale analyses. To estimate the amount of overlap between urban forest and forestland estimates, urban boundaries were overlaid on national FIA plot locations using a geographic information system. Each FIA plot was classified as to whether the plot was 100% forested, partially forested (data were collected only on forested portions of the 4 sub-plots) or 100% non-forest (no data collected).

To estimate the number of FIA plots where data were collected in urban areas within a state, 100% of forested plots were assumed to be sampled, non-forest plots were assumed to be not sampled by field crews, and the number of partial forest plots sampled was estimated as number of partial plots times the average percent urban tree cover in the state (e.g., if tree cover was 50%, then half of the partial forest plots were assumed to be measured). The number of FIA plots measured in urban areas was contrasted with the total number of FIA plots measured in each state to determine the proportion of FIA plots sampled in urban areas.

3. Results

Average carbon storage per square meter of tree cover varies by sampled city and state (Table 2), with overall carbon storage averaging 7.69 kg C m^{-2} (SE 1.36), gross carbon sequestration rate averaging 0.277 kg C m^{-2} year^{-1} (SE 0.045), and net carbon sequestration rate averaging 0.205 kg C m^{-2} year^{-1} (SE 0.041). The net sequestration rate averages 74% of the gross sequestration rate. Total carbon storage and sequestration rates in urban and urban/community areas also varied among the United States (Table 3) with total urban tree carbon storage estimated as 643 million tonnes (SE 23.8 million; value $50.5 billion) and total urban/community tree carbon storage estimated as 1.36 billion tonnes (SE 57.0 million; value $106.9 billion). Annual gross carbon sequestration is 25.6 million tonnes year^{-1} (SE 1.0 million; value $2.0 billion) in urban areas and 50.3 million tonnes year^{-1} in urban/community areas (SE 1.8 million; value $4.0 billion). Annual net carbon sequestration is 18.9 million tonnes year^{-1} (SE 862,000; value $1.5 billion) in urban and 37.2 million tonnes year^{-1} in urban/community areas (SE 1.7 million; value $2.9 billion). However, it should be noted that Alaska contains 17% of the total U.S. urban/community area due to its relatively large community boundaries. If urban/community estimates focus on the conterminous United States, the carbon storage, annual gross sequestration and annual net sequestration estimates drop to 1.1 billion, 44.7 million, and 33.1 million tonnes, respectively (Table 3).

In terms of national overlap between conterminous U.S. forestland estimates and urban forest estimates, 13.7% of urban land, or about 38.6% of all urban tree cover, is measured by the U.S. forest inventory plots. From the national forest plot perspective, about 1.5% of all forestland plots are in urban areas in the

Table 2
Standardized carbon storage and sequestration estimates per unit of tree cover and percent tree cover in measured cities and states.

City/State	Storage		Gross sequestration		Net sequestration		Tree cover	
	kg C m^{-2}	SE	kg C m^{-2} year^{-1}	SE	kg C m^{-2} year^{-1}	SE	%	SE
Arlington, TX	6.37	0.73	0.288	0.028	0.262	0.025	22.5	0.3
Atlanta, GA	6.63	0.54	0.229	0.017	0.175	0.025	53.9	1.6
Baltimore, MD	8.76	1.09	0.282	0.036	0.168	0.032	28.5	1.0
Boston, MA	7.02	0.96	0.231	0.025	0.168	0.023	28.9	1.5
Casper, WY	6.97	1.50	0.221	0.039	0.119	0.038	8.9	1.0
Chicago, IL	6.03	0.64	0.212	0.021	0.149	0.018	18.0	1.2
Freehold, NJ	11.50	1.78	0.314	0.045	0.201	0.050	31.2	3.3
Gainesville, FL	6.33	0.99	0.220	0.032	0.160	0.025	50.6	3.1
Golden, CO	5.88	1.33	0.228	0.045	0.181	0.038	11.4	1.5
Hartford, CT	10.89	1.62	0.329	0.046	0.186	0.051	26.2	2.0
Jersey City, NJ	4.37	0.88	0.183	0.034	0.132	0.035	11.5	1.7
Lincoln, NE	10.64	1.74	0.409	0.063	0.351	0.055	14.4	1.6
Los Angeles, CA	4.59	0.51	0.176	0.017	0.107	0.015	20.6	1.3
Milwaukee, WI	7.26	1.18	0.260	0.033	0.178	0.027	21.6	1.6
Minneapolis, MN	4.41	0.74	0.157	0.023	0.081	0.045	34.1	1.6
Moorestown, NJ	9.95	0.93	0.320	0.030	0.241	0.028	28.0	1.6
Morgantown, WV	9.52	1.16	0.297	0.037	0.231	0.026	39.6	2.2
New York, NY	7.33	1.01	0.230	0.029	0.124	0.028	20.9	1.3
Oakland, CA	5.24	0.19	na	na	na	na	21.0	0.2
Omaha, NE	14.14	2.29	0.513	0.081	0.401	0.066	14.8	1.6
Philadelphia, PA	6.77	0.90	0.206	0.027	0.151	0.023	20.8	1.8
Roanoke, VA	9.20	1.33	0.399	0.058	0.268	0.053	31.7	3.3
Sacramento, CA	7.82	1.57	0.377	0.064	0.327	0.055	13.2	1.7
San Francisco, CA	9.18	2.25	0.241	0.050	0.221	0.046	16.0	2.6
Scranton, PA	9.24	1.28	0.399	0.052	0.296	0.043	22.0	1.9
Syracuse, NY	8.59	1.04	0.285	0.030	0.202	0.039	26.9	1.3
Washington, DC[a]	8.52	1.04	0.263	0.030	0.209	0.026	35.0	2.0
Woodbridge, NJ	8.19	0.82	0.285	0.028	0.208	0.029	29.5	1.7
Indiana	8.80	2.68	0.292	0.077	0.270	0.071	20.1	3.2
Kansas	7.42	1.30	0.284	0.048	0.221	0.040	14.0	1.6
Nebraska	6.67	1.86	0.269	0.074	0.227	0.063	15.0	3.6
North Dakota	7.78	2.47	0.282	0.079	0.134	0.079	2.7	0.6
South Dakota	3.14	0.66	0.128	0.026	0.111	0.022	16.5	2.2
Tennessee	6.47	0.50	0.340	0.021	0.304	0.020	37.7	0.8

na not analyzed.
[a] Tree cover estimated based on high resolution tree cover map of city with an estimated standard error of 2 percent.

conterminous U.S. (9.3 million ha) (Table 4). Carbon storage that is accounted for in both the national forestland and urban forest estimates ranges from 247 million tonnes using the 38.6% urban overlap estimate to 303 million tonnes using the 1.5% national forestland overlap estimate.

4. Discussion

Trees and forests in U.S. urban areas (circa 2005) store 643 million tonnes of carbon (639 million tonnes of carbon in the conterminous U.S.). This new estimate is within range of past estimates for the conterminous U.S. (circa 1990 estimate 700 million tonnes; Nowak and Crane, 2002), but due to the new data, the current estimate has a reduced bound of error. The 95% confidence interval (CI) for the current carbon storage estimate is between 597 million and 690 million tonnes. However, this bound of estimate is conservative as the error estimate is based on sampling error, and does not include estimation error. If community land is combined with the urban land, the total estimate rises to 1.36 billion tonnes with a 95% CI between 1.25 and 1.47 billion tonnes. The relative standard error (SE/total) for carbon storage in urban areas varied among the states from 0.18 to 0.37. Most of this variation is due to differences in SE of tree cover estimates as states had variable sample sizes in estimating tree cover.

Given the potential available space (pervious land) in urban areas of 74.5% or 17.7 million ha (Nowak and Greenfield, 2012b), carbon storage could increase in the United States. However, given the limitations to tree growth and establishment in urban areas imposed by humans (e.g., mowing) and nature (e.g., lack of precipitation), increasing carbon storage in urban areas is not likely without a major effort to change current conditions (both social and physical). As tree cover in urban areas in the United States is on the decline (Nowak and Greenfield, 2012a), carbon storage in urban areas are also likely on the decline. Long term monitoring of urban forests is needed to better understand rates of changes in urban areas and provide better estimates of long term carbon trends.

Carbon storage by trees in forestlands nationally was 20.2 billion tonnes in 2008 (Heath et al., 2011). Given the overlap between urban and U.S. forestland estimates for above and below ground carbon in trees, total U.S. tree carbon storage including urban and forestland areas is estimated at 20.6 billion tonnes. Carbon storage by urban trees nationally is about 3.2% of the estimated carbon stored in U.S. forestland and urban forest trees combined.

Urban tree carbon storage and sequestration in a state is a function of the total amount of urban tree cover. Generally, states in forested regions have higher percent urban tree cover than urban areas in grassland or desert regions (Nowak et al., 2001; Nowak and Greenfield, 2012b). Thus forested regions will typically have the greatest urban forest carbon densities per unit land area. Carbon density per unit of tree cover range from 3.1 to 14.1 kg C m^{-2} and have less variation than carbon estimates per unit of land cover. The carbon per unit of tree cover varies among cities based on variations in tree density, tree size distributions, and species composition.

The estimated rate of carbon storage per square meter of tree cover has decreased from 9.25 kg C m^{-2} (Nowak and Crane, 2002) to 7.69 kg C m^{-2}. This reduction is due to an increased availability of data and better tree cover estimates derived from photo

Table 3
Estimated carbon storage (tonnes), annual sequestration (tonnes yr^{-1}) and sequestration rate in urban and urban/community areas by state. Net sequestration estimates equal 74% of gross sequestration.

State	Storage (x10^6)				Gross sequestration (x10^3)				Rate[b]
	Urban	SE	UC[a]	SE	Urban	SE	UC[a]	SE	
Alabama (AL)	18.7	3.6	53.9	9.8	836	148	2406	402	0.343
Arizona (AZ)	5.5	1.4	21.3	4.3	253	64	981	185	0.354
Arkansas (AR)	7.7	1.6	20.0	3.9	331	66	858	154	0.331
California (CA)	31.4	6.0	66.9	12.3	1591	283	3386	571	0.389
Colorado (CO)	4.4	1.2	10.0	2.3	112	30	257	55	0.197
Connecticut (CT)	23.3	4.3	26.0	4.8	724	123	806	136	0.239
Delaware (DE)	2.3	0.5	2.4	0.5	99	21	106	22	0.335
Florida (FL)	42.9	8.0	62.6	11.4	2650	455	3864	649	0.475
Georgia (GA)	38.5	7.1	60.0	10.9	1770	299	2759	458	0.353
Idaho (ID)	1.1	0.3	1.4	0.5	25	8	33	11	0.184
Illinois (IL)	18.7	3.7	24.4	4.7	688	128	896	161	0.283
Indiana (IN)	9.7	2.2	13.7	2.9	317	67	447	88	0.250
Iowa (IA)	3.8	1.0	7.7	1.8	117	28	240	52	0.240
Kansas (KS)	4.8	1.1	7.3	1.8	176	40	270	62	0.283
Kentucky (KY)	6.5	1.6	9.0	2.0	241	55	334	72	0.286
Louisiana (LA)	10.6	2.2	20.4	4.0	544	109	1052	191	0.397
Maine (ME)	3.8	0.8	13.6	2.7	109	20	390	71	0.221
Maryland (MD)	11.9	2.5	15.6	3.1	497	98	655	123	0.323
Massachusetts (MA)	35.9	6.6	41.1	7.5	1187	199	1359	227	0.254
Michigan (MI)	22.9	4.5	28.9	5.5	654	118	826	146	0.220
Minnesota (MN)	9.3	2.0	27.7	5.3	275	55	825	145	0.229
Mississippi (MI)	7.4	1.6	20.6	4.0	333	67	922	164	0.344
Missouri (MS)	11.2	2.4	20.2	4.0	417	83	750	138	0.285
Montana (MT)	0.5	0.2	21.5	4.2	11	4	514	94	0.184
Nebraska (NE)	1.6	0.4	2.2	0.7	51	13	68	20	0.238
Nevada (NV)	1.3	0.4	5.8	1.5	35	11	155	39	0.207
New Hampshire (NH)	7.1	1.4	12.2	2.3	202	36	344	61	0.217
New Jersey (NJ)	28.0	5.3	34.8	6.4	1069	186	1328	227	0.294
New Mexico (NM)	1.8	0.6	4.9	1.3	62	19	166	44	0.263
New York (NY)	32.1	6.0	43.2	7.9	1005	175	1350	229	0.240
North Carolina (NC)	34.0	6.3	51.0	9.3	1378	236	2067	346	0.312
North Dakota (ND)	0.4	0.1	1.6	0.5	12	4	46	14	0.223
Ohio (OH)	22.9	4.5	32.3	6.1	739	134	1038	182	0.248
Oklahoma (OK)	4.3	1.1	29.1	5.5	187	46	1256	221	0.332
Oregon (OR)	8.1	1.8	10.8	2.3	255	52	339	67	0.242
Pennsylvania (PA)	28.7	5.5	45.4	8.4	911	161	1438	245	0.244
Rhode Island (RI)	4.1	0.8	4.2	0.8	139	26	140	27	0.258
South Carolina (SC)	17.3	3.4	27.1	5.1	760	138	1190	206	0.338
South Dakota (SD)	0.7	0.2	1.8	0.6	21	5	56	17	0.236
Tennessee (TN)	18.9	3.7	38.2	7.1	744	136	1508	259	0.303
Texas (TX)	45.2	8.4	81.4	14.8	2165	370	3897	650	0.368
Utah (UT)	2.1	0.6	7.5	1.8	58	17	210	47	0.215
Vermont (VT)	1.5	0.3	2.8	0.6	42	8	77	15	0.213
Virginia (VA)	16.6	3.3	30.9	5.8	632	117	1174	204	0.293
Washington (WA)	13.8	2.8	23.8	4.6	463	89	799	143	0.258
West Virginia (WV)	5.1	1.1	12.0	2.3	161	31	376	68	0.241
Wisconsin (WI)	9.4	2.1	19.2	3.8	275	57	562	102	0.225
Wyoming (WY)	0.3	0.1	7.4	1.7	7	3	175	39	0.182
US48[c]	638.8	23.8	1126.1	38.9	25,347	955	44,711	1563	0.305
Alaska	2.0	0.4	225.8	41.7	44	7	4945	840	0.168
Hawaii	2.2	0.4	9.0	1.6	167	28	682	112	0.581
US50[d]	643.2	23.8	1361.2	57.0	25,559	956	50,338	1778	0.306

[a] Urban/community land.

[b] Estimated carbon sequestration rate (kg C m^{-2} of tree cover year^{-1}) based on average rate from sample adjusted based on the ratio of the average length of growing season in each state to sample average length of growing season.

[c] Conterminous United States.

[d] 50 states.

interpretation. Storage rates per square meter of tree cover in urban areas (7.69 kg C m^{-2}) are slightly larger than those found within forestlands (7.24 kg C m^{-2}) (Heath et al., 2011). However, this forestland estimate assumes 100% tree cover, which is likely leading to an underestimate of carbon storage per unit of tree cover.

Carbon density rates in this study vary substantially among cities/states from 3.14 to 14.1 kg C m^{-2} cover. This wide range in values illustrates the importance of local forest structure on carbon densities and the need for more local data to refine estimates. This range in values has been illustrated in other studies as well. In the Seattle, WA region, above ground live carbon storage has been estimated at 8.9 kg C m^{-2} with 57% tree cover, which equates to 15.6 kg C m^{-2} of tree cover. These regional values are greater than the urban estimates in our study as the regional values include significant amounts of peri-urban forest stands. When focused on the urban lands, estimates were 0.2 kg C m^{-2} in heavy urban land uses (6% tree cover; or 3.3 kg C m^{-2} of tree cover); 1.5 kg C m^{-2} in medium urban land uses (21% tree cover; or 7.1 kg C m^{-2} of tree cover); and 3.6 kg C m^{-2} in low urban land uses (31% tree cover; or 11.6 kg C m^{-2} of tree cover) (Hutyra et al., 2011). Storage values in our study are comparable to the medium urban land uses in the Seattle region.

Table 4
Statistics on U.S. forestland plots within urban areas by state.

State	Forest plots[a]	Urban plots[b]	Partial forest (%)[c]	100% forest (%)[c]	Urban forest plots[d]	Urban forest (%)[e]	Forest in urban (%)[f]
AL	3614	177	16.9	10.7	35	19.7	1.0
AR	2804	97	17.5	6.2	13	13.7	0.5
AZ[g]	2373	159	44.7	1.9	15	9.2	0.6
CA[g]	4064	765	3.5	0.8	11	1.5	0.3
CO[g]	2312	107	50.5	0.9	10	9.7	0.4
CT	283	181	27.6	15.5	61	33.8	21.6
DE	57	28	10.7	3.6	2	7.6	3.8
FL	2497	679	11.0	5.4	63	9.3	2.5
GA	3849	419	26.3	9.3	96	23.0	2.5
IA	269	96	8.3	3.1	5	5.1	1.8
ID[g]	2010	22	81.8	0.0	2	10.6	0.1
IL	472	385	7.0	3.6	21	5.5	4.5
IN	543	245	8.2	2.9	11	4.7	2.1
KS	157	94	8.5	0.0	2	2.4	1.4
KY	1933	131	13.0	6.9	14	10.4	0.7
LA	2110	189	14.3	5.8	20	10.4	0.9
MA	488	302	28.1	16.9	106	35.0	21.7
MD	338	194	22.7	13.4	40	20.9	12.0
ME	3027	37	54.1	2.7	12	31.9	0.4
MI	2897	365	11.5	4.7	32	8.6	1.1
MN	2224	163	11.7	0.6	7	4.2	0.3
MO	2068	191	11.0	4.2	15	7.6	0.7
MS	3004	96	29.2	6.2	17	18.2	0.6
MT[g]	2805	21	76.2	0.0	1	6.9	0.1
NC	2912	398	26.6	7.5	81	20.4	2.8
ND	70	17	0.0	0.0	0	0.0	0.0
NE	132	51	2.0	0.0	0	0.4	0.1
NH	847	65	43.1	20.0	31	47.6	3.7
NJ	308	306	19.9	8.5	57	18.5	18.4
NM[h]	1308	81	na	na	4	12.0	0.7
NV[g]	339	14	0.0	0.0	0	0.0	0.0
NY	2932	422	21.1	8.3	72	17.0	2.4
OH	1138	424	20.8	6.6	54	12.6	4.7
OK	902	42	19.0	4.8	4	8.4	0.4
OR[g]	2890	110	20.0	2.7	12	10.7	0.4
PA	2548	456	20.2	5.5	56	12.3	2.2
RI	62	44	34.1	4.5	10	23.0	16.3
SC	2036	207	23.7	11.1	46	22.3	2.3
SD	238	17	0.0	5.9	1	5.9	0.4
TN	2211	257	66.9	10.5	94	36.7	4.3
TX	4839	541	10.0	5.9	49	9.1	1.0
UT[g]	2215	74	44.6	0.0	5	6.7	0.2
VA	2569	262	17.9	6.9	34	13.1	1.3
VT	757	18	16.7	11.1	4	19.9	0.5
WA[g]	1531	191	53.9	1.6	37	19.3	2.4
WI	2303	192	12.0	1.6	10	5.1	0.4
WV	1957	69	30.4	8.7	16	23.0	0.8
WY[h]	789	20	na	na	1	9.0	0.2
US[i]	84,031	9421	19.9	6.1	1289	13.8	1.5

[a] Estimated number of forested plots.

[b] Total plots laid in urban areas.

[c] Percent of urban plots.

[d] Estimated number of urban plots that were measured.

[e] Percent of urban plots laid that are forested (urban forest plots/urban plots).

[f] Percent of forest plots within urban areas (urban forest plots/forest plots).

[g] Not all plots sampled to date. Numbers given are for plots with completed data collection. On average, about 76% of the plots have been measured in these western states.

[h] No plot data collected to date. Numbers given are based on all state plots (unsampled). Estimate of urban plots that will have data collection (<0.1% of all plots) assume that urban plots are partially forested proportional to urban tree cover in state.

[i] Conterminous United States.

In three cities in middle Korea: Chuncheon, Kangleung, and Seoul, mean carbon storage by woody plants ranged from 0.47 to 0.72 kg C m^{-2} for urban lands (Jo, 2002), which equates to 3.85–5.58 kg C m^{-2} of tree cover. Annual carbon sequestration values in these urban areas ranged from 0.41 to 0.62 kg C m^{-2} of tree cover year^{-1}. Values in more natural land uses in Korea ranged from 2.6 to 5.87 kg C m^{-2} of tree cover for carbon storage and 0.16–0.39 kg C m^{-2} of tree cover year^{-1} for sequestration assuming 100% tree cover in these areas. The storage values are slightly lower than the U.S. urban average likely due to differences in forest structure. Annual sequestration rate per unit of tree cover are higher likely due to higher growth rates compared to the U.S. average.

In Leipzig, Germany, carbon storage averaged 6.82 kg C m^{-2} of tree cover, but varied from 0.68 kg C m^{-2} of tree cover in afforestation areas to 9.85 kg C m^{-2} of tree cover in riparian forests (Strohbach and Haase, 2012). In Barcelona, Spain, carbon storage averaged 4.45 kg C m^{-2} of tree cover, but varied from 1.53 kg C m^{-2} of tree cover in commercial/industrial areas to 9.67 kg C m^{-2} of tree cover in institutional areas (Chaparro and Terradas, 2009). In Hangzhou, China, carbon storage averaged 4.28 kg C m^{-2} of tree cover (Zhao et al., 2010). Within urban areas of the Boston metropolitan area, above ground carbon storage (live trees, dbh > 5 cm) was estimated at 10.6 kg C m^{-2} of tree cover (Raciti et al., 2012). This value is higher than the national average, but within the range from other U.S. cities (Table 2).

Carbon density rates in this national study (maximum rate of 14.1 kg C m^{-2} cover) are substantially lower than the maximum above ground carbon density for all vegetation in treed areas in Leicester, England (28.1–28.9 kg C m^{-2}) (Davies et al., 2011) and estimates for total carbon within human settlements (23–42 kg C m^{-2}) (Churkina et al., 2010). The human settlement estimates are higher because they account for all carbon (e.g., vegetation, buildings); the Leicester tree estimate could be higher due to increased tree densities (Davies, pers. comm., 2012).

Total annual urban gross carbon sequestration is estimated at 25.6 million tonnes $year^{-1}$ (95% CI 23.7 million–27.4 million tonnes). Total annual urban net carbon sequestration is estimated at 18.9 million tonnes $year^{-1}$ (95% CI 17.2 million–20.6 million tonnes). Urban tree carbon sequestration rates per square meter of tree cover (0.28 kg C m^{-2} $year^{-1}$) from the sampled cities and states fall within range of estimated sequestration rates for the first 15 years of afforestation of crop and pasture land (0.18–0.43 kg C m^{-2} $year^{-1}$) (Lewandrowski et al., 2004). The national average gross sequestration rate per square meter of tree cover is estimated at 0.306 kg C m^{-2} $year^{-1}$, but varies among the states from 0.168 to 0.581 kg C m^{-2} $year^{-1}$ based on length of growing season (Table 3). The net sequestration is estimated at 0.226 kg C m^{-2} $year^{-1}$. Sequestration rates will vary locally based on tree sizes, tree health, and growth rates associated with species and site conditions. Net annual carbon sequestration is positive for growing forests, but sequestration rates will diminish through time as the forest matures. The sequestration will become negative during periods of forest decline and/or loss when carbon emissions from dead trees (e.g., decomposition, fire) exceed carbon uptake by live trees.

The carbon estimates are based on available data from select cities and states, not a random sample of urban areas. However, the standardization of carbon values per unit tree cover allows these standard values to be applied to actual tree cover within an area to provide a reasonable estimate of carbon storage and sequestration. The estimates are reasonable as they are based on, and therefore account for, local tree cover values and local growth rates. State level results would vary from the given estimates if tree diameter distribution, tree density, and to a lesser extent, species composition, varied from the national average per unit of tree cover. Local and national estimates can be improved through field data collection to estimate local forest structure and carbon storage and sequestration.

In addition to direct carbon storage and sequestration reported in this paper, urban trees can also affect carbon emissions in urban areas. Planting trees in energy conserving locations around buildings (e.g., Heisler, 1986) can reduce building energy use and consequently emissions from power plants. Transpirational cooling and changes in albedo due to trees alters urban microclimates that can also reduce carbon emissions from cities (e.g., reduced evaporative emissions with lower air temperatures). Additionally, urban tree management practices need to be considered when estimating the net effects of urban trees on atmospheric CO_2 as various maintenance activities emit carbon back to the atmosphere via fossil fuel combustion (e.g., from chain saws, trucks, chippers) (Nowak et al., 2002). As urban areas produce substantial emissions of carbon, tree effects on carbon emissions through altering of microclimates, albedo, energy use, and maintenance emissions need to be incorporated with tree storage and sequestration estimates to develop a more complete assessment of the role of urban forests on climate change.

Urban soils are estimated to store approximately 1.9 billion tonnes of carbon in the United States (Pouyat et al., 2006), three times more than urban trees. More research is needed on the cumulative effects of trees, soils and their management in urban areas (e.g., Pataki et al., 2006) though carbon estimates for urban ecosystems are improving through time as new data become available. Monitoring of urban and other non forest areas will help improve carbon estimates in urban and other traditionally non forested landscapes. A better understanding and accounting of urban ecosystems can be used to develop management plans and national policies that can significantly improve environmental quality and human health across the nation.

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Arguments to deny the application to destroy the Redwood Tree located at 1430 Mercy Street:

Following the Mountain View City ORDINANCE NO 01.13, SEC. 32.35 Heritage Tree Preservation (page 8), and responding to each paragraph:

paragraph a 1) This tree shows no sign of being at the end of its lifespan, is without obvious disease or infestation, is in general good health, has not suffered damage, is not a public nuisance (it is quite the opposite), nor is it in danger of falling. It does not interfere with utility services. The current property owner says that it does interfere with a proposed or existing structure, however, there are several good options available to mitigate this as seen in the attached Addendum "A" that has been submitted to the Forestry Department by other persons. Note: a different neighbor consulted with a licenced arborist who viewed the tree and said that in his opinion this tree is healthy and not damaged.

Paragraph a 2) It is **Not** necessary to remove this tree in order to construct improvements and/or allow reasonable conforming use of the property. See Addendum "A" mentioned above. Note: I would wonder that Staff and the owner are *not* general contractors, or structural engineers, and so are not qualified to condemn this tree without further investigation. This home has not been declared unsafe or unlivable.

Paragraph a 3) This tree fills *all* of the requirements of this paragraph, including its maturity, its aesthetic qualities such as its canopy, shape and structure, its majestic presence, and its visual impact on the neighborhood. See attached aerial photographs of this tree.

Paragraph a 4) There are no other trees competing for sun or space on this property that would apply.

Paragraph a 5)

subparagraph A: Redwood trees do help soil and water retention.

Paragraph a 5)
sub paragraph B: Mountain View is losing its mature redwood trees at an alarming rate through development and now drought. There are not many left for this ordinance to save. Therefore, the effect of removing this tree is a great negative impact on the entire area, and on the City of Mountain View, especially given the many valuable tasks these trees perform, from reducing energy costs, to carbon storage, to wind and noise buffering and control.
Note: See attached studies, named below under paragraph 5, sub C.

Paragraph a 5)
Sub paragraph C: In removing this tree the neighborhood will lose more shade (increasing energy costs), the noise buffering qualities (more and more people = more and more noise), and protection from wind and air pollution (given the air quality of the last few years this is increasingly important). This tree has historic value given it cannot be replaced by a like-kind tree. It certainly fulfills the scenic beauty task. We also know that in addition to the aforementioned benefits and value of these mighty trees, that these trees contribute to a community's health and prosperity, and general welfare of the entire area and the city as a whole.

See **"Understanding the Benefits and Costs of Urban Forest Ecosystems"**, by David Norwak and John Dwyer, attached, which addresses trees' positive impact on physical and mental health, increased productivity due to increased health, and community health.

Also see the Elsevier Environmental Pollution article "**Tree and forest effects on air quality and human health in the United States**" May 26, 2014, attached, which addresses energy savings, pollution reduction, and other benefits of these trees.

Also see **"Residential building energy conservation and avoided power plant emissions by urban and community trees in the United States"** attached by David J. Nowaka, Nathaniel Appleton, Alexis Ellis, Eric Greenfield.

Please note that I don't expect you to read the entirety of the reports. I believe that even by reading the introductions, conclusions, or just skimming the articles that apply to this topic, will be an eye opening experience, and I include them as expert's opinions to back up the previous statements of my appeal to you.

With respect, following the guidelines of the Heritage Tree Ordinance, this Redwood tree should be preserved, not destroyed. This tree and all of the tasks that it performs should be preserved, not wasted. For everyone. Especially now.

I encourage the committee to deny the application to remove this tree, and I encourage the property owner to develop his property around the majestic gift that he has acquired. This tree cannot be replaced. Please preserve this tree.

Please continue with attachments and photos...

Chapter 2

Understanding the Benefits and Costs of Urban Forest Ecosystems

David J. Nowak[1] and John F. Dwyer[2]

1. Introduction

One of the first considerations in developing a strong and comprehensive urban forestry program is determining the desired outcomes from managing vegetation in cities. Urban trees can provide a wide range of benefits to the urban environment and well-being of people. However, there are also a wide range of potential costs and as with all ecosystems, numerous interactions that must be understood if one is to optimize the net benefits from urban vegetation. Inadequate understanding of the wide range of benefits, costs, and expected outcomes of urban vegetation management options, as well as interactions among them, may drastically reduce the contribution of vegetation toward improving urban environments and quality of life.

By altering the type and arrangement of trees in a city (i.e., the urban forest structure), one can affect the city's physical, biological, and socioeconomic environments. Management plans can be developed and implemented to address specific problems within cities. Although trees can provide multiple benefits at one site, not all benefits can necessarily be realized in each location. Individual management plans should focus on optimizing, in a particular area, the mix of benefits that are most important.

2. Urban Land in the United States

The importance of urban forests and their benefits in the United States is increasing because of the expansion of urban land. The percentage of the coterminous land in United States, classified as urban, increased from 2.5% in 1990 to 3.1% in 2000, an area about the size of Vermont and New Hampshire combined. The states with the

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Urban and Community Forestry in the Northeast, 2nd ed., edited by, J. E. Kuser.

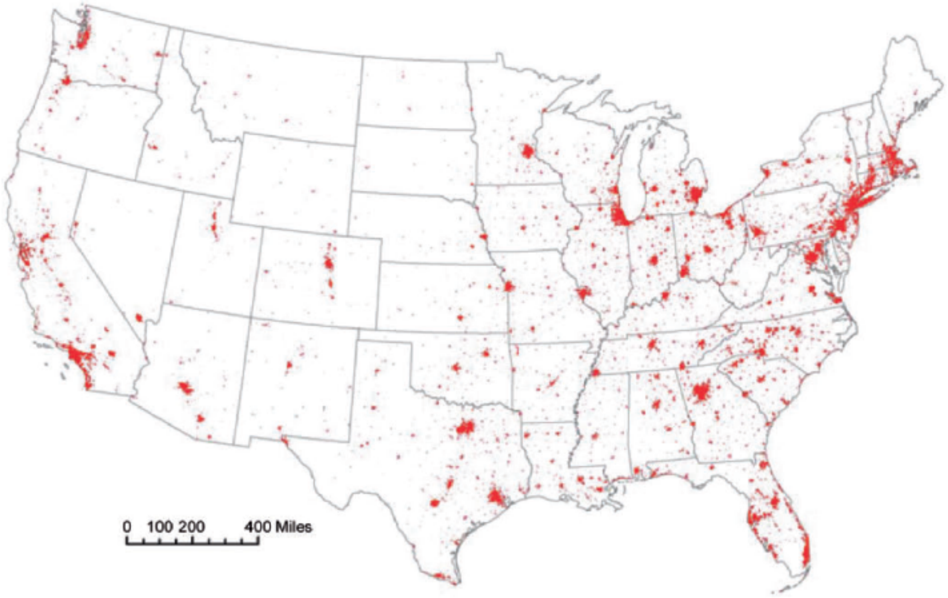

FIGURE 1. Urban areas in coterminous United States (2000) based on the US Census Bureau Definition of Urban Land.

highest percentage of urban land are New Jersey (36.2%), Rhode Island (35.9 %), Connecticut (35.5%), and Massachusetts (34.2%) with 7 of the top 10, most urbanized states in the Northeast United States (Fig. 1) (Nowak et al., 2005).

The most urbanized regions of the United States are the Northeast (9.7%) and the Southeast (7.5%), with these regions also exhibiting the greatest increase in percentage of urban land between 1990 and 2000 (1.5% and 1.8%, respectively). States with the greatest increase in percentage of urban land between 1990 and 2000 were Rhode Island (5.7%), New Jersey (5.1%), Connecticut (5.0%), Massachusetts (5.0%), Delaware (4.1%), Maryland (3.0%), and Florida (2.5%) (Nowak *et al.*, 2005). Nationally, urban tree cover in the United States averages 27.1%. However, urban tree cover tends to be highest in forested regions (34.4% urban tree cover), followed by grasslands (17.8%), and deserts (9.3%) (Dwyer et al., 2000; Nowak et al., 2001).

Patterns of urban growth reveal that increased growth rates are likely in the future (Nowak *et al.*, 2005). As the Northeast is the most urbanized region of the country and is likely to have some of the greatest increases in urban land growth over the next several decades, understanding the benefits and costs of urban vegetation is paramount to sustain human health and environmental quality in this region.

3. Physical/Biological Benefits and Costs of Urban Vegetation

Through proper planning, design, and management, urban trees can mitigate many of the environmental impacts of urban development by moderating climate, reducing building energy-use and atmospheric carbon dioxide (CO_2), improving air quality, lowering rainfall runoff and flooding, and reducing noise levels. However, inappropriate landscape designs, tree selection, and tree maintenance can increase environmental costs, such as pollen production and chemical emissions from trees and maintenance activities that contribute to air pollution, and also increase building energy-use, waste disposal, infrastructure repair, and water consumption. These potential costs must be weighed against the environmental benefits in developing management programs.

3.1. Urban Atmosphere

Trees influence the urban atmosphere in the following four general, interactive ways that can be remembered by using the word TREE (Nowak, 1995): (1) **T**emperature and microclimatic effects, (2) **R**emoval of air pollutants, (3) **E**mission of volatile organic compounds by trees and emissions due to tree maintenance, and (4) **E**nergy conservation in buildings and consequent effects on emissions from power plants. The cumulative effect of these four factors determines the overall impact of urban trees on the urban atmosphere and particularly air pollution.

3.1.1. Temperature and Microclimatic Modifications

Trees influence climate at a range of scales, from an individual tree to a forest covering an entire metropolitan area. By transpiring water, altering windspeeds, shading surfaces, and modifying the storage and exchanges of heat among urban surfaces, trees affect local climate and thereby influence thermal comfort and air quality. Often, one or more of these microclimatic influences of trees produces an important benefit, while other influences can reduce benefits or increase costs (Heisler *et al.*, 1995).

Trees alter windspeed and direction. Dense tree crowns have a significant impact on wind, but for isolated trees, their influence nearly disappears within a few crown diameters downwind (Heisler *et al.*, 1995). Several trees on a residential lot, in conjunction with trees throughout the neighborhood, reduce windspeed significantly. In a residential neighborhood in central Pennsylvania with 67% tree cover, windspeeds at 2 m above ground level were reduced by 60% in winter and 67% in summer compared to windspeeds in a comparable neighborhood with no trees (Heisler, 1990a).

Trees also have a dramatic influence on incoming solar radiation, and can reduce it by 90% or more (Heisler, 1986). Some of the radiation absorbed by tree canopies leads to the evaporation and transpiration of water from leaves. This evapotranspiration cools tree leaves and the air. Despite large amounts of energy used for evapotranspiration on sunny days, air movement rapidly disperses cooled air, thereby dispersing the overall cooling effect. Under individual and small groups of trees, air temperature at 1.5 m above the ground is usually within 1°C of the air temperatures in an open area (Souch and Souch, 1993). Along with transpirational cooling, tree shade can help cool the local environment by reducing the solar heating of some below-canopy artificial surfaces (e.g., buildings, parking lots). Together these effects can reduce air temperatures by as much as 5°C (Akbari *et al.*, 1992).

Although trees usually contribute to cooler summer air temperatures, their presence can increase air temperatures in some instances (Myrup *et al.*, 1991). In areas with scattered tree canopies, radiation can reach and heat ground surfaces; at the same time, the canopy may reduce atmospheric mixing such that cooler air is prevented from reaching the area. In this case, tree shade and transpiration may not compensate for the increased air temperatures due to reduced mixing (Heisler *et al.*, 1995). Thus, it is important to recognize that it is the combined effects of trees on radiation, wind, and transpirational cooling that affect local air temperatures and climate.

Besides providing for transpirational cooling, the physical mass and thermal/radiative properties of trees can affect other aspects of local meteorology and microclimate, such as ultraviolet radiation loads, relative humidity, turbulence, albedo, and boundary-layer heights (i.e., the height of the layer of atmosphere that, because of turbulence, interacts with the earth's surface on a time scale of a few hours or less (Lenschow, 1986)).

3.1.2. Removal of Air Pollutants

Trees remove gaseous air pollution primarily by uptake through leaf stomata, though some gases are removed by the plant surface (Smith, 1990). Once inside the leaf, gases diffuse into intercellular spaces and may be absorbed by water films to form acids or react with the inner surfaces of leaves. Trees also remove pollution by intercepting airborne particles. Some particles can be absorbed into the tree (Ziegler, 1973; Rolfe, 1974), though most intercepted particles are retained on the plant surface. Often vegetation is only a temporary retention site for atmospheric particles as the intercepted particles may be resuspended to the atmosphere, washed off by rain, or dropped to the ground with leaf and twig fall (Smith, 1990).

Pollution removal by trees in a city varies throughout the year (Fig. 2).

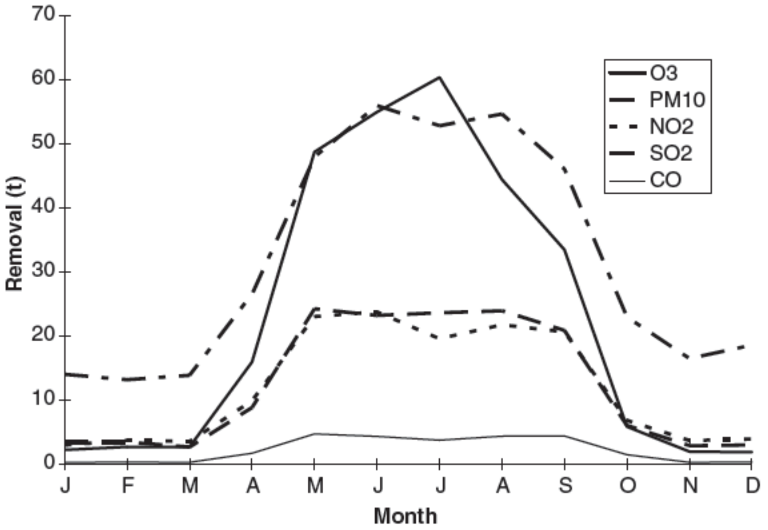

FIGURE 2. Monthly pollution removal by trees (metric tons) in Philadelphia, PA (1994). PM10 = particulate matter <10 microns; O_3 = ozone; NO_2 = nitrogen dioxide; SO_2 = sulfur dioxide; CO = carbon monoxide. PM10 removal assumes 50% resuspension of particles. City area = 350 km^2; tree cover = 21.6%.

Factors that affect pollution removal by trees include the amount of healthy leaf-surface area, concentrations of local pollutants, and local meteorology. Computer simulations using the Urban Forest Effects Model (Nowak and Crane, 2000, Nowak *et al.*, 2002b) with local field data reveal that pollution removal by urban trees in various cities range from 19 metric tons per year in Freehold, New Jersey to over 1500 metric tons per year in Atlanta and New York (Table 1). Pollution removal was typically greatest for ozone, followed by particulate matter less than 10 microns, nitrogen dioxide, sulfur dioxide, and carbon monoxide. Value of pollution removal, based on national median externality values for each pollutant (Murray *et al.*, 1994), ranged from $109,000 in Freehold to $8.3 million in Atlanta.

Average annual pollution removal per square meter of canopy cover was 9.3 g, but ranged between 6.6 g/m^2 in Syracuse and 12.0 g/m^2 in Atlanta (Table 1). The average annual dollar value per hectare of tree cover was $500, but ranged between $378/ha cover in Syracuse and $663/ha cover in Atlanta. As existing canopy cover in cities remove significant amounts of air pollution, increasing tree cover in urban areas will lead to greater pollution removal, as well as reduced air temperatures that can help improve urban air quality.

Average improvement in air quality from pollution removal by trees during the daytime of the in-leaf season among 14 cities (Table 1) was 0.62% for particulate matter less than 10 microns (PM10), 0.61% for ozone (O_3), 0.60% for sulfur dioxide (SO_2), 0.39% for nitrogen dioxide (NO_2), and 0.002% for carbon monoxide (CO). Air quality improvement increases with increased percentage of tree cover and decreased boundary-layer heights. In urban areas (Table 1) with 100% tree cover (i.e., contiguous forest stands), short-term improvements (1 h) in air quality due to pollution removal from trees were as high as 14.9% for SO_2, 14.8% for O_3, 13.6% for PM10, 8.3% for NO_2, and 0.05% for CO. In Chicago in 1991, large, healthy trees—those >77 cm in diameter at breast height (dbh)—removed an estimated 1.4 kg of pollution, about 70 times more pollution than small (<7 cm dbh) trees (Nowak, 1994a).

Trees can also reduce atmospheric CO_2 by directly storing carbon (C) from CO_2 as they grow. Large trees store approximately 3 metric tons of carbon (tC) or 1000 times more carbon than stored by small trees (Nowak, 1994b). Healthy trees continue to sequester additional carbon each year; large, healthy trees sequester about 93 kg C/year vs 1 kg C/year for small trees. Net annual sequestration by trees in the Chicago area (140,600 tC) equals the amount of carbon emitted from transportation in the Chicago area in about 1 week (Nowak, 1994b).

Urban trees in the coterminous United States currently store 700 million metric tons of carbon (335 to 980 million tC; $14,300 million value) with a gross carbon sequestration rate of 22.8 million tC/year (13.7 to 25.9 million tC/year; $460 million/year) (Nowak and Crane, 2002). These results correspond with previous analyses that estimated national carbon storage by urban trees as between 350–750 million tC (Nowak, 1993a) and 600–900 million tC (Nowak, 1994b). Carbon storage by urban trees nationally is only 4.4% of the estimated 15,900 million tC stored in trees in US nonurban forest ecosystems (Birdsey and Heath, 1995). The estimated carbon storage by urban trees in United States is equivalent to the amount of carbon emitted by the US population in about 5.5 months. National annual carbon sequestration by urban trees is equivalent to the US population emissions over a 5-day period (Nowak and Crane, 2002).

Table 1. Total Estimated Pollution Removal (Metric Tons) by Trees During Nonprecipitation Periods (Dry Deposition), and Associated Monetary Value for Various Cities (Pollutant Year = 2000)

City	Pollution removed									
	CO (t)	NO_2 (t)	O_3 (t)	PM10 (t)	SO_2 (t)	Total (t)	Range (t)	g/m^2 cover[a]	$	$/ha cover[b]
New York, NY	67	364	536	354	199	1,521	(619–2,185)	9.1	8,071,000	482
Atlanta, GA	39	181	672	528	89	1,508	(538–2,101)	12.0	8,321,000	663
Baltimore, MD	9	94	223	142	55	522	(183–725)	9.9	2,876,000	545
Philadelphia, PA	10	93	185	194	41	522	(203–742)	9.7	2,826,000	527
San Juan, PR	56	55	161	153	86	511	(222–768)	11.2	2,342,000	511
Washington, DC	18	50	152	107	51	379	(150–568)	8.3	1,956,000	429
Boston, MA	6	48	108	73	23	257	(94–346)	8.1	1,426,000	447
Woodbridge, NJ	6	42	66	62	15	191	(72–267)	10.8	1,037,000	586
San Francisco, CA	7	25	47	42	7	128	(51–195)	9.0	693,000	486
Moorestown, NJ	2	14	43	38	9	107	(41–157)	10.1	576,000	541
Syracuse, NY	2	12	55	23	7	99	(37–134)	6.6	568,000	378
Morgantown, WV	1	5	26	18	9	60	(22–98)	7.5	311,000	387
Jersey City, NJ	2	9	13	9	5	37	(16–56)	8.4	196,000	445
Freehold, NJ	1	3	9	6	1	20	(7–27)	11.4	110,000	632

Estimates are for particulate matter less than 10 microns (PM10), ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and carbon monoxide (CO). Pollution removal model methods are described in Nowak *et al.* (1998). Monetary value of pollution removal by trees was estimated using the median externality values for United States for each pollutant. Externality values are: NO_2 = \$6750 t^{-1}, PM10 = \$4500 t^{-1}, SO_2 = \$1650 t^{-1}, and CO = \$950 t^{-1} (Murray *et al.*, 1994). Externality values for O_3 were set to equal the value for NO_2.

[a] Average grams of pollution removal per year per square meter of canopy cover.

[b] Average dollar value of pollution removal per year per hectare of canopy cover.

Table 2. Estimated Carbon Storage, Gross and Net Annual Sequestration, Number of Trees, and Percent Tree Cover for 10 US Cities (Nowak and Crane, 2002)

City	Storage (tC)		Annual sequestration Gross (tC/yr)		Annual sequestration Net (tC/yr)		No. of trees ($\times 10^3$)		Tree cover (percent)	
	Total	SE	Total	SE	Total	SE	Total	SE	%	SE
New York, NY	1,225,200	150,500	38,400	4,300	20,800	4,500	5,212	719	20.9	2.0
Atlanta, GA	1,220,200	91,900	42,100	2,800	32,200	4,500	9,415	749	36.7	2.0
Sacramento, CA[a]	1,107,300	532,600	20,200	4,400	na	na	1,733	350	13.0	na
Chicago, IL[b]	854,800	129,100	40,100	4,900	na	na	4,128	634	11.0	0.2
Baltimore, MD	528,700	66,100	14,800	1,700	10,800	1,500	2,835	605	25.2	2.2
Philadelphia, PA	481,000	48,400	14,600	1,500	10,700	1,300	2,113	211	15.7	1.3
Boston, MA	289,800	36,700	9,500	900	6,900	900	1,183	109	22.3	1.8
Syracuse, NY	148,300	16,200	4,700	400	3,500	400	891	125	24.4	2.0
Oakland, CA[c]	145,800	4,900	na	na	na	na	1,588	51	21.0	0.2
Jersey City, NJ	19,300	2,600	800	90	600	100	136	22	11.5	1.2

[a] McPherson (1998).
[b] Nowak (1994b).
[c] Nowak (1993c).
SE = standard error.
na = not analyzed.

Carbon storage within the cities ranges from 1.2 million tC in New York City and Atlanta to 19,300 tC in Jersey City, New Jersey (Table 2).

Urban trees in the North Central, Northeast, South Central and Southeast regions of the United States store and sequester the most amount of carbon, with average carbon storage per hectare greatest in Southeast (31.1 tC/ha), North Central (30.7 tC/ha), Northeast (30.5 tC/ha), and Pacific Northwest (30.2 tC/ha) regions, respectively. The national average urban forest carbon storage density is 25.1 tC/ha as compared to 53.5 tC/ha in forest stands (Nowak and Crane, 2002).

3.1.3. Emission of Volatile Organic Compounds and Tree Maintenance Emissions

Some trees emit into the atmosphere volatile organic compounds (VOCs) such as isoprene and monoterpenes. These compounds are natural chemicals that make up essential oils, resins, and other plant products and may be useful to the tree in attracting pollinators or repelling predators (Kramer and Kozlowski, 1979). Isoprene is also believed to provide thermal protection to plants by helping prevent irreversible leaf damage at high temperatures (Sharkey and Singsaas, 1995). The VOC emissions by trees vary with species, air temperature, and other environmental factors (Tingey *et al.*, 1991; Guenther *et al.*, 1994).

Volatile organic compounds can contribute to the formation of O_3 and CO (Brasseur and Chatfield, 1991). Because the VOC emissions are temperature dependent and trees generally lower air temperatures, it is believed that increased tree cover lowers overall VOC emissions and, consequently, reduces O_3 levels in urban areas. A computer simulation of June 4, 1984 ozone conditions in Atlanta, Georgia revealed that a 20% loss in the area's forest could lead to a 14% increase in O_3 concentrations. Although there were fewer trees to emit VOCs, an increase in Atlanta's air temperatures due to the urban heat island, which occurred concomitantly with the tree loss, increased VOC emissions from the remaining trees and anthropogenic sources and altered O_3 photochemistry such that concentrations of O_3 increased (Cardelino and Chameides, 1990).

A simulation of California's South Coast Air Basin suggested that the impact on air quality from increased urban tree cover might be locally positive or negative. The net basinwide effect of increased urban vegetation is a decrease in O_3 concentrations if the additional trees are low-VOC emitters (Taha, 1996). Examples of low-VOC emitting genera include *Fraxinus* spp., *Ilex* spp., *Malus* spp., *Prunus* spp., *Pyrus* spp., and *Ulmus* spp.; high-VOC emitters include *Eucalyptus* spp., *Quercus* spp., *Platanus* spp., *Populus* spp., *Rhamnus* spp., and *Salix* spp. (Benjamin *et al.*, 1996).

Tree management and maintenance also affects pollutant emissions. The equipment used in many maintenance activities emits pollutants and global gases such as VOCs, CO, CO_2, nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter (US EPA, 1991). Thus, while evaluating the overall net change in air quality due to trees, managers and planners must consider the amount of pollution that results from tree maintenance and management activities. The greater the use of fossil fuels (e.g., from vehicles, chain saws, augers, and chippers) in establishing and maintaining a certain vegetation structure, the longer the trees must live and function to offset the pollutant emissions from vegetation maintenance.

While considering the net effect of tree growth on atmospheric CO_2, managers must also consider that nearly all of the carbon sequestered by trees will be converted back to CO_2 due to decomposition after the tree dies. Hence, the benefits of carbon sequestration will be relatively short-lived if vegetation structure is not sustained. However, if carbon (via fossil-fuel combustion) is used to maintain vegetation structure and health, urban forest ecosystems will eventually become net emitters of carbon unless secondary carbon reductions (e.g., energy conservation) or limiting decomposition via long-term carbon storage (e.g., wood products, landfills) can be accomplished to offset the carbon emissions during maintenance (Nowak *et al.*, 2002c).

Trees in parking lots can also help reduce VOCs emissions by shading parked cars and thereby reducing evaporative emissions from vehicles. Increasing parking lot tree cover from 8% to 50% could reduce Sacramento County, California, light duty vehicle VOC evaporative emission rates by 2% and nitrogen oxide start emissions by <1% (Scott *et al.*, 1999).

3.1.4. Net Effects on Ozone

Besides the studies by Cardelino and Chameides (1990) and Taha (1996), other studies reveal that increased urban tree cover can lead to reduced ozone concentrations. Modeling the effects of increased urban tree cover on ozone concentrations from Washington, DC to central Massachusetts revealed that urban trees generally reduce ozone concentrations in cities. Interactions of the effects of trees on the physical and chemical environment demonstrate that trees can cause changes in pollution removal rates and meteorology, particularly air temperatures, wind fields, and mixing-layer heights, which, in turn, affect ozone concentrations. Changes in urban tree species composition had no detectable effect on ozone concentrations (Nowak *et al.*, 2000). Modeling of the New York City metropolitan area also revealed that increasing tree cover by 10% within urban areas could reduce maximum ozone levels by about 4 ppb, which is about 37% of the amount needed for attainment of the National Ambient Air Quality Standard (Luley and Bond, 2002).

Based on the various research on urban tree effects on ozone, the US Environmental Protection Agency (US EPA) released a guidance document that details how new measures, including "strategic tree planting," can be incorporated in State Implementation Plans as a means to help states meet National Ambient Air Quality Standards (US EPA, 2004).

3.1.5. Energy Conservation

Trees can reduce building heating and cooling energy needs, as well as consequent emissions of air pollutants and CO_2 by power plants, by shading buildings and reducing air temperatures in the summer, and by blocking winds in winter. However, trees that shade buildings in winter can also increase heating needs. Energy conservation from trees varies by regional climate, the size and amount of tree foliage, and the location of trees around buildings. Tree arrangements that save energy provide shade primarily on east and west walls and roofs, and wind protection from the direction of prevailing winter winds. However, wind reduction in the summer can lead to increased energy use for air conditioning, but wind and shade effects combined lead to reduced summer energy use for cooling (Akbari *et al.*, 1992; Heisler, 1990b). Energy use in a house with trees can be 20% to 25% lower per year than that for the same house in an open area (Heisler, 1986). It has been estimated that establishing 100 million mature trees around residences in the United States could save about $2 billion annually in reduced energy costs (Akbari *et al.*, 1988).

Proper tree placement near buildings is critical to maximize energy conservation. For example, it has been estimated that annual costs of air conditioning and heating for a typical residence in Madison, Wisconsin, would increase from $671 for an energy-efficient planting design to $700 for no trees and $769 for trees planted in locations that block winter sunlight and provide little summer shade (McPherson, 1987). In this instance, average annual energy savings with properly placed trees were about 4% more than with no trees and 13% more than with improperly placed trees.

3.2. Urban Hydrology

By intercepting and retaining or slowing the flow of precipitation reaching the ground, trees (in conjunction with soils) can play an important role in urban hydrologic processes. They can reduce the rate and volume of stormwater runoff, flooding damage, stormwater treatment costs, and other problems related to water quality. Estimates of runoff for an intensive storm in Dayton, Ohio, showed that the existing tree canopy (22%) reduced potential runoff by 7% and that a modest increase in canopy cover (to 29%) would reduce runoff by nearly 12% (Sanders, 1986). A study of the Gwynns Falls watershed in Baltimore indicated that heavily forested areas can reduce total runoff by as much as 26% and increase low-flow runoff by up to 13% compared with nontree areas in existing land cover and land-use conditions (Neville, 1996). Further, tree cover over pervious surfaces reduced total runoff by as much as 40%; while tree canopy cover over impervious surfaces had a limited effect on runoff.

In reducing runoff, trees function like retention/detention structures. In many communities, reduced runoff due to rainfall interception can also reduce costs of treating stormwater by decreasing the volume of water handled during periods of peak runoff (Sanders, 1986).

There may also be hydrologic costs associated with urban vegetation, particularly in arid environments where water is increasingly scarce or on reactive clay soils where water uptake by roots may cause localized-soil drying, shrinkage, and cracking. Increased water use in desert regions could alter the local water balance and various ecosystem functions that are tied to the desert water cycle. In addition, annual costs of water for sustaining vegetation can be twice as high as energy savings from shade for tree species that use large amounts of water, e.g., mulberry (McPherson and Dougherty, 1989). However, in Tucson, Arizona, 16% of the annual irrigation requirement of trees was offset by the amount of water conserved at power plants due to energy savings from trees (Dwyer *et al.*, 1992).

3.3. Urban Noise

Field tests have shown that properly designed plantings of trees and shrubs can significantly reduce noise. Leaves and stems reduce transmitted sound primarily by scattering it, while the ground absorbs sound (Aylor, 1972). For optimum noise reduction, trees and shrubs should be planted close to the noise source rather than the receptor area (Cook and Van Haverbeke, 1971). Wide belts (30 m) of tall, dense trees combined with soft ground surfaces can reduce apparent loudness by 50% or more (6 to 10 decibels) (Cook, 1978). For narrow planting spaces (<3 m wide), reductions of 3 to 5 decibels can be achieved with dense belts of vegetation, i.e., one row of shrubs along the road and one row of trees behind it (Reethof and McDaniel, 1978). Buffer plantings in these circumstances typically are more effective in screening views than in reducing noise.

Vegetation can also mask sounds by generating its own noise as wind moves tree leaves or as birds sing in the tree canopy. These sounds may make individuals less aware of offensive noises because people are able to filter unwanted noise while concentrating on more desirable sounds (Robinette, 1972). The perception of sounds by humans is also important. By visually blocking the sound source, vegetation can reduce individuals' perceptions of the amount of noise they actually hear (Anderson *et al.*, 1984). The ultimate effectiveness of plants in moderating noise is determined by the sound itself, the planting configuration used, the proximity of the sound source, receiver, and vegetation, as well as climatic conditions.

3.4. Urban Wildlife and Biodiversity

There are many additional benefits associated with urban vegetation that contribute to the long-term functioning of urban ecosystems and the well-being of urban residents. These include wildlife habitat and enhanced biodiversity. Urban wildlife can provide numerous benefits but also have detrimental effects (VanDruff *et al.*, 1995). Urban wildlife can serve as biological indicators of changes in the health of the environment (e.g., the decline of certain bird populations was traced to pesticides), and can provide economic benefit to individuals and society (VanDruff *et al.*, 1995). For example, bird feeding supports a $170 to $517 million American industry (DeGraff and Payne, 1975; Lyons, 1982).

Surveys have shown that most city dwellers enjoy and appreciate wildlife in their day-to-day lives (Shaw *et al.*, 1985). Among New York State's metropolitan residents, 73% showed an interest in attracting wildlife to their backyard (Brown *et al.*, 1979). Feelings of personal satisfaction from helping wildlife were the most frequently reported reason for feeding wildlife in backyards across America (Yeomans and Barclay, 1981). Detrimental wildlife effects include damage to plants and structures, droppings, threats to pets, annoyance to humans, animal bites, and transmission of diseases (VanDruff *et al.*, 1995).

Urbanization can sometimes lead to the creation and enhancement of animal and plant habitats, which, in turn, usually increases biodiversity. For example, tree species diversity and richness in Oakland, California, increased from an index value of about 1.9 (Shannon–Weiner diversity index value) and 10 species in 1850 to 5.1 and >350 species in 1988 (Nowak, 1993c). However, the introduction of new plant species into urban areas can lead to problems for managers in maintaining native plant structure, as exotic plants can invade and displace native species in forest stands. One example of exotic plant invasion in some areas of the northeastern United States is that by Norway maple (*Acer platanoides* L.) (Nowak and Rowntree, 1990). Also, altering vegetation structure in urban areas can change the prevalence of certain tree insects and diseases (Nowak and McBride, 1992) and could increase the potential for urban wildfires (East Bay Hills Vegetation Management Consortium, 1995).

Urban forests can act as reservoirs for endangered species. For example, 20 threatened or endangered faunal species and 130 plant species are listed for Cook County, the most populated county of the Chicago Metropolitan Area (Howenstine, 1993). In addition, urbanites are increasingly preserving, cultivating, and restoring rare and native species and ecosystems (Howenstine, 1993). A notable example of the involvement of a wide range of individuals and groups in the restoration and management of urban natural areas is the work of the Chicago Region Biodiversity Council, often known as Chicago Wilderness (2005).

Because of increased environmental awareness and concerns about quality of life and sustainability of natural systems, ecological benefits of the urban forest are likely to increase in significance over time (Dwyer *et al.*, 1992).

3.5 Phytoremediation

Trees and other plants show significant potential for remediating brownfields, landfills, and other contaminated sites by absorbing, transforming, and containing a number of contaminants (Westphal and Isebrands, 2001). More information about brownfields and the issues and opportunities that they present can be obtained from USEPA (2000) and De Sousa (2003).

4. Social and Economic Benefits and Costs of Urban Vegetation

In conjunction with the many effects of urban trees on the physical/biological environment, trees and associated forest resources can significantly influence the social and economic environment of a city. These influences range from altered aesthetic surroundings and increased enjoyment with everyday life to improved health and a greater sense of meaningful connection between people and the natural environment. The benefits and costs associated with these influences are highly variable within and among urban areas and often difficult to measure. Nevertheless, they reflect important contributions of trees and forests to the quality of life for urban dwellers.

4.1. Benefits to Individuals

Urban forest environments provide aesthetic surroundings and are among the most important features contributing to the aesthetic quality of residential streets and community parks (Schroeder, 1989). Perceptions of aesthetic quality and personal safety are related to features of the urban forest such as number of trees per acre and viewing distance (Schroeder and Anderson, 1984). Urban trees and forests provide significant emotional and spiritual experiences that are important in people's lives and can foster a strong attachment to particular places and trees (Chenoweth and Gobster, 1990; Dwyer *et al.*, 1991; Schroeder, 1991, 2002, 2004). A wide range of individual benefits has been associated with volunteer tree planting and care (Westphal, 1993). Volunteers continue to play an increasingly important role in urban forestry efforts, such as inventory (Bloniarz and Ryan, 1996), and Sommer (2003) encourages exploration of expanding opportunities for resident involvement in tree planting and care.

Nearby nature, even when viewed from an office window, can provide substantial psychological benefits that affect job satisfaction and a person's well-being (Kaplan, 1993). Reduced stress and improved physical health for urban residents have been associated with the presence of urban trees and forests in a number of environments. Living in a green environment has been associated with a wide range of individual benefits, including improved learning and behavior by children in urban areas (Taylor, Kuo, and Sullivan, 2001a, b; Wells, 2000). Experiences in urban parks have been shown to change moods and reduce stress (Hull, 1992a; Kaplan and Kaplan, 1989), and to provide privacy refuges (Hammitt, 2002). Hospital patients with window views of trees have been shown to recover significantly faster and with fewer complications than the patients without such views (Ulrich, 1984). In addition, tree shade reduces ultraviolet radiation and thus can help reduce health problems associated with increased ultraviolet radiation exposure, e.g., cataracts, skin cancer (Heisler *et al.*, 1995).

Many of the benefits associated with urban trees contribute to improved human health in a wide variety of ways, ranging from improved air quality to reduction of stress and interpersonal conflict. With increased concern over obesity and the need for changing lifestyles (e.g., more exercise) to reduce obesity, trees and forests are receiving increased attention as contributing to a solution. This solution ranges from providing environments that encourage exercise (e.g., playing in well-landscaped parks or walking/running along tree-lined streets and trails) to the actual exercise experienced by the many volunteers who work with trees and associated landscapes (Librett *et al.*, 2005). A comprehensive overview of the relationship of urban design to human health and condition concluded, "There are strong public health arguments for the incorporation of greenery, natural light, and visual and physical access to open space in homes and other buildings (Jackson, 2003)."

Along with the human health benefits, such as those outlined above in this section, some decreases in well-being and increases in health care costs may be associated with urban vegetation. This negative side to urban trees is associated with allergic reactions to plants, pollen, or associated animal and insects, diseases such as Lyme disease that are carried by wildlife, injuries from branch or tree failures, and a fear of trees, forests, and associated environments.

4.2. Benefits to Communities

Urban forests can make important contributions to the economic vitality and character of a city, neighborhood, or subdivision. It is no accident that many cities, towns, and subdivisions are named after trees (e.g., Oakland, Elmhurst, Oak Acres) and that many cities strive to be a "Tree City USA." Often, trees and forests on public lands–and on private lands to some extent–are significant "common property" resources that contribute to the economic vitality of an entire area (Dwyer *et al.*, 1992). The substantial efforts that many communities undertake to develop and enforce local tree ordinances and manage their urban forest resource attest to the substantial return that they expect from these investments.

A stronger sense of community and empowerment of inner-city residents to improve neighborhood conditions can be attributed to involvement in urban forestry efforts (Feldman and Westphal, 1999; Westphal, 1999, 2003). Active involvement in tree-planting programs has been shown to enhance a community's sense of social identity, self-esteem, and territoriality; it teaches residents that they can work together to choose and control the condition of their environment. Planting programs also can project a visible sign of change and provide the impetus for other community renewal and action programs (Feldman and Westphal, 1999; Westphal, 1999, 2003). Several studies have shown that participation in tree-planting programs influences individuals' perceptions of their community (Sommer *et al.*, 1994a, 1994b, 1995, 2003). Conversely, a loss of trees within a community can have a significant psychological effect on residents (Hull, 1992b). A useful framework for considering social benefits of urban and community forestry projects has been developed and illustrated with community examples (Westphal, 2003).

Urban trees and forests can help alleviate some of the hardships of inner-city living, especially for low-income groups (Dwyer *et al.*, 1992). Extensive research in inner-city areas of Chicago suggests that urban trees and forests contribute to stronger ties among neighbors, greater sense of safety and adjustment, more supervision of children in outdoor places, healthier patterns of children's play, more use of neighborhood common spaces, fewer incivilities, fewer property crimes, and fewer violent crimes (Kuo, 2003; Kuo *et al.*, 1998; Kuo and Sullivan, 2001a,b; Sullivan and Kuo, 1996).

While there is sometimes concern over the influence of trees and other vegetation in urban areas on the incidence of crime, research has provided management guidelines that can reduce the fear of crime in urban forest areas (Schroeder and Anderson, 1984; Michael and Hull, 1995).

Consumer behavior has been found to be positively correlated with streetscape greening, suggesting important benefits to commercial establishments and a basis for partnerships with the business community in urban forest planning and management (Wolf, 2003a, 2004). However, improper landscaping of business areas can have a negative impact by blocking business signs and/or reducing the attractiveness of the area.

Regardless of the community benefits derived from urban trees, tree planting and maintenance programs might be perceived by some people as an inappropriate use of resources because of the perception that funds for such efforts could be used to address what they see as more critical urban community problems.

4.3. Real Estate Values

The sales value of real estate reflects the benefits that buyers attach to attributes of the property, including vegetation on and near the property. A survey of sales of single-family homes in Athens, Georgia indicated that landscaping with trees was associated with an increase in sales prices of 3.5% to 4.5% (Anderson and Cordell, 1988). Builders have estimated that homes on wooded lots sell on an average for 7% more than equivalent houses on unwooded lots (Selia and Anderson, 1982, 1984). Research in Baton Rouge, Louisiana indicates that mature trees contributed about 2% of the home market (Dombrow *et al.*, 2000). A recent study in Athens, Georgia indicates that an additional percentage increase in relative tree cover is associated with an increase of $296 in residential value (Sydor *et al.*, 2005). A study of small, urban-wildland interface properties in the Lake Tahoe Basin indicates that forest density and health characteristics contributed between 5% and 20% to property values (Thompson *et al.*, 1999). Shopping centers often landscape their surroundings to attract shoppers, thereby increasing the value of the business and shopping center (Dwyer *et al.*, 1992).

Parks and greenways have been associated with increases in nearby residential property values (Corrill *et al.*, 1978; More *et al.*, 1988; Crompton, 2004). Some of these increased values have been substantial, and it appears that parks with "open space character" add the most to nearby property values. Part of the contribution to the value of residential property is associated with the view from that property. A study of the value of a view in the single-family housing market suggests that a good view adds 8% to the value of a single-family house (Rodriquez and Sirmans, 1994). A premium of 5% to 12% in housing prices in the Netherlands was associated with an attractive landscape view from the property (Luttik, 2000). Although this remains to be investigated, parks also may have a negative impact on local property values if these are perceived as unmaintained or a place where undesirable/criminal activities are concentrated.

Increased real estate values generated by trees also produce direct economic gains to the local community through property taxes. A conservative estimate of a 5% increase in residential property values due to trees converts to $25/year on a tax bill of $500 and is equivalent to $1.5 billion/year based on 62 million single-family homes in the United States (Dwyer *et al.*, 1992). However, from a homeowner's perspective, increased tax expense due to trees is an additional annual cost of owning a home.

4.4. Tree Value Formulas

Various approaches and formulas are used to estimate the value of individual trees (see Chapter 19). One of the most widely used is the Council of Tree and Landscape Appraisers' (2000), *Guide for Plant Appraisal*, which estimates the compensation that landowners should receive for the loss of a tree on their property. For smaller trees, the value is the replacement cost. For larger trees, the formula calculates tree value from measured tree variables and tree assessments by professionals. The species, diameter, location, and condition of the tree are an integral part of the assessment. Because the values estimated with the tree valuation formula are not necessarily tied to the functions that trees perform in the urban environment, they do not relate directly to the values associated with the environmental, social, and economic benefits from trees. An exception is a single study that suggested that the formula produced values that were similar to a tree's contribution to residential property values (Morales *et al.*, 1983).

Compensatory values represent compensation to owners for the loss of an individual tree and can be viewed as the value of the tree as a structural asset. Compensatory value is based on the structure in place as an asset, while the functional value is an annual value based on the various functions of the particular structure. Trees can have both positive (e.g., air pollution removal) and negative functional values (e.g., trees can increase annual building energy use in certain locations). Trees also have various maintenance costs, which are essential for maintaining tree health, human safety, and overall tree functional benefits. Management of urban forests is needed to enhance functional values and improve human health and well-being, and environmental quality in cities. Maximizing net functional benefits of the urban forest will lead to the greatest value to society (Nowak *et al.*, 2002a).

Based on the data from eight cities, overall citywide compensatory values ranged between \$23 and \$64/m^2 (\$2.1–\$5.9/feet^2) of tree cover. However, 75% of the city values were between \$27 and \$39 m^2 (\$2.5–\$3.6/feet^2) of cover. The total compensatory value for the urban forests of the 48 adjacent US states is estimated at \$2.4 trillion or \$630/tree (Nowak *et al.*, 2002a).

Urban forest compensatory values can be used to estimate actual or potential loss due to catastrophic agents. For example, the loss to the urban forest in Oakland, California, due to a large fire in 1991 was estimated at \$26.5 million (Nowak 1993b). Compensatory value of potential loss due to Asian longhorned beetle *(Anoplophora glabripennis)* infestation in various US cities ranges between \$72 million (Jersey City, New Jersey) and \$2.3 billion (New York, New York). The estimated maximum potential national urban impact of infestations by *A. glabripennis* is \$669 billion (Nowak *et al.*, 2001b).

4.5. Other Benefits and Costs of Urban Trees and Forests

The presence of urban trees and forests can make the urban environment a more pleasant place to live, work, and spend leisure time. A study of urbanites that use parks and forest preserves indicated that they were willing to pay extra to have trees and forests in recreation areas (Dwyer *et al.*, 1989). For example, they would be willing to pay an addition $1.60/visit to have a site that was “mostly wooded, some open grassy areas under trees” rather than “mowed grass, very few trees anywhere.” The total contribution of trees in urban park and recreation areas to the value of the outdoor leisure and recreation experiences in the United States may exceed $2 billion/year (Dwyer, 1991).

A national survey indicated that drivers prefer trees as a screen of commercial developments along highways (Wolf, 2003b). Reduced driver aggression (Cackowski and Nasar, 2003) and stress recovery (Parsons, *et al.*, 1998) have also been associated with treed thoroughfares. These findings provide the basis for opportunities to incorporate urban forestry into the planning of high-speed urban transportation corridors (Wolf, 2003b).

Urban trees and forests often figure prominently in urban environmental education programs. The high visibility, variability, and complexity of urban forest ecosystems make an outstanding laboratory for environmental education. The lessons learned about forest ecosystems have implications for the management of public and private forest resources far beyond the city boundary (Dwyer and Schroeder, 1994).

Because trees and forests can increase the quality of the urban environment and make spending leisure time there more attractive, there can be a substantial saving in the amount of automobile fuel used because people do not need to drive long distances to reach recreation sites.

At the same time there are direct economic costs associated with urban trees. These include costs of planting, maintenance, management, and removal, as well as costs of damage from falling tree limbs and cracked sidewalks due to tree roots (Dwyer, 1995). However, these costs can be offset by economic benefits generated by trees. For example, homeowners may pay for tree care and driveway repair due to root damage, but receive savings on their utility bill from the energy conserving effects of the trees. At a larger scale, a municipality paying for street and park tree maintenance and management may receive increased tax revenues due to the contribution of trees to property values, and also may achieve savings in storm water management costs due to the influence of trees. Net benefits or costs need to be considered when developing urban vegetation designs or management plans.

5. Benefit–Cost Analyses

The wide range of important benefits and costs that may be associated with managing the urban forest and the significant interactions between the processes that produce important outcomes complicate the analysis of options available to urban forest resource managers. This complexity makes it difficult to predict the influence of trees on the urban environment for various vegetation designs and management options. In many instances, the location of trees with respect to other resources can make a substantial difference in the benefits that they provide, such as with building heating and cooling costs and the management of rights-of-way where improperly placed trees can greatly increase costs. Not all of the benefits are easily translated into monetary terms, and even when they are, it often is difficult to assess the incidence of benefits and costs, i.e., who pays and who gains? Trees planted on a residential property may provide benefits to others in the neighborhood and across the city in terms of aesthetics, reduced air temperatures, and improved air quality. Yet these very trees may present problems for one's neighbor by blocking solar heating through windows in the winter and making it difficult to grow flowers or a vegetable garden in the summer. The management of trees in public areas and rights-of-way often is intertwined with that of other resources, such as park and recreation facilities and programs, streets and roads, utilities, and other aspects of the urban infrastructure. When attempting benefit–cost analyses, one must be aware of these various interconnections, as well as the limitations of the information used in the analyses.

6. Implications for Planning, Design, and Management

It is clear that careful planning and design are critical to increasing the net benefits of trees and forests in urban environments. A change in species or location of trees with respect to each other or buildings and other components of the urban infrastructure can have a major impact on benefits and costs. Similarly, maintenance activities can greatly influence benefits and costs. It often is critical that forest resources are managed in the context of other aspects of the urban structure; including people, buildings, roads and streets, utility rights-of-way, recreation areas, and other open spaces.

Management plans must consider the potential of vegetation to improve individual site conditions or alleviate local problems (e.g., poor air quality, neighborhood revitalization) and design appropriate vegetation structure at the site with consideration of how individual sites interact across the landscape (i.e., the benefits at one site might lead to costs and benefits at other site). Determining the benefits and costs over the urban environment is a complex task that often calls for approaching problems at the landscape level (and sometimes extending beyond the urban system), particularly with respect to aesthetics, meteorology, pest problems, risk of fire, and air quality. Urban landscape designs and management plans must take account of these numerous interactions and the myriad of potential benefits and costs to implement appropriate strategies to maximize the net environmental, social, economic, and human health benefits of urban vegetation. In addition, careful attention must be given to the question of who gains and who pays as a result of forest management efforts across the urban landscape.

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Flynn, Allison

From:	Paul Davis
Sent:	Tuesday, December 7, 2021 11:03 PM
To:	prc@mountainview.gov
Cc:	ronit.bryant@gmail.com; stevefilios@gmail.com; jonathan.mountainview@gmail.com; jsmhome@comcast.net; sandysommer@dslextreme.com
Subject:	Fw: Supporting Appeal of Tree Removal at 1430 Mercy Street

To the Mountain View Parks and Recreation Commission / Urban Forestry Board

Attached is a message I sent in early September contesting approval for the removal of a heritage tree at 1430 Mercy Street; Item 5.1 on the Agenda for your meeting Wednesday evening.

I am surprised that this and the messages from other community members who oppose this approval was not included in your meeting materials. I am unable to attend the meeting on Wednesday evening but hope you realize the extent of opposition in our neighborhood.

Thank you for your consideration and for your good efforts for Mountain View,

Paul Davis

Mountain View, CA 94041

----- Forwarded Message -----
From: Paul Davis
To: parksclerical@mountainview.gov <parksclerical@mountainview.gov>
Sent: Monday, September 6, 2021, 11:11:08 AM PDT
Subject: Supporting Appeal of Tree Removal at 1430 Mercy Street

Forestry Division
City of Mountain View
Attn: Jakob Traconic
231 North Whisman Road
Mountain View, CA 94043

To whomever can help,

I understand that an appeal has been filed to contest approval for the removal of a heritage tree in my neighborhood, Shoreline West, at 1430 Mercy Street. I support the appeal, oppose removal and would like to be notified of any future hearings on this matter.

I oppose removal of this established redwood tree for all the reasons we have an ordinance to protect heritage trees:
1. Trees improve our neighborhoods and make them more livable.
2. Trees improve our air by sequestering carbon dioxide which contributes to all the ills we are currently experiencing in climate change, drought, and fire. Old growth redwoods are some of the most effective sequesters of carbon on earth.
3. An urban canopy can significantly reduce temperatures.

I object to the basis for approval. Any structural issues caused by the tree were fully apparent at the time the property was recently purchased. The new owner was fully aware of this and also that Mountain View protects heritage trees by ordinance. I doubt the prior owner would have been able to secure approval based on needed repairs to structures built long after this tree took root, or that I would be able to remove the heritage trees on my property if I wanted to use that land instead for a structure. If the new owner wants to redevelop the property, there are endless ways to design structures that accommodate and do not damage this priceless part of our neighborhood.

Finally, there are other redwood trees living near this one which may be affected by its removal. UBC Forestry Professor Suzanne Simard demonstrated that organisms living in soil – like fungi – help trees establish and grow. They live inside tree roots and form mycorrhizas (literally "fungus-roots") which help trees acquire nutrients and water from the soil in exchange for carbon. Simard discovered that trees connect to one another through an underground web of mycorrhizal fungi. This network allows trees to communicate by transferring carbon, nutrients and water to one another. Larger trees form hubs that support young trees or seedlings by infecting them with fungi and ferrying them the nutrients they need to grow.

I am sure others will make additional arguments, in more depth with greater clarity. Please listen to them as well.

Sincerely,

Paul Davis

Mountain View, CA 94041-1824

Flynn, Allison

From:	Leslie Friedman
Sent:	Monday, December 6, 2021 8:52 AM
To:	prc@mountainview.gov
Cc:	Steve Filios; jonatham.mountainview@gmail.com; sandysommer@dslextreme.com; Ronit Bryant; Jsmhome
Subject:	Heritage Tree Hearing, Dec. 8
Categories:	Advisory/Council - PRC

To: Officers and Members of the Mountain View Parks and Recreation Commission

To: Parks and Recreation Commission Member Steve Filios

Thank you for the opportunity to speak in support of the appeal on behalf of the Redwood tree at 1430 Mercy Street. I live in that neighborhood. I am including in this message to you the statement I will present at your hearing, Dec. 8.

There is information that I will not include in the statement I will read in order to keep within the 3 minute time allotted. I will add to this letter the names of scientists whose work demonstrates that Redwood trees are considered the best air filters and an observation about civic values.

Scientists who have made studies of the importance of conifers, including cypresses, pines, and Redwoods are Jun-Yang, Urban Ecologist at the Center for Earth System Science, Beijing; Prashant Kumar, founder and director of Global Centre for Clean Air Research, University of Surrey; Rita Baraldi, plant physiologist at the Institute of Bioeconomy of the Italian National Research Council. The scientists of Sempervirens organization also showed that Redwoods capture more CO2 than any other trees. Rob McDonald, lead scientist of the Nature Conservancy organization, addressing international planting of conifers and Redwood trees for air filtering said, “some of the best species for air pollution reduction are non-natives. We should not rule them out for ideological reasons.”

Major cities around the world are planting trees in order to combat their air pollution and protect their buildings. These include Beijing, London, Paris.

Civic Values: I recognize the difficulty of measuring two important civic values, private property and public health, against each other; both are significant. One might ask why one tree matters? Or, why would public health be weighed against one property owner?

Our changed climate and increased air pollution require action to protect the air we breathe. The City of Mountain View has been a leader in working for ecological protections and enhancements, so, why this one tree? This is nothing personal about this property or this owner. While we all wait for the glacially slow action of nations to “do something” about Earth’s changed climate, glaciers have melted.

It is necessary for individuals to make changes in behavior that are do-able and positive. Saving a Redwood tree which can continue to clean our air for hundreds of years is do-able.

It is on all of us to do what we can, step by step, tree by tree to improve what is right in front of us, what we inhale every day, what grandchildren will inhale. I will quote a great teacher: If I am only for myself, what am I? If not now, when? If not this tree, what future tree would qualify to be saved? If not now, when?

My statement for the hearing on Dec. 8 follows. Thank you very much for your kind attention, Leslie Friedman

Hello, I am Leslie Friedman. Thank you for the opportunity to speak to you about this Redwood tree. I will share with you reasons to save the tree. The reasons come from information from a licensed arborist in this county, the world's leading scientists on the power of Redwood trees to reduce air pollution, and observations on civic values.

I hired the arborist to look at the tree and tell me its species, age, health and life expectancy. We had not met before. We did not go on the property. He said it is a California Redwood, about 80 years old, its life expectancy is at least 200 more years, and it is healthy.

Scientists show that Redwoods capture more CO2 from cars, trucks, and power plants than any other tree on earth. When Redwoods are cut down or burned, they release the CO2 and other pollutants which have been sequestered under their bark. The Redwoods' complex canopies trap the pollutants. If someone told you that broadleaf trees are best at filtering our air, it is someone who forgot that their leaves – the part of trees that catch pollutants – fall off. Those trees are bare almost half the year.

Redwoods absorb carbon dioxide and emit oxygen. They capture pollutants including sulphur dioxide, nitrogen dioxide, ammonia and deadly particulate matter. They do this more than any other tree because of their unique, thick bark, size and age.

They shade surfaces, reduce temperatures, and cut need for fans and air-conditioners. Greenhouse gases come with use of A/C. Shade reduces the risk of harmful pollutants like ground level ozone which spikes on hot days in urban and suburban areas. As Mountain View's population grows and becomes denser, this is a serious concern. As fire season grows longer and hotter, pollutants from fires are an urgent health concern.

This Mercy Street Redwood is the only tree on the property. Without this tree there is no shade.

Redwoods capture Particulate Matter. Clouds of minute Particulate Matter crash into the needles, diluting and dispersing PM in the air, decreasing human inhalation. PM is hard to catch – large is one 5th the width of a human hair. Small is 2.5 micrometres across. Particles come from organic chemicals, acids, dust, metals, all emitted from factories, fossil fuel burning vehicles, wild fires.

Approval to kill this tree creates a collision of civic values: private property and public health. The Heritage Tree ordinance describes situations in which a tree should be saved. The public health values of the Redwood tree, its health and life expectancy fit those descriptions. The tree should be saved.

Leslie Friedman, Ph.D., History
Dancer: "with her strong technique and capacity for expression she was simply a joy to watch!"–*The Times*, London
Author: *The Dancer's Garden*, "I love it. It is a perfect book in conception and execution….a marvelous writer..." Diana Ketcham, Editor, *Home & Garden* (ret.), Books Editor, *Oakland Tribune*
The Story of Our Butterflies: Mourning Cloaks in Mountain View, "This is such a wonderful book and I look forward to sharing it with all of the staff here." Joe Melisi, Center for Biological Diversity, National Conservation org., Tucson, AZ

"Leslie Friedman is an historian, dancer and choreographer, and now a perceptive writer about nature. ...in a second splendid work she takes flight into the world of butterflies. ... One is grateful for this delightful book, so well written and illustrated." Peter Stansky, Author, Historian, Professor Stanford University

Flynn, Allison

From:	Leslie Friedman
Sent:	Monday, December 6, 2021 9:33 AM
To:	prc@mountainview.gov
Cc:	Jsmhome; Ronit Bryant; Steve Filios; jonathan.mountainview@gmail.com; sandysommer@dslextreme.com
Subject:	Fw: Heritage Tree Hearing, Dec. 8
Categories:	Advisory/Council - PRC

To: Officers and Members of the Mountain View Parks and Recreation Commission

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It is on all of us to do what we can, step by step, tree by tree to improve what is right in front of us, what we inhale every day, what grandchildren will inhale. I will quote a great teacher: If I am only for myself, what am I? If not now, when? If not this tree, what future tree would qualify to be saved? If not now, when?

My statement for the hearing on Dec. 8 follows. Thank you very much for your kind attention, Leslie Friedman

Hello, I am Leslie Friedman. Thank you for the opportunity to speak to you about this Redwood tree. I will share with you reasons to save the tree. The reasons come from information from a licensed arborist in this county, the world's leading scientists on the power of Redwood trees to reduce air pollution, and observations on civic values.

I hired the arborist to look at the tree and tell me its species, age, health and life expectancy. We had not met before. We did not go on the property. He said it is a California Redwood, about 80 years old, its life expectancy is at least 200 more years, and it is healthy.

Scientists show that Redwoods capture more CO2 from cars, trucks, and power plants than any other tree on earth. When Redwoods are cut down or burned, they release the CO2 and other pollutants which have been sequestered under their bark. The Redwoods' complex canopies trap the pollutants. If someone told you that broadleaf trees are best at filtering our air, it is someone who forgot that their leaves – the part of trees that catch pollutants – fall off. Those trees are bare almost half the year.

Redwoods absorb carbon dioxide and emit oxygen. They capture pollutants including sulphur dioxide, nitrogen dioxide, ammonia and deadly particulate matter. They do this more than any other tree because of their unique, thick bark, size and age.

They shade surfaces, reduce temperatures, and cut need for fans and air-conditioners. Greenhouse gases come with use of A/C. Shade reduces the risk of harmful pollutants like ground level ozone which spikes on hot days in urban and suburban areas. As Mountain View's population grows and becomes denser, this is a serious concern. As fire season grows longer and hotter, pollutants from fires are an urgent health concern.

This Mercy Street Redwood is the only tree on the property. Without this tree there is no shade.

Redwoods capture Particulate Matter. Clouds of minute Particulate Matter crash into the needles, diluting and dispersing PM in the air, decreasing human inhalation. PM is hard to catch – large is one 5th the width of a human hair. Small is 2.5 micrometres across. Particles come from organic chemicals, acids, dust, metals, all emitted from factories, fossil fuel burning vehicles, wild fires.

Approval to kill this tree creates a collision of civic values: private property and public health. The Heritage Tree ordinance describes situations in which a tree should be saved. The public health values of the Redwood tree, its health and life expectancy fit those descriptions. The tree should be saved.

Leslie Friedman, Ph.D., History
Dancer: "with her strong technique and capacity for expression she was simply a joy to watch!"–*The Times*, London
Author: *The Dancer's Garden*, "I love it. It is a perfect book in conception and execution….a marvelous writer..." Diana Ketcham, Editor, *Home & Garden* (ret.), Books Editor, *Oakland Tribune*

The Story of Our Butterflies: Mourning Cloaks in Mountain View, "This is such a wonderful book and I look forward to sharing it with all of the staff here." Joe Melisi, Center for Biological Diversity, National Conservation org., Tucson, AZ

"Leslie Friedman is an historian, dancer and choreographer, and now a perceptive writer about nature. ...in a second splendid work she takes flight into the world of butterflies. ... One is grateful for this delightful book, so well written and illustrated." Peter Stansky, Author, Historian, Professor Stanford University