T&E ITEM 2
April 1, 2013
Worksession 3

Committee members should bring their packets from the February 25 worksession, parts of which are cited in this packet.
Committee members may be asked to retain this packet for future reference.

MEMORANDUM

TO: Transportation, Infrastructure, Energy & Environment Committee

FROM: Michael Faden, Senior Legislative Attorney
Amanda Mihill, Legislative Attorney

SUBJECT: **Worksession 3:** Bill 35-12, Trees – Tree Canopy Conservation

Bill 35-12, Trees – Tree Canopy Conservation, sponsored by the Council President at the request of the County Executive, was introduced on November 27, 2012. A public hearing was held on January 17, 2013, along with Bill 41-12 (see selected testimony, *©29-54*). Transportation, Infrastructure, Energy and Environment Committee worksessions were held on January 28 and February 25.

Bill 35-12 would:

- establish procedures, standards, and requirements to minimize the loss and disturbance of tree canopy as a result of development;
- provide for mitigation when tree canopy is lost or disturbed;
- establish a fund for tree canopy conservation projects, including plantings of individual trees, groups of trees, or forests, on private and public property; and
- generally revise County law regarding tree canopy conservation.

At the first worksession Executive branch staff presented an overview of Bill 35-12 and the issues it raises, and answered Committee members' questions. (See Executive staff presentation, *©63-96.*) The Committee did not take any further action on this Bill at that worksession. At the second worksession, Executive branch staff updated the Committee on discussions they have had with various stakeholders on key issues. Major policy issues raised in testimony and other correspondence are addressed below. Council staff will cover more detailed and technical issues in the memo for the next worksession.

Circle numbers from 29-101 may be cited in this memo but are not included in it. They are included in the February 25 Committee packet, which Committee members should bring to this worksession. This was done to save a few trees.

Issues for Committee Discussion

How do other jurisdictions handle tree canopy protections? At the February 25 worksession, Committee members asked Executive staff to research other jurisdictions that have tree canopy laws and compare them to Bill 35-12. The response from DEP staff is on ©146-158. As DEP staff noted when it transmitted this material:

> This was not any easy task due to the wide variability and complexity of laws in other jurisdictions (imagine someone trying to interpret our Forest Conservation Law, which still sometimes confuses County staff). However, we hope this gives an indication that (1) other jurisdictions have enacted tree protection programs and (2) the approach to doing this varies greatly.

DEP staff also transmitted a USDA Forest Service Study on urban tree canopy retention (see ©136-145). DEP staff noted that:

> This study analyzed the recent change in the urban tree canopy in 20 jurisdictions across the country. Clearly, some of the results of this study would not be applicable to more rural areas of the County, but I think it is applicable in the more urbanized areas (which are increasing). The conclusion notes "Despite various and likely limited tree planting and protection campaigns, tree cover tends to be on the decline in U.S. cities while impervious cover is on the increase. While these individual campaigns are helping to increase or reduce the loss of urban tree cover, more widespread, comprehensive and integrated programs that focus on sustaining overall tree canopy may be needed to help reverse the trend of declining tree cover in cities."

Is the regulatory approach outlined in Bill 35-12 an appropriate way to manage the County's tree canopy? Many organizations and speakers questioned different aspects of the regulatory approach behind Bill 35-12. For instance, Renewing Montgomery and Kenneth Bawer argued that if the County's goal is to retain tree canopy, the law should apply to all property owners regardless of whether they need a sediment control permit. The Maryland National Capital Building Industry Association (BIA) and attorney Timothy Dugan argued that properties that are subject to the forest conservation law should not be subject to a tree canopy law.

Committee members may wish to discuss the following questions with Executive staff and other stakeholders:

- Proposed §55-9(a) (see ©12, lines 279-283) provides that the objective of the bill is to retain existing trees and that "every reasonable effort should be made to minimize the cutting or clearing of trees and other woody plants..." Is this language intended to be a broad policy goal, or is it intended to function as a substantive regulatory standard?
- Why does Bill 35-12 apply only to properties that must obtain a sediment control permit? Why not apply the Bill to all properties? Or trigger the restrictions after a particular amount of tree canopy is disturbed?
- How would this Bill overlap the forest conservation law? Will most properties that are subject to the forest conservation law also be subject to the tree canopy law? Should properties subject to the forest conservation law be exempt from the tree

canopy law? Under Bill 35-12, any tree canopy that is identified as part of a forest in a natural resources inventory/forest stand delineation and subject to a forest conservation plan would not have to pay mitigation fees.

- Bill 35-12 would not require replacing tree canopy where it is removed (i.e., the bill does not require on-site replacement when possible). Should it?
- Bill 35-12 would set a fee based on all canopy within the limits of disturbance, regardless of how much canopy is actually removed. Should the fee structure be set according to how much canopy is removed?

Should Bill 35-12 set canopy goals? Many organizations, including Conservation Montgomery and West Montgomery County Citizens Association, urged that Bill 35-12 be amended to include specific tree canopy goals. Some individuals suggested establishing a no-net loss tree canopy goal; other organizations suggested setting a countywide goal of 55%, with a minimum goal of 40% in all areas evaluated in a county tree canopy assessment.

What is the appropriate fee level? Bill 35-12 would require the payment of a mitigation fee set by Method 3 regulation. The fee would not be applied to the first 5% of the area of tree canopy disturbed and, as already mentioned, would not apply to canopy subject to forest conservation law restrictions. When Committee members pressed for proposed fee levels, DEP staff offered a fee scale based on the forest conservation law's fee-in-lieu payment ($1.05 at 40,000 square feet) (see ©128-135). Some environmental groups, including Conservation Montgomery, urged DEP to set a fee that is high enough to provide incentives to save trees or cover the cost of replacement. The Planning Board was concerned that Bill 35-12 does not set a specific mitigation rate.

What mitigation credits should be available? Some environmental organizations and representatives of the building community seem to agree in theory regarding credits for on-site planting. Conservation Montgomery recommended a 25% canopy fee credit for trees replanted on site (the higher the fee, the higher the level of credit that should be allowed) and a tree protection credit for unusual efforts to save trees on site. Larry Cafritz said that there should be an appreciable credit for homeowners to replant onsite. The Planning Board argued for a credit for protecting individual trees and their critical root zone and for replanting on site. Additionally, BIA expressed concerns that Bill 35-12 does not include a credit for stormwater management structures that builders install on lots to capture stormwater. These structures can impact trees.

Just before this memo went to print, DEP staff submitted an outline of a potential credit program for tree protection and tree planting (see ©159-161).

Should the Parks Department be exempt from Bill 35-12? The County Planning Board and many environmental organizations raised a concern that Bill 35-12 would not exempt the Parks Department from its requirements. As Board Chair Carrier noted in her letter on *©31-32*, many park capital projects involve work under tree canopy and the Department strives to avoid, minimize, and mitigate the negative effects of park projects on native tree canopy. At the February 25 worksession, Executive staff noted that although they were willing to amend Bill 35-12 to assure that the fee the Parks Department pays would be directed back to the Parks system, they concluded that the Parks Department should not be exempt entirely from the bill.

What other exemptions should be allowed? Several organizations or individuals requested certain exemptions from the Bill's requirements:

- As drafted, Bill 35-12 would exempt any tree nursery activity performed with an approved Soil Conservation and Water Quality Plan (see ©6, line 121-123). The Soil Conservation District and the Agricultural Advisory Committee would broaden this exemption to include any agricultural or conservation activity performed with an approved Soil Conservation and Water Quality Plan (see ©112-115).
- Bill 35-12 would exempt any non-coal surface mining conducted in accordance with applicable state law (see ©7, lines 149-150). Tri-State Stone and Building Supply requested the Council to amend the law to specifically exclude quarry operations (see letter from Linowes and Blocher, ©119-121).

Other issues for Committee consideration

- *Tree Conservation Fund* Environmental and builder representatives raised concerns about the Tree Conservation Fund. Conservation Montgomery and Ashton Manor Environmental urged that the Bill be amended to assure that the fund is not used for salaries and other administrative expenses.
- *Should onsite inspections be required?* Conservation Montgomery and Neighbors of the Northwest Branch urged the Bill to require onsite inspections using existing Permitting Services inspection processes.
- *Which if any projects should be grandfathered?* Both attorney Timothy Dugan and Larry Cafritz requested that Bill 35-12 grandfather existing projects. The Bill does not specifically provide when it would take effect or how it would apply to projects that filed applications for sediment control permits or forest conservation law approvals before the Bill takes effect.

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Bill No. 35-12
Concerning: Trees - Tree Canopy Conservation
Revised: 10/25/2012 Draft No. 1
Introduced: November 27, 2012
Expires: May 27, 2014
Enacted:
Executive:
Effective:
Sunset Date: None
Ch. _____, Laws of Mont. Co. _____

COUNTY COUNCIL
FOR MONTGOMERY COUNTY, MARYLAND

By: Council President at the Request of the County Executive

AN ACT to:

(1) save, maintain, and establish tree canopy for the benefit of County residents and future generations;
(2) maximize tree canopy retention and establishment;
(3) establish procedures, standards, and requirements to minimize the loss and disturbance of tree canopy as a result of development;
(4) provide for mitigation when tree canopy is lost or disturbed;
(5) establish a fund for tree canopy conservation projects, including plantings of individual trees, groups of trees, or forests, on private and public property; and
(6) generally revise County law regarding tree canopy conservation.

By adding
Montgomery County Code
Chapter 55, Tree Canopy Conservation
Sections 55-1, 55-2, 55-3, 55-4, 55-5, 55-6, 55-7, 55-8, 55-9, 55-10, 55-11, 55-12, 55-13 and 55-14.

Boldface	***Heading or defined term.***
Underlining	***Added to existing law by original bill.***
[Single boldface brackets]	***Deleted from existing law by original bill.***
Double underlining	***Added by amendment.***
[[Double boldface brackets]]	***Deleted from existing law or the bill by amendment.***
* * *	***Existing law unaffected by bill.***

The County Council for Montgomery County, Maryland approves the following Act:

Sec. 1. Chapter 55 is added as follows:

Article 1. Purpose and General Provisions.

55-1. Short title.

This Chapter may be cited as the Montgomery County Tree Canopy Conservation Law.

55-2. Findings and purpose.

(a) *Findings.* The County Council finds that trees and tree canopy constitute important natural resources. Trees filter groundwater, reduce surface runoff, help alleviate flooding, and supply necessary habitat for wildlife. They cleanse the air, offset the heat island effects of urban development, and reduce energy needs. They improve the quality of life in communities by providing for recreation, compatibility between different land uses, and aesthetic appeal. The Council finds that tree and tree canopy loss as a result of development and other land disturbing activities is a serious problem in the County.

(b) *Purpose.* The purposes of this Chapter are to:

(1) save, maintain, and establish tree canopy for the benefit of County residents and future generations;

(2) maximize tree canopy retention and establishment;

(3) establish procedures, standards, and requirements to minimize the loss and disturbance of tree canopy as a result of development;

(4) provide for mitigation when tree canopy is lost or disturbed; and

(5) establish a fund for tree canopy conservation projects, including plantings of individual trees, groups of trees, or forests, on private and public property.

55-3. Definitions.

In this Chapter, the following terms have the meanings indicated:

Critical Root Zone means the minimum area beneath a tree. The critical root zone is typically represented by a concentric circle centering on the tree trunk with a radius equal in feet to 1.5 times the number of inches of the trunk diameter.

Development plan means a plan or an amendment to a plan approved under Division 59-D-1 of Chapter 59.

Director of Environmental Protection means the Director of the Department of Environmental Protection or the Director's designee.

Director of Permitting Services means the Director of the Department of Permitting Services or the Director's designee.

Forest conservation plan means a plan approved under Chapter 22A.

Forest stand delineation means the collection and presentation of data on the existing vegetation on a site proposed for development or land disturbing activities.

Land disturbing activity means any earth movement or land change which may result in soil erosion from water or wind or the movement of sediment into County waters or onto County lands, including tilling, clearing, grading, excavating, stripping, stockpiling, filling, and related activities, and covering land with an impermeable material.

Limits of disturbance means a clearly designated area in which land disturbance is planned to occur.

Limits of tree canopy disturbance means all areas within the limits of disturbance where tree canopy or forest exists.

Lot means a tract of land, the boundaries of which have been established by subdivision of a larger parcel, and which will not be the subject of further subdivision, as defined by Section 50-1, without an approved forest stand delineation and forest conservation plan.

Mandatory referral means the required review by the Planning Board of projects or activities to be undertaken by government agencies or private and public utilities under Section 20-302 of the Land Use Article of the Maryland Code.

Natural resources inventory means a collection and presentation of data on the existing natural and environmental information on a site and the surrounding area proposed for development and land disturbing activities.

Person means:

(a) To the extent allowed by law, any agency or instrument of the federal government, the state, any county, municipality, or other political subdivision of the state, or any of their units;

(b) An individual, receiver, trustee, guardian, executor, administrator, fiduciary, or representative of any kind;

(c) Any partnership, firm, common ownership community or other homeowners' association, public or private corporation, or any of their affiliates or subsidiaries; or

(d) Any other entity.

Planning Board means the Montgomery County Planning Board of the Maryland-National Capital Park and Planning Commission, or the Planning Board's designee.

Planning Director means the Director of the Montgomery County Planning Department or the Director's designee.

Preliminary plan of subdivision means a plan for a proposed subdivision or resubdivision prepared and submitted for approval by the Planning Board under Chapter 50 before preparation of a subdivision plat.

Project plan means a plan or an amendment to a plan approved under Division 59-D-2 of Chapter 59.

Public utility means any water company, sewage disposal company, electric company, gas company, telephone company, or cable service provider.

Qualified professional means a licensed forester, licensed landscape architect, or other qualified professional who meets all of the requirements under Section 08.19.06.01A of the Code of Maryland Regulations or any successor regulation.

Retention means the deliberate holding and protecting of existing trees and forests on the site.

Sediment control permit means a permit required to be obtained for certain land disturbing activities under Chapter 19.

Site means any tract, lot, or parcel of land, or combination of tracts, lots, or parcels of land, under a single ownership, or contiguous and under diverse ownership, where development is performed as part of a unit, subdivision, or project.

Site plan means a plan or an amendment to a plan approved under Division 59-D-3 of Chapter 59.

Special exception means a use approved under Article 59-G of Chapter 59.

Subwatershed means the total drainage area contributing runoff to a single point, and generally refers to the 8-digit hydrologic unit codes.

Technical Manual means a detailed guidance document adopted under Section 55-13 and used to administer this Chapter.

Tree means a large, woody plant having one or several self-supporting stems or trunks and numerous branches that can grow to a height of at least 20 feet at maturity. **Tree** includes the critical root zone.

Tree canopy means the area of one or many crowns of the trees on a site including trees in forested areas.

Tree Canopy Conservation Fund means a special fund maintained by the County to be used as specified in Section 55-14.

Tree canopy cover means the combined area of the crowns of all trees on the site, including trees in forested areas.

Tree canopy cover layer means the Geographic Information System (GIS) layer, or shape file, that contains polygons outlining the aerial extent of tree canopy in the County or any portion of the County.

55-4. Applicability.

Except as otherwise provided under Section 55-5, this Chapter applies to any person required by law to obtain a sediment control permit.

55-5. Exemptions.

This Chapter does not apply to:

(a) any tree nursery activity performed with an approved Soil Conservation and Water Quality Plan as defined in Section 19-48;

(b) any commercial logging or timber harvesting operation with an approved exemption from the requirements under Article II of Chapter 22A;

(c) cutting or clearing trees in a public utility right-of-way for the construction or modification of electric generation facilities approved under the Maryland Code Public Utilities Article if:

(1) the person cutting or clearing the trees has obtained a certificate of public convenience and necessity required under Sections 7-207 and 7-208 of the Public Utilities Article; and

(2) the cutting or clearing of forest or tree canopy is conducted so as to minimize the loss of both;

(d) routine maintenance or emergency repairs of any facility located in public utility rights-of-way;

(e) routine or emergency maintenance of an existing stormwater management facility, including an existing access road, if the person performing the maintenance has obtained all required permits;

(f) any stream restoration project if the person performing the work has obtained all necessary permits;

(g) the cutting or clearing any tree by an existing airport currently operating with all applicable permits to comply with applicable provisions of any federal law or regulation governing the obstruction of navigable airspace if the Federal Aviation Administration has determined that the trees create a hazard to aviation;

(h) cutting or clearing any tree to comply with applicable provisions of any federal, state, or local law governing the safety of dams; or

(i) any non-coal surface mining conducted in accordance with applicable state law.

Article 2. Tree Canopy Conservation Requirements, Procedures, and Approvals.

55-6. Tree Canopy – General.

(a) *Submissions.* A person that is subject to this Chapter must submit to either the Director of Permitting Services or the Planning Director the following information on the amount of disturbance of tree canopy.

(1) Any person required by law to obtain a sediment control permit for land disturbing activity that is not subject to Chapter 22A must submit a limits of tree canopy disturbance concurrently with the sediment control permit application to the Director of Permitting Services under Section 55-7.

(2) Any person engaging in activity that is subject to Chapter 22A must submit a limits of tree canopy disturbance concurrently with any other plan required under Chapter 22A to the Planning Director under Section 55-8.

(b) *Timing of submissions.* The person must submit the limits of tree canopy disturbance for review in conjunction with the review process for a sediment control permit, forest conservation plan, development plan, project plan, preliminary plan of subdivision, site plan, special exception, or mandatory referral. If a natural resources inventory/forest stand delineation is required, the person must include the aerial extent of the tree canopy with the natural resources inventory/forest stand delineation as specified in Section 22A-10.

(c) *Incomplete submissions.* The Director of Permitting Services or the Planning Director must not approve an incomplete submission.

(d) *Review of submissions.* Each submission required under this Chapter must be reviewed concurrently with the review of any submission required under Article I of Chapter 19 or Chapter 22A.

(e) *Coordination of review.* The Director of Permitting Services and the Planning Director may coordinate the review of any information submitted under subsection (a) with other agencies as appropriate. The reviews may be performed concurrently, and in accordance with, any review coordination required under Chapter 19 or Chapter 22A.

(f) *Time frame of validity.* An approved limits of tree canopy disturbance submission remains valid for:

(1) not more than 2 years unless the Planning Director has approved either a final forest conservation plan or preliminary forest conservation plan that includes the limits of tree canopy disturbance;

(2) not more than 2 years unless a sediment control permit has been issued by the Director of Permitting Services and remains valid; or

(3) 5 years if the accuracy of the limits of tree canopy disturbance has been verified by a qualified professional.

(g) *Issuance of sediment control permit.* The Director of Permitting Services must not issue a sediment control permit to a person that is required to comply with this Article until:

(1) the Planning Board or Planning Director, as appropriate, or the Director of Permitting Services has approved an applicant's limits of disturbance; and

(2) the applicant pays any fee required under this Article.

55-7. Tree Canopy – Submissions to the Director of Permitting Services.

(a) *General.* The limits of tree canopy disturbance information submitted to the Director of Permitting Services must document the extent of the existing area of tree canopy and the total area of tree canopy to be disturbed by the proposed activity.

(b) *Incorporation of limits of tree canopy disturbance.* The limits of tree canopy disturbance information for the subject property must be incorporated in a sediment control permit or the site plan submitted for a building permit.

(c) *The limits of tree canopy disturbance.* The limits of tree canopy disturbance information for the subject site must include:

(1) a map delineating:

(A) the property boundaries;

(B) the proposed limits of disturbance including any off-site areas;

(C) the aerial extent of existing tree canopy cover on the subject site, up to 45 feet beyond the proposed limits of disturbance;

(D) the intersection of aerial extent of existing tree canopy cover and the limits of disturbance; and

(E) any additional information specified by regulation; and

(2) a table summarizing the square footage of:

(A) the property;

(B) the limits of disturbance of the proposed activity;

(C) the aerial extent of existing tree canopy cover;

(D) the limits of tree canopy disturbance; and

(E) any additional information specified by regulation.

(d) *Modification to limits of tree canopy disturbance.* The Director of Permitting Services may approve a modification to an approved limits of tree canopy disturbance if:

(1) the modification is consistent with this Chapter, field inspections or other evaluations reveal minor inadequacies of the plan, and modifying the plan to remedy the inadequacies will not increase the amount of tree canopy removed as shown on the final approved plan; or

(2) the action is otherwise required in an emergency.

(e) *Qualification of preparer.* If a tree canopy cover layer developed by the County is available and is used without alteration, a professional engineer, land surveyor, architect, or other person qualified to prepare erosion and sediment control plans under Chapter 19 is also qualified to prepare the limits of tree canopy disturbance information under this Section. Otherwise, the limits of tree canopy disturbance information must be prepared by a qualified professional as defined in Section 08.19.06.01 of the Code of Maryland Regulations or any successor regulation.

55-8. Tree Canopy – Submission to the Planning Director.

(a) *General.* The limits of tree canopy disturbance information submitted to the Planning Director must document the extent of existing tree canopy and the total area of tree canopy to be disturbed by the proposed activity. The Planning Director may use the information to identify the most suitable and practical areas for tree conservation and mitigation.

(b) *Limits of tree canopy disturbance.* A person that is subject to this Section must submit the same limits of tree canopy disturbance information as required under Section 55-7.

(c) *Incorporation of the limits of tree canopy, the natural resources inventory/forest stand delineation, and forest conservation plan.* If an applicant is required to submit a natural resources inventory/forest stand delineation, the extent of tree canopy must be incorporated into that submission for the same area included in the natural resources inventory/forest stand delineation. If an applicant is required to submit a forest conservation plan, both the extent of tree canopy and the limits of tree canopy disturbance must be incorporated into that submission for the same area included in the forest conservation plan.

(d) *Modification to limits of tree canopy disturbance.* The Planning Director may approve a modification to an approved limits of tree canopy disturbance that is consistent with this Chapter if:

(1) field inspection or other evaluation reveals minor inadequacies of the plan, and modifying the plan to remedy those inadequacies will not increase the amount of tree canopy removed as shown on the final approved plan; or

(2) the action is required because of an emergency.

(e) *Submission for special exception.* If a special exception application is subject to this Chapter, the applicant must submit to the Planning Board any information necessary to satisfy the requirements of this Chapter before the Board of Appeals considers the application for the special exception.

55-9. Tree Canopy – Fee to Mitigate Disturbance.

(a) *Objectives.* The primary objective of this Section is the retention of existing trees. Every reasonable effort should be made to minimize the cutting or clearing of trees and other woody plants during the development of a subdivision plan, grading and sediment control activities, and implementation of the forest conservation plan.

(b) *Fees paid for mitigation.* Mitigation required to compensate for the loss of, or disturbance to, tree canopy must take the form of fees set by regulation under Method 3, which the applicant pays to the Tree Canopy Conservation Fund. Mitigation fees are based on the square footage of tree canopy disturbed and, therefore, increase as the amount of tree canopy disturbance increases. To provide credit for on-site landscaping, mitigation fees must not be applied to the first 5 percent of the area of tree canopy disturbed. Canopy identified as part of any

forest delineated in an approved natural resources inventory/forest stand delineation and subject to a forest conservation plan is not subject to mitigation fees under this Chapter.

Article 3. Enforcement and Appeals.

55-10. Inspections and notification.

(a) *Permission to gain access.* The Director of Permitting Services or the Planning Director may enter any property subject to this Chapter to inspect, review, and enforce.

(b) *Plan to be on site; field markings.* A copy of the approved limits of tree canopy disturbance must be available on the site for inspection by the Director of Permitting Services or the Planning Director. Field markings must exist on site before and during installation of all tree protection measures, sediment and erosion control measures, construction, or other land disturbing activities.

(c) *Inspections.*

(1) The Director of Permitting Services must conduct field inspections concurrently with inspections required for a sediment control permit under Article I of Chapter 19 for any activity subject to Section 55-7.

(2) The Planning Director must conduct field inspections concurrently with inspections required for a forest conservation plan for any activity subject to Section 55-8.

(3) The Director of Permitting Services or the Planning Director may authorize additional inspections or meetings as necessary to administer this Chapter.

(d) *Timing of inspections.* The inspections required under this Section must occur:

(1) after the limits of disturbance have been staked and flagged, but before any clearing or grading begins;

(2) after necessary stress reduction measures for trees and roots have been completed and the protection measures have been installed, but before any clearing or grading begins; and

(3) after all construction activities are completed, to determine the level of compliance with the limits of tree canopy disturbance.

(e) *Scheduling requirements.* A person must request an inspection by:

(1) the Director of Permitting Services within the time required to schedule an inspection under Section 19-12; or

(2) the Planning Director within the time required to schedule an inspection under Section 22A-15.

(f) *Coordination.* The Department of Permitting Services and the Planning Department must coordinate their inspections to avoid inconsistent activities relating to the limits of tree canopy disturbance.

55-11. Penalties and enforcement.

(a) *Enforcement authority.* The Department of Permitting Services has enforcement authority for any activity approved under Section 55-7 and the Planning Board has enforcement authority for any activity approved under Section 55-8.

(b) *Enforcement action.* The Director of Permitting Services or the Planning Director may issue a notice of violation, corrective order, stop-work order, or civil citation to any person that causes or allows a violation of this Chapter.

(c) *Civil penalty.* The maximum civil penalty for any violation of this Chapter or any regulation adopted under this Chapter is $1,000. Each day that a violation continues is a separate offense.

(d) *Other remedy.* In addition to any other penalty under this Section, the Planning Board may seek any appropriate relief authorized under Section 22A-16.

55-12. Administrative enforcement.

(a) *Administrative order.* In addition to any other remedy allowed by law, the Planning Director may at any time, including during the pendency of an enforcement action under Section 55-11, issue an administrative order requiring the violator to take one or more of the following actions within the time specified by the Planning Director:

(1) stop the violation;

(2) stabilize the site to comply with a forest conservation plan;

(3) stop all work at the site;

(4) restore or reforest unlawfully cleared areas;

(5) submit a limits of tree canopy disturbance, forest conservation plan, or tree save plan for the net tract area;

(6) place forested land, reforested land, or land with individual significant trees under long-term protection by a conservation easement, deed restriction, covenant, or other appropriate legal instrument; or

(7) submit a written report or plan concerning the violation.

(b) *Effectiveness of order.* An order issued under this Section is effective when it is served on the violator.

Article 4. Administration

55-13. General.

(a) *Regulations.* The County Executive must adopt regulations, including technical manuals, to administer this Chapter, under Method 2. The

regulations must include procedures to amend a limits of tree canopy disturbance.

(b) *Technical manual.* The technical manual must include guidance and methodologies for:

(1) preparing and evaluating maps of the aerial extent of the tree canopy and the limits of tree canopy disturbance;

(2) providing protective measures during and after clearing or construction, including root pruning techniques and guidance on removing trees that are or may become hazardous;

(3) monitoring and enforcing the limits of disturbance and the limits of tree canopy disturbance; and

(4) other appropriate guidance for program requirements consistent with this Chapter and applicable regulations.

(c) *Administrative fee.* The Planning Board and the County Executive may each, by Method 3 regulation, establish a schedule of fees to administer this Chapter.

(d) *Reports.* On or before March 1 of each year, the Department of Permitting Services, the Planning Board, and the Department of Environmental Protection each must submit an annual report on the County tree conservation program to the County Council and County Executive.

(e) *Comprehensive plan for mitigation.* The Department of Environmental Protection must develop and maintain a comprehensive County-wide plan to mitigate disturbance to tree canopy. The Department of Environmental Protection should develop the plan in consultation with the Planning Department, the Department of Transportation, the Department of General Services,

the Department of Economic Development, the Soil Conservation District, and other agencies as appropriate.

(f) *Sediment control permit application.* To prevent circumvention of this Chapter, the Planning Director and the Director of Permitting Services may require a person to submit an application for a sediment control permit enforceable under this Chapter if that person:

(1) limits the removal of tree canopy or limits land disturbing or construction activities to below requirements for a sediment control permit; and

(2) later disturbs additional tree canopy or land on the same property, or by any other means, such that in total, a sediment control permit would be required.

55-14. Tree Canopy Conservation Fund.

(a) *General.* There is a County Tree Canopy Conservation Fund. The Fund must be used in accordance with the adopted County budget and as provided in this Section.

(b) *Mitigation fees paid into the Tree Canopy Conservation Fund.* Money deposited in the Tree Canopy Conservation Fund to fulfill mitigation requirements must be spent on establishing and enhancing tree canopy, including costs directly related to site identification, acquisition, preparation, and other activities that increase tree canopy, and must not revert to the General Fund. The Fund may also be spent on permanent conservation of priority forests, including identification and acquisition of a site within the same subwatershed where the disturbance occurs.

(c) *Fines paid into the Tree Canopy Conservation Fund.* Any fines collected for noncompliance with a limits of tree canopy disturbance

or forest conservation plan related to tree canopy disturbance must be deposited in a separate account in the Tree Canopy Conservation Fund. The Fund may be used to administer this Chapter.

(d) *Use of the Tree Canopy Conservation Fund.*

(1) Any fees collected for mitigation must be used to:

(A) establish tree canopy;

(B) enhance existing tree canopy through non-native invasive and native invasive species management control, supplemental planting, or a combination of both;

(C) establish forest; and

(D) acquire protective easements for existing forests or areas with existing tree canopy that are not currently protected, including forest mitigation banks approved under Section 22A-13.

(2) The canopy established under paragraph (1)(A) should shade impervious surfaces, manage stormwater runoff, and generally increase tree canopy coverage. Trees native to the Piedmont area of the County should be used, if feasible, to meet the mitigation requirements of this Chapter.

(3) The establishment of tree canopy to satisfy the mitigation requirements of a project must occur in the subwatershed where the project is located. Otherwise the tree canopy may be established anywhere in the County.

LEGISLATIVE REQUEST REPORT

Bill 35-12
Tree Canopy Conservation

DESCRIPTION:	This bill introduces requirements for fees when tree canopy is disturbed. Generally, it applies when a sediment control permit is required under Chapter 19 of the Montgomery County Code and the trees are not subject to Article II of Chapter 22A. The bill requires the fees to be used to plant new trees to mitigate for the loss of benefits provided by the tree canopy. The new trees will be located using a comprehensive approach to enhancing tree canopy across the County.
PROBLEM:	Currently, the Forest Conservation Law (FCL) does not apply to most disturbances to individual trees outside of forests during development. Also, it does not apply to development activity on lots less than approximately one acre. In recent years, a significant increase in development activity on small lots that are not subject to the FCL has raised awareness of the value of trees to all residents, as well as the need to provide communities some compensation for the loss of trees when development occurs.
GOALS AND OBJECTIVES:	This bill is designed to provide mitigation for the loss or disturbance to tree canopy not currently regulated by the FCL, as well as specifying that the fees will be used to plant trees across the county using a comprehensive approach that will enhance the existing canopy.
COORDINATION:	Department of Permitting Services, Maryland-National Capital Park & Planning Commission, Department of Environmental Protection
FISCAL IMPACT:	See Fiscal and Economic Impact Statement
ECONOMIC IMPACT:	See Fiscal and Economic Impact Statement
EVALUATION:	
EXPERIENCE ELSEWHERE:	The Forest Conservation Law, Chapter 22A of the Montgomery County Code, requires mitigation when forest land and/or champion trees, as well as certain other vegetation, are disturbed.
SOURCE OF INFORMATION:	Stan Edwards, Division Chief, Division of Environmental Policy and Compliance, Department of Environmental Protection (7-7748)
APPLICATION WITHIN MUNICIPALITIES:	This bill applies to all municipalities if the land disturbing activity requires a sediment control permit under Chapter 19 of the Montgomery County Code that is approved and enforced by the Department of Permitting Services.
PENALTIES:	Class A

OFFICE OF THE COUNTY EXECUTIVE
ROCKVILLE, MARYLAND 20850

Isiah Leggett
County Executive

MEMORANDUM

October 25, 2012

TO: Roger Berliner, President
County Council

FROM: Isiah Leggett
County Executive

SUBJECT: Proposed Legislation: Tree Canopy Conservation Program

I am transmitting for Council introduction a bill that creates a Tree Canopy Conservation Program which is intended to protect and enhance the County's valuable tree canopy. I am also transmitting a Legislative Request Report, Fiscal Impact Statement, and Economic Impact Statement.

This bill introduces requirements for fees when tree canopy is disturbed as a result of development activity. Generally, the bill applies when a sediment control permit is required under Chapter 19 of the Montgomery County Code and the trees are not subject to the County's Forest Conservation Law (FCL). The bill requires the fees to be used to plant new trees to mitigate the loss of benefits that were provided by the disturbed tree canopy.

When the FCL was adopted, the majority of development in the County was occurring on large, previously undeveloped parcels, much of which was forested. The FCL was intended to provide compensation for the loss of forested land through the long-term protection of undisturbed forest or the planting of new forests. As the amount of undeveloped land in the County has diminished, the majority of development is now occurring on smaller, previously undeveloped "in-fill" properties or as the result of redevelopment of previously built-out sites. While these parcels contain few forests, they often contain significant tree canopy due to the presence of individual trees or clusters of trees not meeting the definition of a forest. These trees provide significant benefits to communities, including helping to reduce ambient temperatures, clean the air, manage stormwater, and generally increasing the economic value of the property. However, the majority of these trees are not covered under the FCL and, as a result, there is no mechanism requiring compensation for the loss of these trees.

The Tree Canopy Conservation Program would be implemented by the Department of Permitting Services or the Montgomery County Planning Department, depending on the nature of the development activity. The process has been designed to be as streamlined as possible by incorporating tree canopy review into the existing sediment control permitting process or the existing FCL review process. The bill outlines the process for determining the extent of disturbed tree canopy subject to regulation, but the specific fee structure would be set by regulation.

(20)

If you have any questions about this bill, please contact Bob Hoyt, Director of the Department of Environmental Protection, at 240-777-7730 or bob.hoyt@montgomerycountymd.gov.

Attachments (4)

c. Bob Hoyt, Director Department of Environmental Protection
Joe Beach, Director, Finance Department
Kathleen Boucher, Assistant Chief Administrative Officer
Marc Hansen, County Attorney
Diane Jones, Director, Department of Permitting Services
Jennifer Hughes, Director, Office of Management and Budget

ROCKVILLE, MARYLAND

MEMORANDUM

September 25, 2012

TO: Timothy L. Firestine, Chief Administrative Officer

FROM: Jennifer A. Hughes, Director, Office of Management and Budget
Joseph F. Beach, Director, Department of Finance

SUBJECT: Bill XX-12 – Tree Canopy Conservation

Please find attached the fiscal and economic impact statement for the above-referenced legislation.

JAH:ms

Attachment

c: Kathleen Boucher, Assistant Chief Administrative Officer
Lisa Austin, Offices of the County Executive
Joy Nurmi, Special Assistant to the County Executive
Patrick Lacefield, Director, Public Information Office
Michael Coveyou, Department of Finance
David Platt, Department of Finance
Stan Edwards, Department of Environmental Protection
Barbara Comfort, Department of Permitting Services
Reginald Jetter, Department of Permitting Services
Alex Espinosa, Office of Management and Budget
Amy Wilson, Office of Management and Budget
Matt Schaeffer, Office of Management and Budget
Naeem Mia, Office of Management and Budget

Fiscal Impact Statement
Bill XX-12 – Tree Canopy Conservation

1. **Legislative Summary**
The proposed bill revises County law regarding tree canopy conservation in an effort to save, maintain, and establish tree canopy for the benefits of County residents and future generations. The bill would maximize tree canopy retention and establishment by establishing fees to be assessed when disturbance to the tree canopy occurs; these fees would then fund mitigation activities to restore the disturbed tree canopy.

The Department of Permitting Services (DPS) and the Maryland National Capital Park and Planning Commission (M-NCPPC) will administer the law; the Department of Environmental Protection (DEP) will have oversight of tree canopy restoration activities.

2. **An estimate of changes in County revenues and expenditures regardless of whether the revenues or expenditures are assumed in the recommended or approved budget. Includes source of information, assumptions, and methodologies used.**
DEP has indicated that new work created as a result of this legislation (tree canopy restoration activities) will have costs that will correlate to the amount of received fees. While the cost of future work is not known, DEP has asserted that any future costs related to tree canopy restoration activities will not exceed collected fees.

A. M-NCPPC has estimated a cost of $12,480 annually and a one-time first-year expenditure of $3,600 related to planning the tree canopy restoration policies outlined in the bill. Some of the specific planning activities related to tree canopy restoration conducted by MNCPPC[1] include:

- Development of a planting plan (One-time investment of 20 work hours)
- Annual Report development (20 work hours)
- Development of a Fee Schedule (One-time investment of 40 work hours)
- Annual adjustment of fee schedules (8 work hours)
- Plan Review Time (60 forest conservation plans per year @ 3 hours per plan)

B. DPS has indicated fiscal impacts relating to the inspection and fine assessments of tree canopy disturbance of approximately $67,118 annually in the following work areas:

500 additional inspection and assessment projects ($25,752/annually)

- **Permit Technicians (250 work hours): $8,878**
(.5 Hrs each project @ Grade 19 midpoint salary of $56,828 plus benefits[2] or $35.51/hr)
- **Permit Services Specialists/Plan Reviewers (125 work hours): $6,166**
(.25 Hrs each project @ Grade 26 midpoint salary of $78,929 plus benefits or $49.33/hr)
- **Inspectors (250 work hours): $10,708**
(.5 Hrs each project @ Grade 23 midpoint salary of $68,531 plus benefits or $42.83/hr)

200 additional complaints relating to tree loss ($41,366/annually)

- **Permit Technicians (200 work hours): $7,102**
(1 Hr each project @ Grade 19 midpoint salary of $56,828 plus benefits or $35.51/hr)

[1] Cost estimates are based on a rate of $60 per hour.
[2] Benefit calculation is 30 percent of base pay.

(23)

- **Inspectors (800 work hours): $34,264**
  (4 Hrs each project @ Grade 23 midpoint salary of $68,531 plus benefits or $42.83/hr)

Revenues resulting from this legislation will depend on the determination of a rate model for tree canopy disturbance fees. The rate model will be established via method 2 regulation.

3. **Revenue and expenditure estimates covering at least the next 6 fiscal years.**
DEP has indicated that new work created as a result of this legislation (tree canopy restoration activities) will have costs that will correlate to the amount of received fees. While the cost of future work is not known, DEP has asserted that any future costs related to tree canopy restoration activities will not exceed collected fees.

DPS reports future expenditures of approximately $62,118 annually (as explained above). The total six-year expenditures for DPS are approximately **$402,708.**

M-NCPPC reports annual expenditures of $12,480 with a one-time startup charge of $3,600 to implement the planning and implementation plan for the bill (as explained above). Total six-year expenditures for M-NCPPC are approximately **$78,480.**

Revenues resulting from this legislation will depend on the determination of a rate model for tree canopy disturbance fees. The rate model will be established via method 2 regulation.

4. **An actuarial analysis through the entire amortization period for each bill that would affect retiree pension or group insurance costs.**
Not applicable. This bill does not affect retiree pension or group insurance costs.

5. **Later actions that may affect future revenue and expenditures if the bill authorizes future spending.**
The bill authorizes the creation of a Tree Canopy Conservation Fund that would fund tree canopy restoration activities in the future.

6. **An estimate of the staff time needed to implement the bill.**
While DEP does not expect the need for additional staff time to implement the bill, future staff needs could change depending on the extent of tree canopy restoration activities resulting from the bill.

DPS reports the need for an additional 1,625 work hours annually in different job classes to implement the bill.

MNCPPC reports the need for an additional 208 hours annually and 60 hours to start up the program in the first year of implementation.

7. **An explanation of how the addition of new staff responsibilities would affect other duties.**

(24)

While DEP does not expect the need for additional staff time to implement the bill, the actual impact on staff will depend on the extent of tree canopy restoration activities as a result of implementing the bill.

DPS reports that the bill would impact both the workload of permitting staff and permit reviewing staff. Estimates for costs of additional work are provided above.

M-NCPPC reports that the bill would impact the workload of forest conservation planners. Estimates for costs of addition work are provided above.

8. **An estimate of costs when an additional appropriation is needed.**
Not applicable.

9. **A description of any variable that could affect revenue and cost estimates.**
DEP has indicated that costs and revenues relating to tree canopy restoration will be dependent on the amount of fees received. The rate model for fees will be established by method 2 regulation.

Article IV, Section 55-13(c) allows for the establishment of a fee for administering the program; this fee would be adopted under method 3. An administrative fee has not been established but could impact revenue and cost estimates.

Article III, Section 55-11(c) establishes a maximum $1,000 civil penalty for violation of the proposed legislation. Fines would be deposited into the Tree Canopy Conservation Fund and could be used to implement any part of the bill. Estimates of revenue from these fines are difficult to predict without knowing the extent of the violations.

10. **Ranges of revenue or expenditures that are uncertain or difficult to project.**
DEP has indicated that costs and revenues relating to tree canopy restoration will be dependent on the amount of fees received. The rate model for fees will be established by method 2 regulation.

Article IV, Section 55-13(c) allows for the establishment of a fee for administering the program; this fee would be adopted under method 3. An administrative fee has not been established but could impact revenue and cost estimates.

Article III, Section 55-11(c) establishes a maximum $1,000 civil penalty for violation of the proposed legislation. Fines would be deposited into the Tree Canopy Conservation Fund and could be used to implement any part of the bill. Estimates of revenue from these fines are difficult to predict without knowing the extent of the violations.

11. **If a bill is likely to have no fiscal impact, why that is the case.**
Not applicable.

(25)

12. Other fiscal impacts or comments.
This bill creates a Tree Canopy Conservation Fund as the account for fees collected as a result of tree canopy disturbance and the source of funds for tree canopy restoration projects. DEP would manage this fund.

13. The following contributed to and concurred with this analysis:
Stan Edwards, Department of Environmental Protection
Barbara Comfort, Department of Permitting Services
Reginald Jetter, Department of Permitting Services
Rose Krasnow, MNCPPC
Amy Wilson, Office of Management and Budget
Matt Schaeffer, Office of Management and Budget
Naeem Mia, Office of Management and Budget

Jennifer A. Hughes, Director
Office of Management and Budget

9/21/12
Date

(26)

Economic Impact Statement
Council Bill XX-12, Tree Canopy Conservation

Background:

The purpose of this legislation is to: 1) save, maintain, and establish tree canopy for the benefit of County residents and future generations; 2) maximize tree canopy retention and establishment; 3) establish procedures, standards, and requirements to minimize the loss and disturbance of tree canopy as a result of development; 4) provide for mitigation when tree canopy is lost or disturbed; and 5) establish a fund for tree canopy conservation projects, including plantings of individual trees, groups of trees, or forests, on private and public property. The proposed legislation generally revises County law regarding tree canopy conservation.

The requirements of this bill are applicable when a sediment control permit is required under Chapter 19 of the Montgomery County Code and the trees are not subject to Article II of Chapter 22A. The bill supplements the Forest Conservation Law (FCL). The FCL does not apply to most disturbances to individual tress outside of forests during development, and it does not apply to development activity on lots less than approximately one acre.

1. The sources of information, assumptions, and methodologies used.

Not applicable

2. A description of any variable that could affect the economic impact estimates.

The economic impact of the bill will vary based on a number of factors including the amount of acreage that is the subject of the sediment control permit, the area of tree canopy on land covered by such a permit, the amount of the fee imposed per square foot of tree canopy disturbed as a result of the development activity subject to the permit, and the market conditions at the time of development. The cost of development for each property will be affected by the amount of tree canopy disturbed times the fee.

3. The Bill's positive or negative effect, if any on employment, spending, saving, investment, incomes, and property values in the County.

The bill may increase the cost for developing some properties, and those costs may affect the gross profit margin to the developers or the price of the property. However, some studies indicate that property with trees can have a higher value than property that is cleared of trees. To the extent that the proposed legislation encourages developers to retain trees, they may realize a higher return than if they clear the site. However, this analysis would vary by property and market conditions and would need to factor in the cost of removing trees as well as the impact of the cost of the fee. With a specific fee structure it will be possible to estimate these potential costs.

(27)

Economic Impact Statement
Council Bill XX-12, Tree Canopy Conservation

4. If a Bill is likely to have no economic impact, why is that the case?

Not applicable; see item 3.

5. The following contributed to and concurred with this analysis: David Platt and Mike Coveyou, Finance and Stan Edwards, Environmental Protection.

Joseph F. Beach, Director
Department of Finance

9/12/12
Date

(28)

Circles 29-101 are found in the February 25 Committee packet and are not reprinted in this packet.

Testimony of Diane Cameron
Before the Montgomery County Council
on behalf of the Montgomery County Stormwater Partners Network
on Bills 35-12 (Tree Canopy Conservation) and 41-12 (Roadside Trees)
January 17, 2013

Good evening, I am Diane Cameron, Coordinator of the Montgomery County Stormwater Partners. On behalf of the Stormwater Partners, whose 22 member organizations support improved water quality in Montgomery County, I am here tonight to give support to these two bills – the Tree Canopy and Roadside Tree bills, and to generally support the direction of further improvements that several Stormwater Partners member groups have requested for the Tree Canopy bill.

- We support initiatives that will increase the tree canopy in Montgomery County, as essential to the health of our local streams and to the success of our stormwater permit.
- The intent of these two bills is to reverse the trends in massive tree canopy losses in Montgomery County; we support this intent.
- We strongly support the Street Tree Bill, since our street trees are unacknowledged stormwater managers, that kept healthy and replaced when lost so they can help keep our streams healthy.
- The Planning Board and others have highlighted the need to amend the Tree Canopy bill in order to correct some gaps. We have listed below a set of 6 improvements to the Tree Canopy Bill. We look forward to having the chance to provide further input in the next few weeks.

The Tree Canopy bill, 35-12, provides mitigation in the form of fees and replanting to be done by the County, for loss or damage to trees not otherwise covered by the existing Forest Conservation Law. The Street Tree bill, 41-12, seeks to deter the wanton removal of roadside trees through requiring a permit for actions that would damage such trees. Taken together, these bills will help to slow the loss of Montgomery's tree canopy. The paying of fees to mitigate and replace lost trees might – if the fees are high enough - serve as a deterrent to reckless tree-cutting. Permits such as those in the Street tree bill, create a mechanism to scrutinize proposed actions and ensure they are proper.

Particularly in the downcounty area, the loss of urban trees has been alarming in recent years. We appreciate that Department of Environmental Protection (DEP) staff worked hard on these bills, as have several key individuals and member organizations of the Stormwater Partners, and we applaud the efforts of all who have gotten us this far in the very difficult process of protecting street trees and the urban tree canopy.

Attached to my written testimony is the Stormwater Partners' position summary, listing the 12-point agenda for improvements to the Stormwater Permit. Point number 8 reads:

> ***"Require actions to protect and restore forested stream buffers and other forested areas, linked to a strengthened county Forest Conservation Law."***

The reason we included protection and restoration of forested areas in a stormwater agenda, is that trees, groves and forests are by far our best, most cost-effective stormwater managers. In fact, we have asked DEP to work with us to pilot-test several tree-based stormwater management practices, because they are the most effective, multifunctional, and least expensive approach to runoff reduction.

Improvements to Bill 35-12 requested by the Conservation Montgomery, (among other organizations); items 1 through 3 are requested by the Montgomery County Planning Board:

1. Parks stewardship projects need to be exempt, as are DEP's own stewardship projects.

2. Additional mitigation options must be identified. For instance, Homeowner or builder should have the option to replant onsite themselves approved native species. Also, builders could be given stormwater retention credit for trees that they plant on a building site. There is ample evidence that trees are the most cost-effective stormwater management measures. In fact, Audubon Naturalist Society and Conservation Montgomery have proposed a Stormwater-Tree Practice Specification to DEP and the Department of Permitting Services. We crafted this Stormwater-Tree Practice in close coordination with local builders.

3. The mitigation rate is still unknown and needs to be determined.

4. Set a countywide canopy goals (we think 55 to 60% is the range for the canopy goal, with minimum goals of 40% in all areas evaluated in the county tree canopy assessment used by the Planning Department)

5. Bill 35-12 proposes to delegate Department of Permtting Services (DPS) with a new role in implementation of tree canopy regulations, yet DPS is not prepared for this new role. . There must be an International Society for Arboriculture (ISA)-certified arborist within DPS. If an ISA-certified arborist is assigned with duties under the provisions in Bill 41-12, perhaps the same professional can administer the urban canopy legislation.

6. The maximum civil penalty of $1,000 is far too low. The penalties should be increased along with setting a substantial cost for demolition of mature tree canopy.

potomac conservancy 8601 Georgia Ave • Suite 612 • Silver Spring, MD 20910 • 301.608.1188
www.potomac.org

TESTIMONY OF
HEDRICK BELIN, EXECUTIVE DIRECTOR
POTOMAC CONSERVANCY

January 17, 2013

Thank you for the opportunity to speak tonight. My name is Hedrick Belin, and I live in Silver Spring Maryland. I'm also fortunate to lead the Potomac Conservancy which has nearly 4,000 members, including 1,000 in Montgomery County. We fight every day to safeguard the Potomac River and its surrounding lands through conservation and advocacy.

Our message tonight is simple – trees matter.

Trees matter to people, to our communities and to our economy.

- Trees improve water quality by absorbing rain water where it falls and cost-effectively filtering polluted runoff before it reaches our local creeks and streams.

- Trees reduce neighborhood flooding and the associated property damage when it rains by reducing the volume and slowing the velocity of water.

- Trees enhance the recreational resources in our communities, whether it is a walkable residential street or streams where we fish.

If we want a healthy Nation's River, if we want children to be able to play in Sligo Creek without getting sick, if we want a safe drinking water supply, then we need to do everything we can to stop pollution from flowing across the land when it rains. And a key ingredient to achieving this goal is having a robust, healthy tree canopy in our urban and suburban communities.

That's why Potomac Conservancy supports the passage of Montgomery County Council Bill 35-12 (Urban Tree Canopy Bill) and Bill 41-12 (Roadside Tree Protection Bill)

Both pieces of legislation offer elegant, simple solutions to compliment the county's current Forest Conservation Law. This law has made great strides towards protecting larger tracts of forested land in the county. But within the more urban areas of the county, we continue to lose trees.

Let's be clear. There will be future development and redevelopment of private property in the county. With this additional development, Bill 35-12 allows a property owner to cut down healthy trees on smaller lots and pay into a fund dedicated to replacing those trees.

We recognize that there will be proposed changes to Bill 35-12. We believe a future version of this bill must include provisions that:

1) Exempt park stewardship projects from this legislation
2) Offer additional mitigation options to provide incentives to preserve healthy trees on site
3) Specify the mitigation rate and set it at a meaningful level to deter the unnecessary removal of mature and healthy trees
4) Set a county-wide tree canopy goal of at least 55 percent with minimum goal of at least 40 percent in all areas evaluated in the county tree canopy assessment
5) Ensure the Department of Planning Services has ISA-certified arborists on staff to ensure the successful implementation of the legislation and the associate regulations
6) Set the maximum civil penalties at a higher level than $1,000/day, again to provide a meaningful incentive to protect healthy, mature trees.

In addition, Bill 41-12 presents a timely solution for the protection of trees in the public right of way. These trees are a valuable community asset, just the way a side walk is a community asset. And when that publically owned community asset is removed, it must be replaced.

We look forward to continuing to work with Council Members, as well as county staff, to ensure we enact strong protections for these community assets.

Overall, the Potomac Conservancy advocates for protecting existing trees and strategically replanting more trees in order to improve the water quality in the Potomac watershed. We call on the County Council to promptly move both pieces of legislation forward to send a strong signal to our citizens that an important community asset – trees – matter.

Thank you.

Testimony on
Bill 41-12, Streets & Roads – Roadside Trees – Protection
Bill 35-12, Tree Canopy Conservation

Clark Wagner, Pleasants Development
MNCBIA, VP - Montgomery County

Good evening, my name is Clark Wagner with Pleasants Development and the MNCBIA. I will be testifying on both tree bills.

As a developer in the building industry for the last 12 years, and as a municipal planning professional for the 15 prior years, I can relate to these bills quite well. In fact I wrote the Forest Conservation law, Tree Ordinance, and Tree Manual for the City of Gaithersburg, many moons ago. I am also a four-year member of the county's Forest Conservation Advisory Committee.

Regarding the Roadside Tree bill, I do not see the need for a law that is completely redundant to the existing state Roadside Tree Law. The only problems that I have heard relative to the state law are ones associated with a lack of enforcement. Currently, the county has the authority to augment enforcement of the state law, without this bill being enacted. I don't see any reason to create a new permit, a new fee, and a new replacement fund, when we have a state law in place that has been working for decades. If we want to improve compliance with the state law, then we should utilize existing staff and better educate the public to accomplish that goal. As you know, we are currently undertaking steps to streamline the development review process and this bill seems to run contrary to those efforts.

Regarding the Tree Canopy Conservation bill, I have been involved with a small group of builders who in the recent past were negotiating a new tree bill with Conservation Montgomery, negotiations that ended in an impasse over how many trees builders should be required to plant. I believe the bill you have before you is so flawed, and so unnecessary, that we need to simply start over. Here are the problems I see with this bill.

1. **There is no evidence that we are losing tree canopy** in Montgomery County and therefore no sound basis for this bill. The 2009 study by the University of Vermont found the county to have a 50% Tree Canopy Coverage overall, much higher than any of the neighboring jurisdictions. In the down-county the percentages are the highest, exceeding 60% (how did that happen with no tree canopy bill in place for the past 50 years?), and in the up-county the canopy is the lowest due to the amount of farmland.

The middle section of the county is where the tree canopy has the potential to increase the most, since this section of the county developed in the last 30 years, and many of these trees have not fully matured. Of course there are some small urban areas, like the CBD's that have lower canopy coverage, but that is to be expected. This bill does not take into account that new trees are planted every year: By homeowners, By commercial property owners, By homeowner associations, By utility companies (Pepco planted 3,000 trees in the county last year), By the Parks Department, By the School System, and By builders and developers, who often end up planting more trees than current laws require. I believe that if the research was done, we would find our tree canopy percentage is actually increasing from year to year.

2. **The bill is in essence just a tax** on builders and home owners, once again setting up a new plan review, with a new application fee, and a new mitigation fee.

3. Through the FCL developers are currently discouraged from impacting existing forest on their sites, and forced to impact existing individual trees that would be covered under this bill. This is not fair. We should be able to build on some portion of our land without coming under opposing mitigation requirements. **Any new tree planting bill should only apply to properties that ARE NOT subject to the forest conservation law**.

4. There is **no credit for the new storm water management** structures that builders install on the lots to capture storm water, and invariably impact trees in the process. One set of regulations should not cause fees to be paid under a separate set of regulations.

5. There is also **no recognition that builders and developers must impact trees to install utilities**, when they have very little flexibility in where the utility service is located.

In Conclusion, I strongly suggest you reject both the Roadside Tree bill and the Tree Canopy bill at this time and allow industry representatives work with the environmental community to craft something that is more workable. Thank you very much.

Faden, Michael

From: ginnybarnes@juno.com
Sent: Monday, February 25, 2013 8:17 AM
To: Faden, Michael
Subject: Fw: Tree Bills @ T&E

Mike - FYI - ginny

----- Forwarded Message -----
From: ginnybarnes@juno.com
To: Josh.Faust@montgomerycountymd.gov, councilmember.berliner@montgomerycountymd.gov
Date: Mon, 25 Feb 2013 08:09:52 -0500
Subject: Tree Bills @ T&E
Message-ID: <20130225.051024.31248.163903@mailpop03.vgs.untd.com>

Conservation Montgomery

Working together to enhance our quality of life

Hi Josh

We'd like Roger to know that we (Conservation Montgomery - Caren Madsen, Ginny Barnes and Alan Bowser on behalf of our coalition members) met with DEP staff (Director Hoyt, Stan Edwards and Laura Miller), Rick Brush from DPS and Kathleen Boucher on February 15th and presented a list of the changes we need to see in order to support **Bill 35-12.**

DEP went over their prior meeting with Parks staff, Chairman Carrier and Mark Pfefferle and encouraged us to reach consensus with Park and Planning on outstanding issues. Caren and I subsequently met with Mark Pfefferle and did so. All this was in preparation for DEP taking our collective changes to the County Executive. Apparently this meeting did take place late last week. However, the County Executive does not agree with our changes. You will hear about it this morning.

We are disappointed primarily in the unwillingness to grant an exemption to Parks (who are in the business of saving trees) or to set a canopy fee that has any meaning. We believe the canopy fee should be high enough to provide incentives to save trees and if they can't be saved, to cover the cost of replacement. Please remember that this bill is not intended nor will it do any more than make a dent in canopy lost in our urban areas. I'd suggest you ask DEP staff today to give you an estimate of what it costs per sq. ft. to replace trees of any size on site or elsewhere.

Below is the list of changes we still want to see and we are in agreement with P&P on these:

At the most basic:

1) Parks - We are in agreement on a full exemption for Parks (that should be revised in the bill).
2) Mitigation options

- We are in agreement that up to 25% of canopy fee credit for trees replanted on site. We favor a list offering choices of trees depending on what the site will accommodate. (see below)

- We are in favor of tree protection credit for unusual effort to save trees on site.
- We agree that the higher the fee, the higher the level of mitigation credit that should be offered (as discussed in our meeting last Friday) and the lower the fee rate, the lower the level of credit that should be allowed under the bill.

3) Fees for Canopy disturbance

P&P has no official stand on canopy fee rate but agrees (as above) that the higher the fee, the higher the level of credit that should be allowed (up to 50%). But the lower the fee, the lower the credit should be allowed (up to 25%). At a staff level, though, Mark concurs that ideally the fee should be in keeping with the cost of replanting.

4) Canopy Goals - We are in agreement that canopy goals need to be addressed somehow. How about including them in a countywide planting plan (targeted plan done as a collaborative effort between Planning Department, DEP, and DOT?)

5) Arborculture expertise at DPS - Rick agrees it's needed and we understand this is already underway.

6) Quality, species and size of trees

We agree there should be standards in place to guide choices of tree species. Choices from a small and large canopy tree list should be based on 20-yr. canopy. This will help to get canopy planted where it will be lost.

7) Site Inspections - On site inspections are doable at minimal expense using existing DPS inspection procedures. This is taking into consideration the need for additional training for DPS inspectors and the addition of an ISA-certified arborist at DPS.

8) Management of Tree Conservation Fund - As Kathleen noted, language will be added to clarify management of the fund and that the fund not to be used for salaries. We all agree this is needed in the bill.

Regards .....Ginny Barnes

Ginny Barnes, *Vice Chair*,
Conservation Montgomery
(301) 762-6423

Bill 35-12, Trees -- Tree Canopy Conservation
1/17/2013 testimony by Kenneth A. Bawer, 8 Cleveland Ct, Rockville, MD 20850
(kbawer@msn.com)

Dear Councilmembers:

I have a special interest in tree conservation as a volunteer Weed Warrior Supervisor for the Parks Department and as a Board member of the Maryland Native Plant Society. Tonight, however, I am only speaking on my own behalf.

I wholeheartedly thank the County Executive and the Council President for submitting Bill 35-12 to the County Council. Protection for tree canopies on small lots is long overdue and I enthusiastically support this effort in principle.

The benefits of trees are not disputed: improved air quality due to their uptake of pollutants, uptake of carbon dioxide which slows global warming, shade which counteracts summer heat, absorption of storm water which decreases runoff into eroded stream valleys, decreased noise pollution, and valuable wildlife habitat.

What may be disputed is the financial impact this bill will have on the building community. The fact is that there will be NO negative financial impact if there is no tree canopy disturbance. A Scenic America Technical Bulletin (1) states that in two studies of developers, "it was found that preserving trees on site was a sound economic decision." In one of the studies, all of the "builders reported that they were always able to recover the extra costs of preserving trees in a higher sales price for the house." In the other study, "The builders reported that public demand is higher for houses with trees and any extra costs incurred in preserving trees were recovered in the final sales price." Finally, a statement from the National Association of Home Builders (2) says, "Trees are aesthetically pleasing and are well known to increase real estate values by as much as 15 percent."

While I support the concept of this Bill, there are a number of concerns I have about the Bill as written.

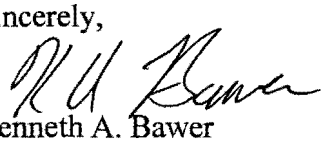
1. The bill should consider the protection of heritage and specimen trees.
2. All mitigation fees generated by Department of Park projects should be returned to the Department of Parks.
3. The bill should be expanded to include tree removal even when a sediment control permit is NOT required. Existing homeowners are removing non-hazardous, healthy trees at an alarming rate for reasons such as desiring more light. Trees greater than a certain diameter should require a removal permit which should be granted only if a tree is either a current hazard to property or is in the footprint of a proposed, approved structure.

Bill 35-12, Trees -- Tree Canopy Conservation
1/17/2013 testimony by Kenneth A. Bawer, 8 Cleveland Ct, Rockville, MD 20850
(kbawer@msn.com)

4. Section 55-7 (d) (2) (line 237) says "The Director of Permitting Services may approve modification to an approved limits of tree canopy disturbance if the action is otherwise required in an emergency." As the saying goes, "Poor planning on your part does not constitute an emergency on my part." Thus, the term "emergency" should be explicitly defined.
5. In Section 55-8 (d) (2) (line 272): Again, the term "emergency" should be explicitly defined.
6. In Section 55-9 (a) (line 280), states "Every reasonable effort should be made to minimize the cutting or clearing of trees..." This is too vague. There needs to be an explicit requirement. The bill should require a minimum tree canopy conservation percentage to discourage "cut and pay".
7. Section 55-9 (b) (line 284) should be modified to allow onsite mitigation – let trees be replanted on the same site. This would benefit the immediate neighborhood suffering the loss.

Thank you for your consideration of my views.

Sincerely,



Kenneth A. Bawer

(1) "Trees in Our Communities, The Value of Trees to Residential Houses," Scenic America Technical Bulletin, Vol. 1, No. 1, 1992
(2) "Tree Preservation Ordinances," National Association of Home Builders, Land Development Services Department, October, 1991

Montgomery Soil Conservation District
18410 Muncaster Road - Derwood, MD 20855 - Phone (301) 590-2855
www.montgomeryscd.org

January 17, 2013

The Honorable Nancy Navarro
Montgomery County Council President
100 Maryland Avenue
Rockville, MD 209050

Re: Bill 41-12, Streets and Roads – Roadside Trees – Protection and
Bill 35-12 Trees – Tree Canopy Conservation

Dear Council President Navarro and Council Members:

On behalf of the Montgomery Soil Conservation District (MSCD) I would like to thank you for the opportunity to provide comments on Bill 41-12 and Bill 35-12. As farmers and landowners in the Agricultural Reserve, we would like to express our concerns about roadside tree maintenance and the challenges trees present for the agricultural community.

I would first like to mention the observations made by Council Member Floreen during our last discussion regarding a tree bill. Back in June 2012 when we met to discuss Bill 16-12, Council Member Floreen pointed out that our urban and rural sections of the County have distinct and critical differences regarding tree management issues. While we all acknowledge the values that trees provide, we also recognize that the intended purpose of the Agricultural Reserve is to produce the food and fiber needed by a growing population. As in June, the Montgomery Soil Conservation District opposes these bills as they pertain to the rural areas of the County, and respectfully requests that the County Council provide exemptions to these bills for the agricultural community.

The lack of maintenance on roadside trees in the rural areas of the county has become a serious concern. Critical public safety issues and economic impacts created by unmanaged roadside trees continue to be ignored. I have provided along with my testimony several pictures of an incident that occurred Tuesday on Travilah Road. Problems like this exist throughout the county and they are dangerous and costly.

As our rural roads continue to become commuter routes, the volume of traffic combined with overhanging, unmanaged branches has created a hazardous situation throughout the county. Many of the trees along our rural roads represent an accident waiting to happen, and the only question is whether it will impact farm equipment, emergency vehicles, a school bus, or some other county citizen.

Ask any farmer in this county about tree maintenance along the roads and you will begin to understand the problems farmers experience with poorly maintained roadside trees:

- Constant and expensive damage to all farm equipment on both the roadways and on the field side where overgrown trees impede planting and harvesting.
- Lost production due to shading and moisture impacts of roadside trees.

- Spreading of invasive and exotic trees, shrubs, and vines that start in roadside hedgerows and relocate throughout the farm and create increased costs to control.
- Dangerous limited sight distances when pulling out of fields onto roads.
- Longer delays in power restoration when trees cause outages in rural areas. It is not uncommon for rural homeowners to be out of power many more days than urban residents because they live in less populated areas, and therefore become a lower priority.

Specifically regarding Bill 41-12, we request that the county provide the agricultural community with an exemption to the law under Section 49-36A Roadside tree work (b) Applicability; Exceptions. This exemption is critical for rural landowners if we ever hope to address the safety and economic concerns along the roads in our agricultural areas. We also recommend that fees collected from this bill be designated to trim trees and provide a fund to reimburse residents for damages caused by roadside trees.

The focus of Bill 35-12, Trees –Tree Canopy Conservation appears to be on minimizing "the loss and disturbance of tree canopy as a result of development." However, it does not provide a clear exemption for all agricultural practices. **Section 55-5 Exemptions** reads "This Chapter does not apply to: any tree nursery activity performed with an approved Soil Conservation and Water Quality Plan as defined in Section 19-48;" We believe this first exemption should be amended to include any agricultural or conservation activity performed with an approved SCWQ Plan.

Many Council Members attended the Farming at Metro's Edge conference last weekend. A recurring theme at this landmark event was that constant increases in regulation represent one of the biggest threats to the future prosperity of the Ag Reserve. These bills, along with the lack of tree maintenance along our rural roads, create an obstacle for many of the rural businesses and policies we strive to promote. Along our rural roadways, trees must be managed so they do not impede commerce, public safety, power reliability, or private property rights.

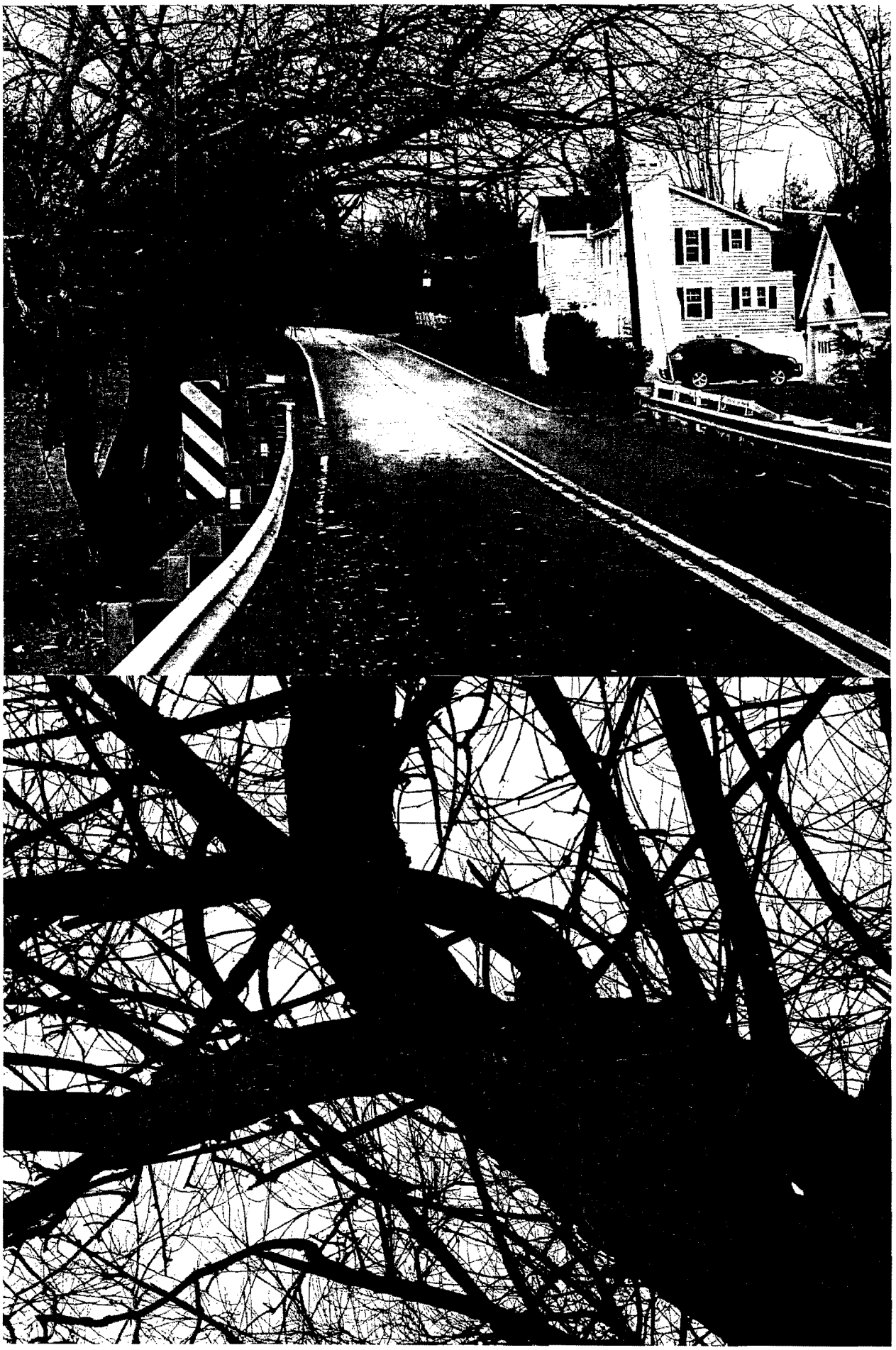
I would like to thank the County Council for providing this opportunity to present our concerns on Bills 41-12 and 35-12, and for their continued support for agriculture. We look forward to participating in the work sessions on these two bills.

Respectfully,

Wade Butler, Treasurer
Montgomery SCD Board of Supervisors

Cc: Council Members
Jeremy Criss, Ag Services Division Manager


410-247-5700
TRUCK RENTAL AND LEASING
DEALEASE



SHULMAN ROGERS | GANDAL PORDY ECKER

TIMOTHY DUGAN | ATTORNEY
t 301.230.5228 | tdugan@shulmanrogers.com

November 28, 2012

By Email
Michael Faden, Esq.
Ms. Amanda Mihill
Montgomery County Council
100 Maryland Avenue
Rockville, Maryland 20850

Re: Bill 35-12 Trees - Tree Canopy Conservation

Dear Michael and Amanda:

Please include my letter in the Record. Although I do not support the legislation, please consider the following:

Circle page	Line#'s	Discussion
6	120-150	Section 55-5 Exemptions The legislation should expressly provide that one of the exemptions is "forest and its related canopy that is subject to an approved forest conservation plan." Later, in Section 55-9, it provides that the mitigation fee does not apply to such areas. Section 55-5 lists the exemptions. I simply would add to the list: "forest and its related canopy that is subject to an approved forest conservation plan"
12	278-283	Section 55-9. Tree Canopy Fee to Mitigate Disturbance. Subparagraph (a) reads that "every reasonable effort should be made to minimize the cutting or clearing of trees . . . " The legislation's provision is establishing not only a new procedure and a related fee but also a new substantive threshold to be satisfied before any affected tree may be removed. Stated another way, Montgomery County would be requiring that a developer not only identify the proposed tree canopy but also justify/evidence that "every reasonable effort" has been made to minimize the cutting or clearing, etc. The

Circle page	Line#'s	Discussion
		reviewers at M-NCPPC and/or DPS will require a documented justification. They will reference this provision as having granted them the authority to determine whether or not the developer has indeed justified/evidenced that all reasonable efforts to save the tree have been made. The universe of trees that will be subject to the new threshold include all trees. That is, the determination is not limited to specimen trees that are affected by a sediment and erosion control permit. The provision requires a justification involving any trees affected by a sediment and erosion control permit. In essence, I believe the provision will establish for all trees to be removed a justification process similar to processes such as: (1) a specimen tree variance application/procedure involving a sediment and erosion control permit; or (2) other justifications now required to justify proposed tree removal involving a forest conservation plan. The provision allows for a denial of the sediment and erosion control permit even though a specimen tree or a forest is not involved. I suggest that Section 55-9(a) be eliminated. It is one burden to calculate the canopy and impose a fee, and, yet again, an exponentially greater burden to impose a "justification" threshold for all trees, where, of course, the removal may be denied. In short, if the bill is intended to impose a fee, then eliminate the other language that imposes more entitlement process.
12-13	291-294	Section 55-9 Fee To Mitigate Disturbance Subparagraph (b) expressly provides that the mitigation fees are not to be imposed on "forest and its related canopy that is subject to an approved forest conservation plan." If Section 55-5 is amended and exempts "forest and its related canopy that is subject to an approved forest conservation plan" as I suggest, then the language in Section 55-9 is unnecessary.
N/A	N/A	Finally, I suggest that the deliberations address "grandfathering" and that express language be added.

Thank you for your consideration. Please call with your comments and questions.

Very truly yours,

Timothy Dugan

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LINOWES AND BLOCHER LLP
ATTORNEYS AT LAW

February 22, 2013

Stephen Z. Kaufman
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301.961.5156

Phillip A. Hummel
phummel@linowes-law.com
301-961-5149

By Hand Delivery

Council President Nancy Navarro, Members of the Transportation, Infrastructure, Energy & Environment Committee, and all Councilmembers of the Montgomery County Council
100 Maryland Avenue
Rockville, Maryland 20850

Re: Tri-State Stone & Building Supply Inc. – Bills 35-12 and 41-12

Dear Council President Navarro and Councilmembers of the Montgomery County Council,

Our client, Tri-State Stone & Building Supply Inc., hereby submits this letter to comment on proposed Bill 35-12 (Trees – Tree Canopy Conservation) and Bill 41-12 (Streets and Roads – Roadside Trees – Protection). Tri-State Stone & Building Supply operates a quarry at 8200 Seven Locks Road in Bethesda and has been family owned and operated since 1926. The purpose of this letter is to support generally the exemption in Section 55-5(i) of Bill 35-12 for non-coal surface mining and to clarify that it also cover quarry operations. An additional purpose is to request that a specific exemption be added for quarry operations to Section 49-36(b) of Bill 41-12.

Bill 35-12 would require a person subject to its provisions to submit information to the County regarding limits of tree canopy disturbance that documents the extent of existing tree canopy and the area of tree canopy to be disturbed by the proposed activity. Bill 35-12 would also authorize a mitigation fee to compensate for the loss of, or disturbance to, tree canopy. Under Bill 35-12, the County must not issue a sediment control permit until an applicant has had its limits of tree canopy disturbance approved and paid any required mitigation fee.

As currently written, Bill 35-12 does include a number of exemptions and these do apply to, among other things, "any non-coal surface mining conducted in accordance with applicable state law." § 55-5(i) of Bill 35-12. Similarly, the County's Forest Conservation Law currently exempts "noncoal surface mining regulated under Title 7 of the Natural Resources Article of the

Maryland Code."[1] § 22A-5(i) of the Montgomery County Code. Tri-State Stone & Building Supply Inc. strongly supports this exemption and believes it should remain if Bill 35-12 is adopted by the County Council. To ensure that the exemption language covers quarries, Tri-State Stone & Building Supply requests that the exemption from Section 55-5(i) of Bill 35-12 be amended as follows: "any non-coal surface mining, including quarry operations, conducted in accordance with applicable state law."

Unlike Montgomery County's existing Forest Conservation Law and proposed Bill 35-12, Bill 41-12 does not specifically contain a relevant exemption for quarry operations. In order to achieve consistency with existing and proposed law, as well as ensure the future operation and economic viability of Tri-State Stone & Building Supply, Bill 41-12 should be amended to include an exemption in Section 49-36(b) for "any non-coal surface mining including quarry operations." This change would conform with the Forest Conservation Law and proposed Bill 35-12 and prevent any harm to Tri-State Stone & Building Supply's and other local quarry operations.

As a quarry, Tri-State Stone & Building Supply is currently subject to a number of State and County laws. These existing laws are sufficient to protect the well-being of the County while allowing an important activity that contributes to the economic fabric of the community and provides a desired service. Thus, Tri-State Stone & Building Supply supports the current exemption in Section 55-5(i) of Bill 35-12 but believes it should be clarified to ensure that it covers quarry operations. Accordingly, Tri-State Stone & Building Supply believes Section 49-36(b) should be amended to include an exemption for quarry operations, which is consistent with the existing Forest Conservation Law and proposed Bill 35-12.

[1] Title 7 of the Natural Resources Article of the Maryland Code, which regulated surface mining, was recodified at Title 15 of the Environment Article of the Maryland Code in 1995. Chapter 488, Laws of Maryland 1995.

Please let us know if you have any questions. We appreciate the opportunity to comment on these two important bills and to have these comments included in the formal record of the proceedings.

Sincerely,

LINOWES AND BLOCHER LLP

Stephen Z. Kaufman

Phillip A. Hummel

**L&B 2271200v1/12230.0002

Different Approaches to Mitigating Tree Loss

- Plant certain number of trees/canopy area based on property size
  - Fairfax, VA; Chesapeake, VA; Athens-Clarke County, GA
- Forest Conservation Law fee-in-lieu
  - Counties and municipalities in MD
- Pay, or plant certain number of trees, based on tree size
  - District of Columbia

Determining the Tree Canopy Fee - Factors to Consider

Factor 1 – The trees/canopy to be replaced

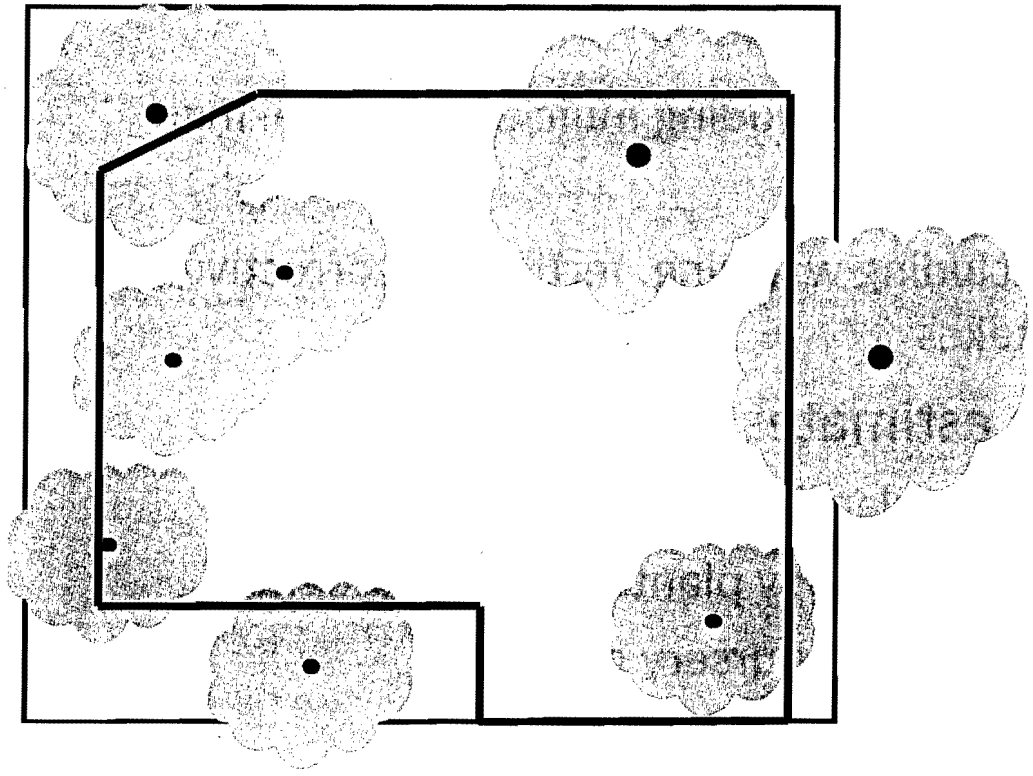
Factor 2 – The cost to plant trees

Factor 3 – Tree mortality, i.e., the number of trees that must be planted to have the desired number of living trees

Factor 4 – The timeframe for consideration

Factor 1: Trees/canopy area to be replaced

- Canopy within *Limit of Disturbance*

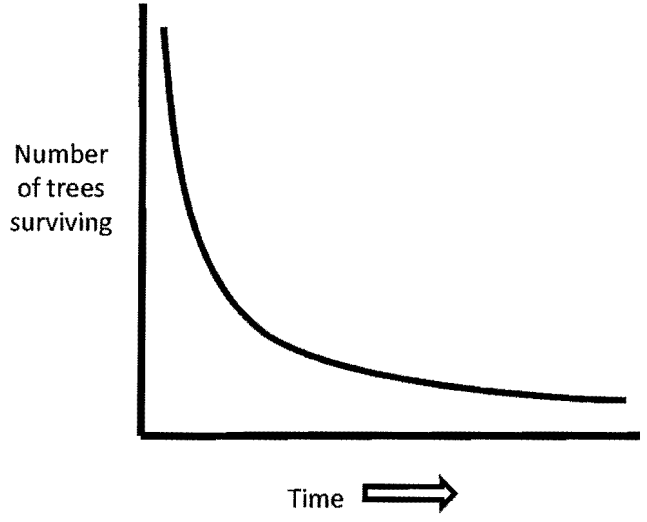


Factor 2: The cost to plant trees

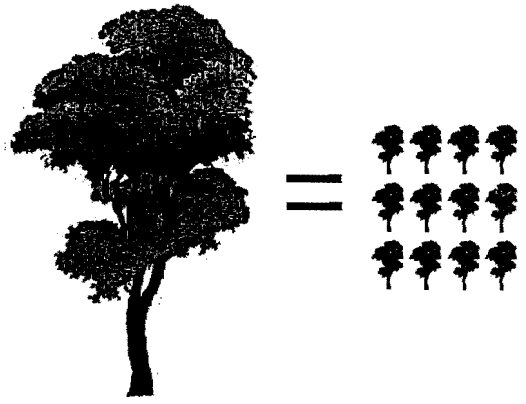
- The cost to plant a tree is based on:
  - Optimal size of new tree
  - Cost of nursery stock
  - Cost of installation including mulching and staking
  - Deer protection
  - Aftercare including watering, fertilizing, corrective pruning, and removing stakes
- Current price estimates include:
  - DOT street tree planting contract
  - Rainscapes tree canopy planting rebate program
  - Retail and wholesale nursery prices

Factor 3: Tree mortality

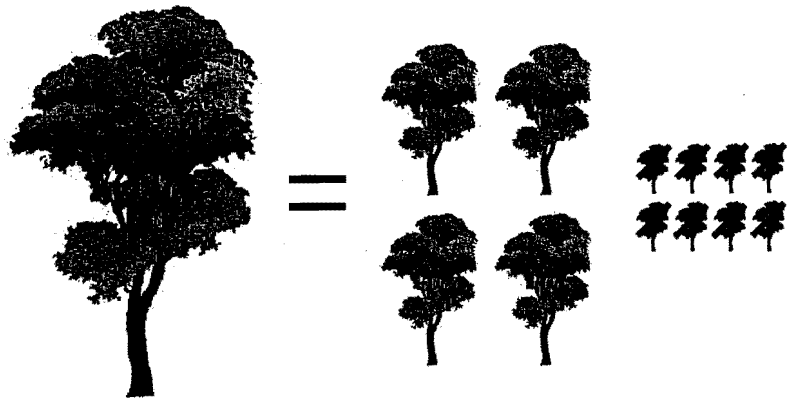
- The mortality rate of trees depends on a number of variable factors. Generally, mortality decreases with time since planting.
  - Quality of plant material
  - Size of plant material
  - Species
  - Planting technique
  - Season of planting
  - Unusual weather conditions
  - Soil conditions
  - Quality and consistency of aftercare



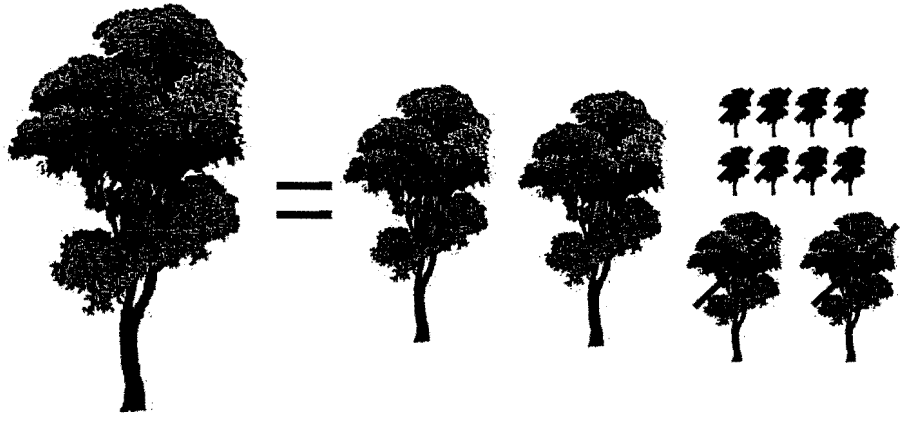
Factor 3: Tree mortality



At the time of planting



5 years after planting



10 years after planting

20 years after planting

Determining the Mitigation Fee

High

Low

- Full replacement
- Maximum deterrent
- More options for credit for protection/planting

- Partial replacement
- Minimal deterrent
- Fewer options for credit for protection/planting

Determining the Mitigation Fee

High

Low

Fee to cover full replacement of lost canopy

Based on high FCL fee-in-lieu ($5.00 @40,000 sf)

Based on County FCL fee-in-lieu ($1.05 @40,000 sf)

Proposed Mitigation Fees

Incremental Area (sq. ft.)		Increment
From	To	Fee ($/sq. ft.)
0	2,000	$0.25
2,001	4,000	$0.35
4,001	6,000	$0.45
6,001	8,000	$0.55
8,001	10,000	$0.65
10,001	15,000	$0.75
15,001	20,000	$0.85
20,001	30,000	$0.95
30,001	40,000	$1.05
40,001	55,000	$1.15
55,001	70,000	$1.25
70,001	and above	$1.35

2010

2011

Canopy within LOD

Size of lot (sq. ft.)	19,565
Assessed Value	$928,800
Canopy within LOD (sq. ft.)	1,385
Proposed Fee	$346

(131)

2004	2008	Canopy within LOD
		

Size of lot (sq. ft.)	13,819	13,819
Assessed Value	Unknown	$1,991,800
Canopy within LOD (sq. ft.)	5,490	1.272
Proposed Fee	$1,871	$318

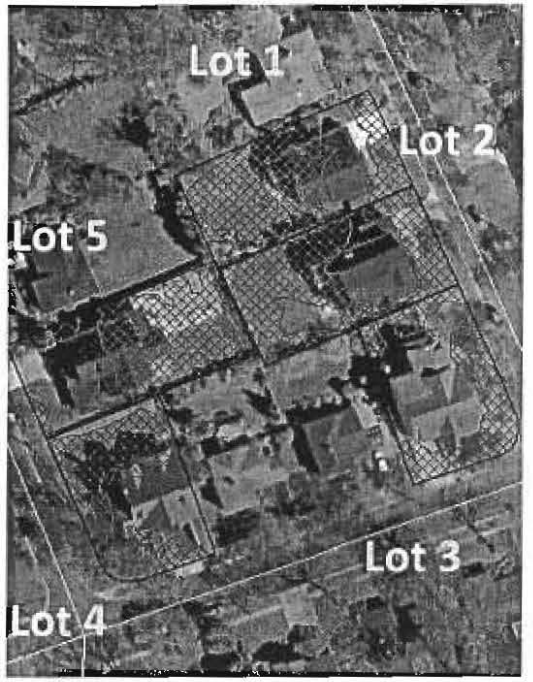
1998 **2011** **Canopy within LOD**

	Lot 1	Lot 2	Lot 3
Size of lot (sq. ft.)	8,552	7,566	7,405
Assessed Value	$1,225,700	$1,314,700	$1,320,400
Canopy within LOD (sq. ft.)	6,574	5,902	6,677
Proposed Fee	$2,416	$2,056	$2,472

2006

2011

Canopy within LOD



	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
Size of lot (sq. ft.)	12,878	12,578	11,225	10,763	13,223
Assessed Value	$1,394,600	$1,616,200	$1,581,500	$1,603,800	$1,709,500
Canopy within LOD (sq. ft.)	8,689	8,871	4,822	5,335	8,202
Proposed Fee	$3,648	$3,766	$1,570	$1,801	$3,331

(134)

1998	2002	Canopy within LOD

Size of lot (sq. ft.)	45,299
Assessed Value	$3,993,000
Canopy within LOD (sq. ft.)	24,964
Proposed Fee	$17,216

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Tree and impervious cover change in U.S. cities

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USDA Forest Service, Northern Research Station, 5 Moon Library, SUNY-ESF, Syracuse, NY 13210, United States

ARTICLE INFO

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Forest monitoring
Urban forestry
Urban greening
Urban trees

ABSTRACT

Paired aerial photographs were interpreted to assess recent changes in tree, impervious and other cover types in 20 U.S. cities as well as urban land within the conterminous United States. National results indicate that tree cover in urban areas of the United States is on the decline at a rate of about 7900 ha/yr or 4.0 million trees per year. Tree cover in 17 of the 20 analyzed cities had statistically significant declines in tree cover, while 16 cities had statistically significant increases in impervious cover. Only one city (Syracuse, NY) had a statistically significant increase in tree cover. City tree cover was reduced, on average, by about 0.27 percent/yr, while impervious surfaces increased at an average rate of about 0.31 percent/yr. As tree cover provides a simple means to assess the magnitude of the overall urban forest resource, monitoring of tree cover changes is important to understand how tree cover and various environmental benefits derived from the trees may be changing. Photo-interpretation of digital aerial images can provide a simple and timely means to assess urban tree cover change to help cities monitor progress in sustaining desired urban tree cover levels.

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Introduction

Tree cover in cities is constantly changing due to various natural and anthropogenic forces. Natural forces for change include natural regeneration, tree growth and tree mortality from insects and diseases or old age. Anthropogenic factors that influence tree cover include tree planting and tree mortality or removal from either direct or indirect human actions such as development and air pollution (Nowak, 1993). The combination of these factors through time determines existing and future tree cover levels.

An important question for city managers is how their local tree cover is currently changing as present-day benefits derived from urban forests are related to the amount of tree cover in cities. As many urban forest ecosystem services are directly related to the amount of healthy and functioning leaves, tree cover becomes a simple measure of the extent of the urban forest and consequently the magnitude of services provided by the forest. To help sustain tree cover in cities, various city programs are planting large numbers of trees (e.g., City of New York, 2011; City of Los Angeles, 2011), protecting existing trees (e.g., Town of Chapel Hill, 2011; City of Pasadena, 2011) and developing tree canopy goals (e.g., City of Seattle, 2011; Maryland Department of Natural Resources, 2011).

Though tree cover in cities is constantly changing, limited studies have investigated how overall tree cover in cities has or is changing. Nowak (1993) illustrated through an analysis of historical imagery and documents that the tree cover in Oakland, CA, has increased from a presettlement tree cover of approximately 2 percent in 1850s to 19 percent in 1991. Land cover maps have been used to quantify how various cover classes have changed through time, but assessments of tree cover change within cities are limited (e.g., Zhou et al., 2008). In Seattle, tree cover was estimated to change from 22.5 percent in 2002 to 22.9 percent in 2007 by comparing digital land cover maps developed from 0.6 m resolution imagery (Parlin, 2009). However, the accuracy of the map classification is unknown and comparing cover maps to estimate change can lead to false changes due to misclassification of cover types on either map.

Various land cover change analyses have been conducted using satellite-based approaches. Moderate Resolution Imaging Spectroradiometer (MODIS) data (250-m) and Landsat data (30-m) have and are being used to estimate changes in land cover and impervious surface cover (e.g., Yang et al., 2003; Lunetta et al., 2006; U.S. EPA, 2011). MODIS data (500-m) also has the ability to estimate change in percent tree cover across the globe (Hansen et al., 2003; Schwarz et al., 2006). These satellite-based approaches have limitations based on image resolution and inaccuracies of image classifications. Photo-interpretation of high resolution images to detect cover changes has the ability to overcome these limitations, but lacks the ability to develop detailed comprehensive cover change maps.

Trees and impervious surfaces provide numerous ecosystem services and values to a community, but also have various economic or environmental costs. Trees provide various benefits associated

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with air and water quality, building energy conservation, cooler air temperatures, reductions in ultraviolet radiation, and many other environmental and social benefits (e.g., Dwyer et al., 1992; Kuo and Sullivan, 2001; Westphal, 2003; Wolf, 2003; Nowak and Dwyer, 2007). Costs associated with trees are both economic (e.g., planting and maintenance and increased building energy costs) and environmental (e.g., pollen and volatile organic compound emissions) (Nowak and Dwyer, 2007).

Likewise, impervious cover plays an important role in the landscape, particularly in urban areas. These surfaces, such as roads, buildings, sidewalks, and parking lots, facilitate transportation and provide shelter, but also can negatively impact the environment. Increased impervious surfaces enhance local temperatures and heat islands (Oke, 1989; Heisler and Brazel, 2010), which consequently affects building energy use, human comfort and health, ozone production, and pollutant emissions in cities. In addition, impervious surfaces significantly affect urban hydrology (e.g., stream flow and water quality) (e.g., U.S. EPA, 1983; National Research Council, 2008).

As development occurs in forests, tree cover will decrease to make space for buildings and other impervious surfaces. In non-forest regions, tree cover can increase due to urbanization (unpublished data). Thus, urbanization as a process will alter regional tree cover. As tree cover changes in cities, so will the associated ecosystem services and their effects on environmental quality and human health. Unfortunately, within existing cities, rates and direction of change in tree and impervious cover are largely unknown. This paper investigates tree and impervious cover change in urban areas and select cities across the United States using a simple and repeatable measure that can be used worldwide where paired multi-year digital aerial imagery exists. The objective of this paper is to determine the current direction and rate of tree and impervious cover change in U.S. cities to help guide cities in sustaining desired tree cover levels and associated ecosystem services.

Methods

To determine the percent tree/shrub cover (hereafter referred to as tree cover or canopy) and impervious cover change in cities in the United States, 20 cities from across the nation were selected (Table 1). Some cities were selected based on existing projects (Syracuse, NY; Baltimore, MD; Spokane, WA). Other cities were selected by picking major cities scattered throughout the conterminous United States where paired imagery could be obtained. Two cities were specifically selected to determine the effect of recent suspected tree cover change: (1) New Orleans, LA (effect of 2005 Hurricane Katrina), and (2) Detroit, MI (effect of recent infestation of emerald ash borer (*Agrilus planipennis*)). For each city, paired digital aerial photographs were obtained for the most recent date possible and imagery as close to 5 yr prior to the most current date as possible.

In 18 of the 20 cities, 1000 random points were laid and interpreted across the city to provide a maximum standard error of 1.6 percent if all points are classified (Lindgren and McElrath, 1969). In two cities, more points were laid and interpreted (Baltimore: 2500 points; Spokane, WA: 2000 points). City geographic boundaries were determined using census incorporated or designated places boundaries (U.S. Census Bureau, 2007). Each point was laid in the same geographic position on both sets of temporal images in the city, and paired image interpretation was conducted (i.e., interpreter classified each point pair by contrasting and classifying the image points in sequence). In cases of misregistration of the image or point, the interpreter corrected the point location to ensure the exact same location was interpreted. For example, sometimes the points would shift position slightly between images due to issues of image misregistration. In these cases, the interpreter moved the point on the most recent image back to the position on the oldest image to make the interpretation of change at the same point on both images.

In some cases, not all of the points could be classified. Non-classification occurred when one of the images were missing part of the city area (incomplete imagery) or had cloud cover. All cities had greater than 97.2 percent of the points interpreted. As some cities have substantial amounts of water within their city boundary (Table 1), cover estimates were only based on points that were not classified as water in both years. That is, permanent water points were deleted from the sample so that cover estimates were based on city land area, not city total area.

For the photo-interpretation, trained photo interpreters with experience interpreting leaf-off and leaf-on imagery classified each point as to either: trees/shrubs (woody vegetation), grass

Table 1
Resolution and year of imagery for 20 analyzed cities. Percent of city area classified as water in both years (%Water) was removed from analysis so that cover estimates could be based on land area. Human population density change (#/ha) between year 1 and year 2 is based on U.S. Census estimates (1).

City	Year 1	Res.[a] (m)	Leaf on/off	Year 2	Res.[a] (m)	Leaf on/off	%interp[b]	%Water	*n*	Change (#/ha)
Albuquerque, NM	2006	0.15	Off	2009	1	On	100	0.2	998	0.6
Atlanta, GA	2005	2	On	2009	1	On	99.5	0.4	991	1.7
Baltimore, MD	2001	1	On	2005	1	On	99.9	12.6	2184	−0.2
Boston, MA	2003	1	On	2008	1	On	99.9	13.6	863	2.3
Chicago, IL	2005	2	On	2009	1	On	100	0.8	992	0.5
Denver, CO	2005	1	On	2009	1	On	100	1.6	984	1.2
Detroit, MI	2005	1	On	2009	1	On	99.9	0.3	996	−0.3
Houston, TX	2004	1	On	2009	1	On	99.5	1.6	979	1.4
Kansas City, MO	2003	1	On	2009	1	On	100	1.5	985	0.4
Los Angeles, CA	2005	1	On	2009	1	On	100	0.2	998	0.3
Miami, FL	2003	1	On	2009	0.3	On	100	9.3	907	6.3
Minneapolis, MN	2003	1	On	2008	1	On	98.9	7.1	919	0.3
Nashville, TN	2003	0.15	Off	2008	0.15	Off	100	0.7	993	0.3
New Orleans, LA	2005	2	On	2009	1	On	97.2	38.4	563	−2.1
New York, NY	2004	0.15	On	2009	1	On	98.1	2.9	953	2.8
Pittsburgh, PA	2004	1	On	2008	1	On	99.5	4.8	947	−0.6
Portland, OR	2005	1	On	2009	1	On	100	1.6	984	1.0
Spokane, WA	2002	0.15	On	2007	0.15	On	100	1.0	1980	0.3
Syracuse, NY	2003	0.3	Off	2009	0.3	Off	99.6	2.0	976	−0.7
Tacoma, WA	2001	0.15	On	2005	0.15	On	100	8.6	914	−0.1

[a] Image (pixel) resolution.
[b] Percent of original points (land and water) that were able to be classified on both images. *n* – sample size – number of points not classified as permanent water points (classified as water in both years).

or herbaceous cover, bare soil, water, impervious (buildings), impervious (roads), or impervious (other). For the analysis of Albuquerque, NM, only, an eighth class of scrub/shrub was added due to the different vegetation cover morphology of that region. This class was included in the tree/shrub cover classification, but the scrub/shrub class results were also reported separately. Within Syracuse, which was one of the first cities analyzed, impervious other and impervious road categories were combined by the interpreter as was the grass/herbaceous and soil categories. In subsequent city analyses these categories were separated.

In interpreting change from aerial imagery, image parallax (tall objects appearing to lean on the image) and seasonal changes can appear to cause changes, but in fact are not actual changes. In these cases the interpreter could use judgment to determine if actual change did occur. In cases of tall object parallax, the interpreter's classification was based on the oldest image and if there was no change, both dates of imagery were classified the same. For example, tall objects (e.g., buildings and trees) may lean to the left in the first image, but lean to the right in the second image and a point may land on the object in the first image, but miss the object in the second image. The point classification would appear to change class, but no actual change would have occurred. Also agricultural fields can change cover class depending on time of year (herbaceous cover vs. bare soil depending upon time of imagery). These types of seasonal changes were classified as no change and classified as herbaceous cover. By conducting paired-point image analysis, the interpreter can correct these false changes to no change in the analysis. A five-percent random sample of points was reinterpreted by another photo-interpreter to check for classification accuracy. Overall, the two interpreters were in agreement on 97 percent of the classifications.

Within each city, the percentage of each cover class (p) was calculated as the number of sample points (x) hitting the cover attribute divided by the total number of interpretable sample points (n) within the area of analysis ($p = x/n$). The standard error of the estimate (SE) was calculated as $SE = \sqrt{p \times (1-p)/n}$ (Lindgren and McElrath, 1969). This method has been used to assess canopy cover in many cities (e.g., Nowak et al., 1996).

If changes in cover classes were observed at any point on the image then it is known that cover classes are changing within the city (i.e., no statistical test is needed to determine if change is greater than zero). However, as a cover class can both gain and lose cover through time and space, the McNemar test (Sokal and Rohlf, 2003) was used to determine if the net change in cover was different from zero (alpha levels 0.90 and 0.95). Pearson product moment correlation was used to test for a relationship between change in percent tree cover and change in population density among the 18 cities.

As the overall time frame of change in cover varied among cities from between 3 and 6 yr, change results were annualized for comparative purposes among cities. Results were combined with city area and population data from the year of the oldest photo date (U.S. Census Bureau, 2011) to determine actual tree and impervious cover change (ha) and cover change per capita in each city. Results of percent change were reported as absolute change (percent of city area that changed = cover change/city area) and relative change (percent of existing cover class that changed = cover change/original cover area). For example, a city with 30 percent tree cover that changed to 20 percent tree cover would have a 10 percent absolute change, but a 33 percent relative change.

As the 20 analyzed cities are not a truly random sample, an analysis of change in tree and impervious cover in urban areas across the conterminous United States was conducted using Google Earth® (Google, 2011) imagery to determine the relative magnitude of net change in urban tree and impervious cover. Urban land was defined based on population density as delimited using the U.S. Census Bureau's (2007) definition: all territory, population, and housing units located within urbanized areas or urban clusters. Urbanized area and urban cluster boundaries encompass densely settled territories, which are described by one of the following:

- one or more block groups or census blocks with a population density of at least 386.1 people/km^2 (1000 people/mile^2),
- surrounding census blocks with a minimum population density of 193.1 people/km^2 (500 people/mile^2), or
- less densely settled blocks that form enclaves or indentations, or are used to connect discontinuous areas.

In the conterminous United States, 1000 points randomly located within urban land were interpreted based on paired imagery from Google using the images with the most recent date and the next oldest interpretable imagery with the goal of trying to get the second set of imagery about 5 yr apart from the first set. Imagery date along with cover class was recorded for each point. This type of analysis of change with Google imagery has varying date issues that were not encountered with the paired city imagery, but does give a general indication of direction and magnitude of change nationally. Analysis of Google imagery was similar to the city imagery in terms of non-interpretable images and adjusting for misregistered images. However, Google imagery could also not be interpreted in some locations due to poor image resolution. Overall, 97 percent of the points could be interpreted using Google imagery.

Results

Of the 20 cities analyzed, tree cover ranged from 53.9 percent in Atlanta to 9.6 percent in Denver; building impervious cover ranged from 27.1 percent in Chicago to 4.8 percent in Kansas City; road and other impervious cover ranged from 36.2 percent in Miami to 12.3 percent in Nashville; and total impervious cover varied from 61.1 percent in New York City to 17.7 percent in Nashville (Table 2). Two cover classes – tree/shrub and bare soil generally exhibited a reduction in percent cover, while the other land classes generally exhibited an increase in cover.

Change in tree cover during the varying periods of analysis ranged from reduction in percent tree cover of −9.6 in New Orleans to an increase in percent tree cover of 1.0 in Syracuse (Table 3). Nineteen of the 20 cities analyzed showed a reduction in tree cover, 17 of those cities had a statistically significant net reduction. Average change was calculated for all 20 cities and for 18 cities – excluding the two cities (New Orleans and Detroit) that were targeted due to an expected loss in tree cover. Percent tree cover dropped on average by 1.1 percent during the varying periods of analysis (1.5 percent for 20 city average) with the greatest decreases in percent tree cover in New Orleans (−9.6 percent), Houston (−3.0 percent) and Albuquerque (−2.7 percent). The relative reduction in tree cover was as high as −29.2 percent in New Orleans, but averaged −3.8 percent (−5.0 percent for 20 city average).

Cities with the greatest annual loss in tree cover were New Orleans (average of −1120 ha/yr), Houston (−890 ha/yr) and Albuquerque (−420 ha/yr) (Table 3). Tree cover losses per capita were greatest in New Orleans (−24.6 m^2/person/yr), Albuquerque (−8.3 m^2/person/yr) and Nashville (−5.3 m^2/person/yr) with an average loss of −1.9 m^2/person/yr (−3.0 m^2/person/yr for 20 city average). Average annual loss in percent tree cover was −0.27 percent/yr (−0.37 percent/yr for 20 city average). Relative annual loss in tree cover was −0.90 percent/yr (−1.29 percent/yr for 20 city average). Loss of tree cover was slightly correlated to increased population density in the 18 cities (Pearson product moment correlation coefficient (r) = −0.31).

Table 2
Change of percent of city land area occupied by various cover classes in 20 U.S. cities.

City	1st year cover class	2nd year cover class							1st year	
		Grass/herb[a]	Tree/shrub	Imp. bldg[b]	Imp. road[c]	Imp. other[d]	Water	Soil	Total	SE
Albuquerque, NM (2006–2009)[e]	Grass/herb	8.8	0.1	0.1	0.0	0.1	0.0	0.0	9.1	0.9
	Tree/shrub	0.4	38.0	0.0	0.0	0.4	0.0	2.0	40.8	1.6
	Imp. bldg	0.1	0.0	11.9	0.0	0.0	0.0	0.0	12.0	1.0
	Imp. road	0.0	0.0	0.0	9.4	0.0	0.0	0.0	9.4	0.9
	Imp. other	0.0	0.0	0.0	0.0	13.9	0.0	0.0	13.9	1.1
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.4	0.0	0.5	0.3	0.5	0.0	13.0	14.7	1.1
	2nd year total	9.7	38.1	12.5	9.7	14.9	0.0	15.0		
	2nd year SE	0.9	1.5	1.0	0.9	1.1	0.0	1.1		
	Net (2006–2009)	0.6	−2.7	0.5	0.3	1.0	0.0	0.3		
Atlanta, GA (2005–2009)	Grass/herb	15.1	0.4	0.1	0.0	0.3	0.0	0.6	16.5	1.2
	Tree/shrub	1.0	51.6	0.4	0.1	0.3	0.0	0.5	53.9	1.6
	Imp. bldg	0.0	0.0	9.6	0.0	0.1	0.0	0.1	9.8	0.9
	Imp. road	0.0	0.0	0.0	7.4	0.0	0.0	0.0	7.4	0.8
	Imp. other	0.0	0.0	0.1	0.0	9.2	0.0	0.0	9.3	0.9
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	1.3	0.1	0.2	0.2	0.2	0.0	1.1	3.1	0.6
	2nd year total	17.5	52.1	10.4	7.7	10.1	0.0	2.3		
	2nd year SE	1.2	1.6	1.0	0.8	1.0	0.0	0.5		
	Net (2005–2009)	0.9	−1.8	0.6	0.3	0.8	0.0	−0.8		
Baltimore, MD (2001–2005)	Grass/herb	22.2	0.1	0.2	0.0	0.7	0.0	0.3	23.5	0.9
	Tree/shrub	0.9	28.4	0.4	0.1	0.5	0.0	0.1	30.4	1.0
	Imp. bldg	0.0	0.0	15.3	0.0	0.0	0.0	0.3	15.6	0.8
	Imp. road	0.0	0.0	0.0	10.9	0.0	0.0	0.0	11.0	0.7
	Imp. other	0.0	0.0	0.0	0.0	16.8	0.0	0.2	17.1	0.8
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.1	0.0	0.3	0.0	0.3	0.0	1.6	2.3	0.3
	2nd year total	23.2	28.5	16.3	11.0	18.5	0.0	2.5		
	2nd year SE	0.9	1.0	0.8	0.7	0.8	0.0	0.3		
	Net (2001–2005)	−0.4	−1.9	0.7	0.0	1.3	0.0	0.2		
Boston, MA (2003–2008)	Grass/herb	17.8	0.5	0.1	0.0	0.6	0.0	0.1	19.1	1.3
	Tree/shrub	0.6	27.1	0.6	0.2	0.1	0.0	0.2	28.9	1.5
	Imp. bldg	0.1	0.0	16.5	0.0	0.1	0.0	0.0	16.7	1.3
	Imp. road	0.0	0.0	0.0	12.5	0.0	0.0	0.0	12.5	1.1
	Imp. other	0.2	0.2	0.0	0.1	18.4	0.0	0.0	19.0	1.3
	Water	0.1	0.0	0.0	0.0	0.0	0.0	0.7	0.8	0.3
	Soil	0.5	0.1	0.1	0.1	0.5	0.0	1.7	3.0	0.6
	2nd year total	19.4	27.9	17.3	13.0	19.7	0.0	2.8		
	2nd year SE	1.3	1.5	1.3	1.1	1.4	0.0	0.6		
	Net (2003–2008)	0.2	−0.9	0.6	0.5	0.7	−0.8	−0.2		
Chicago, IL (2005–2009)	Grass/herb	20.0	0.0	0.0	0.0	0.3	0.1	0.4	20.8	1.3
	Tree/shrub	0.3	18.0	0.1	0.0	0.0	0.0	0.1	18.5	1.2
	Imp. bldg	0.4	0.0	26.5	0.0	0.1	0.0	0.1	27.1	1.4
	Imp. road	0.0	0.0	0.0	12.1	0.0	0.0	0.0	12.1	1.0
	Imp. other	0.0	0.0	0.2	0.0	19.1	0.0	0.0	19.3	1.3
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.0	0.0	0.0	0.0	0.1	0.1	2.0	2.2	0.5
	2nd year total	20.7	18.0	26.8	12.1	19.6	0.2	2.6		
	2nd year SE	1.3	1.2	1.4	1.0	1.3	0.1	0.5		
	Net (2005–2009)	−0.1	−0.5	−0.3	0.0	0.3	0.2	0.4		
Denver, CO (2005–2009)	Grass/herb	41.1	0.0	0.1	0.0	0.3	0.0	0.9	42.4	1.6
	Tree/shrub	0.1	9.6	0.1	0.0	0.1	0.0	0.0	9.9	1.0
	Imp. bldg	0.0	0.0	12.8	0.0	0.0	0.0	0.1	12.9	1.1
	Imp. road	0.0	0.0	0.1	12.5	0.0	0.0	0.0	12.6	1.1
	Imp. other	0.2	0.0	0.2	0.1	13.9	0.0	0.1	14.5	1.1
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.8	0.0	0.1	0.1	1.0	0.2	5.5	7.7	0.9
	2nd year total	42.2	9.6	13.4	12.7	15.3	0.2	6.6		
	2nd year SE	1.6	0.9	1.1	1.1	1.1	0.1	0.8		
	Net (2005–2009)	−0.2	−0.3	0.5	0.1	0.8	0.2	−1.1		
Detroit, MI (2005–2009)	Grass/herb	27.9	0.1	0.0	0.0	0.2	0.0	0.3	28.5	1.4
	Tree/shrub	0.1	22.3	0.1	0.2	0.4	0.0	0.1	23.2	1.3
	Imp. bldg	0.1	0.0	17.1	0.0	0.0	0.0	0.0	17.2	1.2
	Imp. road	0.0	0.0	0.0	14.7	0.0	0.0	0.0	14.7	1.1

Table 2 (*Continued*)

City	1st year cover class	2nd year cover class							1st year	
		Grass/herb[a]	Tree/shrub	Imp. bldg[b]	Imp. road[c]	Imp. other[d]	Water	Soil	Total	SE
	Imp. other	0.0	0.0	0.1	0.0	14.5	0.0	0.0	14.6	1.1
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.2	0.1	0.1	0.0	0.3	0.0	1.2	1.9	0.4
	2nd year total	28.3	22.5	17.4	14.9	15.4	0.0	1.6		
	2nd year SE	1.4	1.3	1.2	1.1	1.1	0.0	0.4		
	Net (2005–2009)	−0.2	−0.7	0.2	0.2	0.8	0.0	−0.3		
Houston, TX (2004–2009)	Grass/herb	28.7	0.0	0.5	0.0	0.5	0.2	0.2	30.1	1.5
	Tree/shrub	1.4	27.4	0.3	0.1	0.2	0.1	0.8	30.3	1.5
	Imp. bldg	0.0	0.0	13.5	0.0	0.0	0.0	0.2	13.7	1.1
	Imp. road	0.0	0.0	0.0	12.0	0.0	0.0	0.0	12.0	1.0
	Imp. other	0.1	0.0	0.1	0.0	11.8	0.0	0.1	12.2	1.0
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.4	0.0	0.0	0.0	0.1	0.0	1.2	1.7	0.4
	2nd year total	30.6	27.4	14.4	12.1	12.7	0.3	2.6		
	2nd year SE	1.5	1.4	1.1	1.0	1.1	0.2	0.5		
	Net (2004–2009)	0.5	−3.0	0.7	0.1	0.5	0.3	0.8		
Kansas City, MO (2003–2009)	Grass/herb	48.5	0.5	0.2	0.3	0.7	0.1	0.3	50.7	1.6
	Tree/shrub	1.1	27.5	0.0	0.1	0.0	0.0	0.5	29.2	1.4
	Imp. bldg	0.0	0.0	4.6	0.0	0.2	0.0	0.0	4.8	0.7
	Imp. road	0.0	0.0	0.0	6.3	0.0	0.0	0.0	6.3	0.8
	Imp. other	0.0	0.0	0.2	0.1	6.8	0.0	0.0	7.1	0.8
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.2	0.0	0.0	0.0	0.7	0.0	1.0	1.9	0.4
	2nd year total	49.8	28.0	5.0	6.8	8.4	0.1	1.8		
	2nd year SE	1.6	1.4	0.7	0.8	0.9	0.1	0.4		
	Net (2003–2009)	−0.8	−1.2	0.2	0.5	1.3	0.1	−0.1		
Los Angeles, CA (2005–2009)	Grass/herb	21.0	0.0	0.3	0.0	0.2	0.0	0.3	21.8	1.3
	Tree/shrub	0.4	20.6	0.2	0.0	0.3	0.0	0.0	21.5	1.3
	Imp. bldg	0.0	0.0	21.0	0.0	0.2	0.0	0.0	21.2	1.3
	Imp. road	0.0	0.0	0.0	14.7	0.0	0.0	0.0	14.7	1.1
	Imp. other	0.0	0.0	0.4	0.0	15.8	0.0	0.1	16.3	1.2
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.3	0.0	0.5	0.2	0.2	0.0	3.1	4.3	0.6
	2nd year total	21.7	20.6	22.4	14.9	16.7	0.0	3.5		
	2nd year SE	1.3	1.3	1.3	1.1	1.2	0.0	0.6		
	Net (2005–2009)	−0.1	−0.9	1.2	0.2	0.4	0.0	−0.8		
Miami, FL (2003–2009)	Grass/herb	14.2	0.2	0.1	0.1	0.6	0.0	0.1	15.3	1.2
	Tree/shrub	1.1	21.2	0.4	0.2	0.1	0.1	0.1	23.3	1.4
	Imp. bldg	0.3	0.0	23.5	0.0	0.0	0.0	0.1	23.9	1.4
	Imp. road	0.0	0.0	0.0	18.0	0.0	0.0	0.0	18.0	1.3
	Imp. other	0.2	0.2	0.6	0.0	17.0	0.0	0.1	18.1	1.3
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.0	0.0	0.2	0.0	0.2	0.0	1.0	1.4	0.4
	2nd year total	15.9	21.6	24.8	18.3	17.9	0.1	1.4		
	2nd year SE	1.2	1.4	1.4	1.3	1.3	0.1	0.4		
	Net (2003–2009)	0.6	−1.7	0.9	0.3	−0.2	0.1	0.0		
Minneapolis, MN (2003–2008)	Grass/herb	18.6	0.2	0.0	0.0	0.3	0.0	0.4	19.6	1.3
	Tree/shrub	1.0	33.7	0.1	0.2	0.1	0.0	0.0	35.1	1.6
	Imp. bldg	0.0	0.0	14.4	0.0	0.1	0.0	0.1	14.6	1.2
	Imp. road	0.0	0.1	0.0	12.3	0.0	0.0	0.0	12.4	1.1
	Imp. other	0.0	0.0	0.3	0.0	15.6	0.0	0.0	15.9	1.2
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.2	0.0	0.1	0.0	0.1	0.2	1.7	2.4	0.5
	2nd year total	19.8	34.1	14.9	12.5	16.2	0.2	2.3		
	2nd year SE	1.3	1.6	1.2	1.1	1.2	0.2	0.5		
	Net (2003–2008)	0.2	−1.1	0.3	0.1	0.3	0.2	−0.1		
Nashville, TN (2003–2008)	Grass/herb	28.3	0.4	0.1	0.1	0.0	0.0	0.3	29.2	1.4
	Tree/shrub	0.7	49.4	0.1	0.2	0.1	0.0	0.5	51.1	1.6
	Imp. bldg	0.0	0.0	5.4	0.0	0.0	0.0	0.0	5.4	0.7
	Imp. road	0.0	0.0	0.0	5.6	0.0	0.0	0.0	5.6	0.7
	Imp. other	0.0	0.0	0.0	0.0	6.7	0.0	0.0	6.7	0.8
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.4	0.0	0.2	0.0	0.3	0.1	0.9	1.9	0.4
	2nd year total	29.4	49.8	5.8	5.9	7.2	0.1	1.7		

Table 2 (*Continued*)

City	1st year cover class	2nd year cover class							1st year	
		Grass/herb[a]	Tree/shrub	Imp. bldg[b]	Imp. road[c]	Imp. other[d]	Water	Soil	Total	SE
	2nd year SE	1.4	1.6	0.7	0.8	0.8	0.1	0.4		
	Net (2003–2008)	0.2	−1.2	0.4	0.3	0.4	0.1	−0.2		
New Orleans, LA (2005–2009)	Grass/herb	22.7	0.0	0.0	0.0	0.2	0.4	0.7	24.0	1.8
	Tree/shrub	6.6	23.3	0.0	0.9	1.1	0.4	0.7	32.9	2.0
	Imp. bldg	1.4	0.0	14.6	0.0	0.4	0.0	0.4	16.7	1.6
	Imp. road	0.0	0.0	0.0	15.5	0.0	0.0	0.0	15.5	1.5
	Imp. other	0.2	0.0	0.0	0.0	9.1	0.0	0.0	9.2	1.2
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.2	0.0	0.0	0.0	0.2	0.0	1.4	1.8	0.6
	2nd year total	31.1	23.3	14.6	16.3	10.8	0.7	3.2		
	2nd year SE	2.0	1.8	1.5	1.6	1.3	0.4	0.7		
	Net (2005–2009)	7.1	−9.6	−2.1	0.9	1.6	0.7	1.4		
New York, NY (2004–2009)	Grass/herb	14.9	0.1	0.2	0.0	0.6	0.1	0.6	16.6	1.2
	Tree/shrub	1.2	19.3	0.0	0.2	0.2	0.0	0.0	20.9	1.3
	Imp. bldg	0.0	0.0	24.4	0.0	0.1	0.0	0.0	24.6	1.4
	Imp. road	0.0	0.0	0.0	16.1	0.0	0.0	0.0	16.1	1.2
	Imp. other	0.0	0.3	0.2	0.1	18.5	0.0	0.0	19.1	1.3
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
	Soil	0.5	0.0	0.3	0.0	0.1	0.0	1.8	2.7	0.5
	2nd year total	16.6	19.7	25.2	16.4	19.5	0.1	2.5		
	2nd year SE	1.2	1.3	1.4	1.2	1.3	0.1	0.5		
	Net (2004–2009)	0.0	−1.2	0.6	0.3	0.4	0.0	−0.2		
Pittsburgh, PA (2004–2008)	Grass/herb	16.9	0.0	0.0	0.0	0.1	0.0	0.1	17.1	1.2
	Tree/shrub	0.2	41.6	0.1	0.0	0.0	0.0	0.0	41.9	1.6
	Imp. bldg	0.0	0.0	14.7	0.0	0.1	0.0	0.1	14.9	1.2
	Imp. road	0.0	0.0	0.0	13.3	0.0	0.0	0.1	13.4	1.1
	Imp. other	0.0	0.0	0.1	0.0	11.6	0.0	0.0	11.7	1.0
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.1	0.0	0.0	0.0	0.0	0.0	0.8	1.0	0.3
	2nd year total	17.2	41.6	14.9	13.3	11.8	0.0	1.2		
	2nd year SE	1.2	1.6	1.2	1.1	1.0	0.0	0.3		
	Net (2004–2008)	0.1	−0.3	0.0	−0.1	0.1	0.0	0.2		
Portland, OR (2005–2009)	Grass/herb	21.4	0.3	0.3	0.1	0.3	0.0	0.2	22.7	1.3
	Tree/shrub	0.7	30.4	0.1	0.0	0.3	0.0	0.0	31.5	1.5
	Imp. bldg	0.2	0.1	14.4	0.0	0.0	0.0	0.0	14.7	1.1
	Imp. road	0.0	0.0	0.0	12.5	0.0	0.0	0.0	12.5	1.1
	Imp. other	0.0	0.1	0.1	0.0	15.8	0.0	0.0	16.0	1.2
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	0.6	0.0	0.2	0.1	0.5	0.0	1.2	2.6	0.5
	2nd year total	23.0	30.9	15.1	12.7	16.9	0.0	1.4		
	2nd year SE	1.3	1.5	1.1	1.1	1.2	0.0	0.4		
	Net (2005–2009)	0.3	−0.6	0.4	0.2	0.9	0.0	−1.2		
Spokane, WA (2002–2007)	Grass/herb	24.0	0.7	0.2	0.1	0.4	0.0	1.7	27.1	1.0
	Tree/shrub	0.5	20.6	0.2	0.0	0.1	0.0	1.1	22.4	0.9
	Imp. bldg	0.0	0.0	12.0	0.0	0.1	0.0	0.0	12.1	0.7
	Imp. road	0.0	0.0	0.0	11.1	0.0	0.0	0.1	11.1	0.7
	Imp. other	0.1	0.0	0.0	0.0	10.5	0.0	0.1	10.6	0.7
	Water	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	Soil	1.3	0.5	0.5	0.2	0.7	0.0	13.6	16.7	0.8
	2nd year total	25.9	21.8	12.8	11.4	11.6	0.0	16.5		
	2nd year SE	1.0	0.9	0.8	0.7	0.7	0.0	0.8		
	Net (2002–2007)	−1.2	−0.6	0.8	0.3	1.0	−0.1	−0.2		
Syracuse, NY (2003–2009)[f]	Grass/herb	21.7	1.6	0.1	0.6	na	0.0	na	24.1	1.4
	Tree/shrub	0.5	25.0	0.1	0.3	na	0.0	na	25.9	1.4
	Imp. bldg	0.7	0.0	18.9	0.1	na	0.0	na	19.7	1.3
	Imp. road	0.6	0.3	0.2	29.2	na	0.0	na	30.3	1.5
	Imp. other	na	na	na	na	na	0.0	na	na	na
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	na	na	na	na	na	0.0	na	na	na
	2nd year total	23.6	26.9	19.3	30.2	na	0.0	na		
	2nd year SE	1.4	1.4	1.3	1.5	na	0.0	na		
	Net (2003–2009)	−0.5	1.0	−0.4	−0.1	na	0.0	na		
Tacoma, WA (2001–2005)	Grass/herb	24.8	1.2	0.1	0.1	0.8	0.0	0.1	27.1	1.5
	Tree/shrub	1.8	21.3	0.1	0.0	0.8	0.0	0.4	24.4	1.4

Table 2 (*Continued*)

City	1st year cover class	2nd year cover class							1st year	
		Grass/herb[a]	Tree/shrub	Imp. bldg[b]	Imp. road[c]	Imp. other[d]	Water	Soil	Total	SE
	Imp. bldg	0.2	0.0	13.2	0.0	0.3	0.0	0.2	14.0	1.1
	Imp. road	0.0	0.0	0.0	12.5	0.0	0.0	0.0	12.5	1.1
	Imp. other	0.0	0.1	0.1	0.1	13.8	0.0	0.1	14.2	1.2
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Soil	1.3	0.3	0.3	0.1	2.0	0.3	3.4	7.8	0.9
	2nd year total	28.1	23.0	13.9	12.8	17.6	0.3	4.3		
	2nd year SE	1.5	1.4	1.1	1.1	1.3	0.2	0.7		
	Net (2001–2005)	1.0	−1.4	−0.1	0.3	3.4	0.3	−3.5		
Average 20 cities[g]	Grass/herb	23.0	0.3	0.1	0.0	0.4	0.0	0.4	24.3	na
	Tree/shrub	1.1	27.8	0.2	0.1	0.3	0.0	0.4	29.9	na
	Imp. bldg	0.2	0.0	15.2	0.0	0.1	0.0	0.1	15.6	na
	Imp. road	0.0	0.0	0.0	12.1	0.0	0.0	0.0	12.1	na
	Imp. other	0.1	0.1	0.1	0.0	13.6	0.0	0.0	13.9	na
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	na
	Soil	0.5	0.1	0.2	0.1	0.4	0.1	3.0	4.3	na
	2nd year total	24.7	28.2	15.9	12.3	14.8	0.1	4.0		
	2nd year SE	na	na	na	na	na	na	na		
	Average net	0.5	−1.5	0.3	0.3	0.8	0.1	−0.3		
Average 18 cities[h]	Grass/herb	22.7	0.3	0.2	0.0	0.4	0.0	0.4	24.0	na
	Tree/shrub	0.8	28.4	0.2	0.1	0.2	0.0	0.4	30.0	na
	Imp. bldg	0.1	0.0	15.1	0.0	0.1	0.0	0.1	15.4	na
	Imp. road	0.0	0.0	0.0	11.7	0.0	0.0	0.0	11.7	na
	Imp. other	0.1	0.1	0.2	0.0	13.8	0.0	0.0	14.2	na
	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	na
	Soil	0.5	0.1	0.2	0.1	0.4	0.1	3.2	4.6	na
	2nd year total	24.2	28.8	15.9	12.0	15.0	0.1	4.2		
	2nd year SE	na	na	na	na	na	na	na		
	Average net	0.1	−1.1	0.4	0.2	0.8	0.0	−0.4		

SE – standard error. Net – net difference between the years (2nd year – 1st year).

[a] Grass and other herbaceous ground cover.

[b] Impervious cover occupied by buildings.

[c] Impervious cover occupied by roads.

[d] Other impervious cover (e.g., sidewalks, driveways, and parking lots).

[e] Scrub/shrub/chaparral was a cover class only measured in Albuquerque, NM, and is included in tree/shrub cover. This cover class occupied 31.6 percent of the city area in 2006 and dropped to 29.4 percent in 2009, a loss of 2.2 percent of the city area.

[f] Soil cover is included in grass and herbaceous cover; impervious other is included in impervious road.

[g] Results from Syracuse are not included in average of grass/herbaceous, impervious road, impervious other or soil (see table footnote f).

[h] Average result not including New Orleans or Detroit as these cities were specifically selected due to expected losses from hurricane and emerald ash borer damage respectively. Results from Syracuse are not included in average of grass/herbaceous, impervious road, impervious other or soil (see table footnote f).

Most of the loss of tree cover converted to grass/herbaceous cover (47 percent), followed by conversions to impervious cover (29 percent) and bare soil (23 percent) (Table 2). Likewise, new cover most often converted from grass/herbaceous cover (68 percent), followed by impervious cover (17 percent) and bare soil (14 percent). Only one city (Syracuse) exhibited an overall increase in tree cover, with most of this increase coming from grass/herbaceous cover.

Change in percent impervious cover during the varying periods of analysis ranged from an increase of 3.6 percent in Tacoma to a decrease in percent impervious cover of −0.5 in Syracuse (Table 3). Seventeen of the 20 cities analyzed showed an increase in net impervious cover, 16 of those cities had a statistically significant increase. Four cities exhibited small changes in net impervious cover that were not statistically significant from zero (Syracuse, Chicago, Pittsburgh, New Orleans). Percent impervious cover increased on average by 1.4 percent during the varying periods of analysis (1.3 percent for 20 city average) with the greatest increases in percent impervious cover in Tacoma (3.6 percent), Baltimore (2.1 percent) and Kansas City and Spokane (2.0 percent each). The relative increase in impervious cover was as high as 11.2 percent in Kansas City, but averaged 3.9 percent (3.7 percent for 20 city average).

Cities with the greatest annual increase in impervious cover were Los Angeles (average of 550 ha/yr), Houston (400 ha/yr) and Albuquerque (280 ha/yr) (Table 3). Impervious cover increases per capita were greatest in Tacoma (6.0 m^2/person/yr), Kansas City (5.9 m^2/person/yr) and Albuquerque (5.5 m^2/person/yr) with an average increase of 2.2 m^2/person/yr (2.1 m^2/person/yr for 20 city average). Average annual increase in percent impervious cover was 0.31 percent/yr (0.30 percent/yr for 20 city average). Relative annual increase in impervious cover was 0.87 percent/yr (0.82 percent/yr for 20 city average).

The analysis of the 20 cities shows a general loss in tree cover and increase in impervious cover in the mid to late 2000s. This overall trend of change was also exhibited in the results of national urban land cover change using Google Earth imagery. Of the 1000 random paired-points laid throughout the conterminous urban United States, 970 points were interpretable, with average length of time between points of 6.4 yr. The most recent imagery had an average year of 2009, but ranged between 2004 and 2011. The older paired image year averaged 2002 with a range of 1990–2006. Tree cover increases between images averaged 2.1 percent (SE = 0.5 percent) with average losses of −2.3 percent (SE = 0.5 percent) for an average net change in tree cover of −0.2 percent. Impervious cover increases between images averaged 3.2 percent (SE = 0.6 percent)

Table 3
Percent net and annualized net absolute and relative tree and impervious cover change in 20 U.S. cities. Absolute percent change is based on city land area between the years (percent of city land in year 1 minus percent of city land in year 2). Relative percent change is based on amount of cover in year 1 (percent of city in year 1 minus percent of city in year 2 divided by percent of city in year 1). Annualized change is percent change during time period on an annual basis. Per capita change estimates are based on population in the first year of analysis.

City	Net				Tree cover change		Impervious cover change		Annualized net			
	Absolute change		Relative change		ha/yr[c]	m²/cap/yr[d]	ha/yr[c]	m²/cap/yr[d]	Absolute change		Relative change	
	Tree[a]	Imp.[b]	Tree[a]	Imp.[b]					Tree[a]	Imp.[b]	Tree[a]	Imp.[b]
New Orleans, LA (2005–2009)	−9.6**	0.4	−29.2**	0.9	−1120	−24.6	40	0.9	−2.49	0.09	−8.27	0.21
Houston, TX (2004–2009)	−3.0**	1.3**	−9.8**	3.5**	−890	−4.3	400	1.9	−0.60	0.26	−2.03	0.69
Albuquerque, NM (2006–2009)	−2.7**	1.8**	−6.6**	5.1**	−420	−8.3	280	5.5	−0.91	0.60	−2.26	1.67
Baltimore, MD (2001–2005)	−1.9**	2.1**	−6.3**	4.7**	−100	−1.5	110	1.7	−0.48	0.51	−1.62	1.16
Atlanta, GA (2005–2009)	−1.8**	1.7**	−3.4**	6.5**	−150	−3.1	150	3.1	−0.46	0.43	−0.85	1.58
Miami, FL (2003–2009)	−1.7**	1.0*	−7.1**	1.7*	−30	−0.8	20	0.5	−0.28	0.16	−1.22	0.27
Tacoma, WA (2001–2005)	−1.4**	3.6**	−5.8**	8.9**	−50	−2.6	117	6.0	−0.36	0.89	−1.49	2.15
Kansas City, MO (2003–2009)	−1.2**	2.0**	−4.2**	11.2**	−160	−3.5	270	5.9	−0.20	0.34	−0.71	1.78
Nashville, TN (2003–2008)	−1.2**	1.1**	−2.4**	6.2**	−300	−5.3	270	4.8	−0.24	0.22	−0.48	1.21
New York, NY (2004–2009)	−1.2**	1.4**	−5.5**	2.3**	−180	−0.2	210	0.3	−0.23	0.27	−1.13	0.45
Minneapolis, MN (2003–2008)	−1.1**	0.8**	−3.1**	1.8**	−30	−0.8	20	0.5	−0.22	0.15	−0.63	0.35
Boston, MA (2003–2008)	−0.9*	1.7**	−3.2*	3.6**	−20	−0.3	40	0.7	−0.19	0.35	−0.65	0.71
Los Angeles, CA (2005–2009)	−0.9**	1.8**	−4.2**	3.4**	−270	−0.7	550	1.4	−0.23	0.45	−1.06	0.85
Detroit, MI (2005–2009)	−0.7**	1.2**	−3.0**	2.6**	−60	−0.7	110	1.2	−0.18	0.30	−0.77	0.64
Portland, OR (2005–2009)	−0.6	1.5**	−1.9	3.5**	−50	−0.9	130	2.4	−0.15	0.38	−0.49	0.87
Spokane, WA (2002–2007)	−0.6	2.0**	−2.5	5.8**	−20	−1.0	60	3.0	−0.11	0.39	−0.50	1.14
Chicago, IL (2005–2009)	−0.5**	0.0	−2.7**	0.0	−70	−0.2	0	0.0	−0.13	0.00	−0.69	0.00
Pittsburgh, PA (2004–2008)	−0.3*	0.0	−0.8*	0.0	−10	−0.3	0	0.0	−0.08	0.00	−0.19	0.00
Denver, CO (2005–2009)	−0.3*	1.4**	−3.1*	3.6**	−30	−0.5	140	2.5	−0.08	0.35	−0.78	0.88
Syracuse, NY (2003–2009)	1.0*	−0.5	4.0*	−1.0	10	0.7	−6	−0.4	0.17	−0.09	0.65	−0.17
20 city average	−1.5	1.3	−5.0	3.7		−3.0		2.1	−0.37	0.30	−1.29	0.82
18 city average[e]	−1.1	1.4	−3.8	3.9		−1.9		2.2	−0.27	0.31	−0.90	0.87

[a] Percent tree and shrub cover (including shrub/scrub/chaparral cover in Albuquerque, NM).
[b] Percent impervious surfaces (building, roads and other combined).
[c] Average annual change in hectares per year.
[d] Average annual change in square meters per capita per year.
[e] Average result not including New Orleans or Detroit as these cities were specifically selected due to expected losses from hurricane and emerald ash borer damage respectively.
* Change significantly different from zero at alpha = 0.90.
** Change significantly different from zero at alpha = 0.95.

with average losses of −0.4 percent (SE = 0.2 percent) for an average net change in impervious cover of +2.8 percent.

Discussion

While cities expend resources to plant millions of new trees, land development, storms, old age and other factors are reducing the number of older, established trees in cities. Though current planting campaigns may increase tree cover now and in the future, recent trends indicate that tree cover is decreasing in many U.S. cities. Tree cover is decreasing at a rate of about 0.27 percent of the city land area per year, which is equivalent to about 0.9 percent of the existing tree cover being lost annually.

The tree cover loss in the analyzed cities was higher than the average tree cover loss for urban land in the conterminous United States by a factor of about 6 (1.1 vs. 0.2 percent over the varying time frames). This difference is likely because these analyzed cities do not represent the entire urban area. The selected cities are relatively major cities with increased population densities and likely increased development pressures when compared with the average urban landscape, which includes many smaller, less densely populated areas. These city boundaries, which are often in forested regions, can also include non-urban lands that may have a high likelihood for development and therefore loss of tree cover and increased impervious cover. The change effects in these cities are likely more representative of change in major cities than the national urban change estimates.

Using the national tree cover loss estimate of 0.2 percent of urban land over about a 6 yr period, which equates to about 1/30 of a percent per year, a first order approximation of tree cover loss in urban areas of the conterminous United States is a loss rate of about 7900 ha of urban tree cover per year. Given an average tree density per unit of urban tree cover of approximately 508 trees/ha (average from Cumming et al., 2007; Nowak et al., 2007, in press-a, in press-b; Nowak and Greenfield, 2008; unpublished data), this loss equates to an annual net loss of about 4.0 million trees per year in urban areas of the conterminous United States. This estimate of number of trees lost may be excessive as much of canopy loss may be due to loss of mature trees that would have a lower tree density per unit canopy than the average urban forest, but further research is needed to understand the composition and size class distribution of the canopy loss. Although tree planting and natural regeneration are occurring in urban areas, net tree cover is on a general decline in urban areas of the United States. Tree canopy loss of mature trees, for whatever reason (storms, insects, development, old age), can create relatively large gaps in the canopy cover that will require new tree plantings or regeneration and time to fill.

It is apparent that tree planting and natural regeneration are insufficient to offset the current losses of established urban tree canopies. However, without various tree planting efforts in cities, tree cover loss would be higher. Efforts to facilitate more natural regeneration in cities (e.g., limits on mowing) may also be needed to sustain tree cover. Natural regeneration may not work in all locations (e.g., water limited areas) or produce desired tree species, but it can provide for relatively low cost tree/shrub establishment. Similarly, tree planting may not be appropriate in all cities (e.g., water limited areas) due to the resource costs of maintaining vegetation (e.g., water). Sustaining tree cover not only includes establishing new trees, but also limiting the loss of existing canopy, particularly

large trees that provide substantial amounts of canopy per tree. Sustaining tree health and protection of healthy tree canopies from human removal (e.g., development) or natural mortality forces (e.g., insects and diseases) can also help sustain existing tree cover and associated environmental services.

Though the current trend is a decline in canopy cover, not all cities are losing tree cover. One of the 20 cities analyzed (Syracuse, NY) had an absolute increase in canopy cover of one percent, or 0.2 percent increase per year, with most of the tree cover increase occurring in grass/herbaceous areas. This increase in tree cover matches field data estimates of urban forest change in Syracuse (U.S. Forest Service, unpublished data) that shows that the number of trees (woody plants with stem diameter at 1.37 m greater than 2.54 cm) are increasing. This increase is dominated by European buckthorn (*Rhamnus cathartica* L.), an invasive small tree/shrub from Europe. Thus, the cover increase in Syracuse is most likely due to natural regeneration in concert with limited development or activities that would tend to reduce regeneration.

New Orleans, as expected, had a significant reduction in tree cover (−9.6 percent absolute reduction or −29.2 percent relative reduction), which is most likely due to the devastation of Hurricane Katrina in 2005 (e.g., Chapman et al., 2008). In contrast, the loss in tree cover due to the emerald ash borer in Detroit was lower than expected. Since 2002, this beetle has killed more than 30 million ash trees in Southeastern Michigan (US Forest Service et al., 2011). However, the loss of tree cover in Detroit (−0.18 percent absolute annual reduction or −0.77 percent relative annual reduction) was less than the average loss from the sampled cities (−0.27 percent absolute annual reduction or −0.90 percent relative annual reduction). This difference could be due to ash trees not comprising a major component of overall tree cover in Detroit and/or new trees being established through tree planting programs or natural regeneration that help offset the loss of ash and other trees.

Overall, most of the tree losses converted to grass/herbaceous cover (47 percent) or impervious cover (29 percent), while most of the gain of new tree cover also came from grass/herbaceous cover (68 percent) or impervious cover (17 percent). Some of the conversions from tree to impervious cover are due to development, but are also due to impervious cover being beneath trees. When trees are removed, the ground surface beneath the trees switches to the new cover class. Likewise, as trees cover ground surfaces, additional tree cover can tend to reduce impervious cover estimates when trees grow over the impervious surfaces.

Of the overall average increase in impervious cover, about 29 percent of that change was due to changes with loss of tree cover. That 29 percent of newly classified impervious cover is a combination of new development and exposure of existing impervious cover beneath trees. However, at least 71 percent of the impervious cover increase was due to new development. Some cities (i.e., Chicago, Pittsburgh) exhibited no net change in impervious cover during the analysis period, but did exhibit increases and decreases in impervious cover that offset each other. Syracuse exhibited a decrease in impervious cover, which may be, in part, due to the overall increase in tree cover. However, most of the changes in impervious cover in Syracuse occurred with grass/herbaceous cover. New Orleans also lost a substantial amount of building cover (2.1 percent absolute reduction), most likely due to damage from Hurricane Katrina (e.g., Kates et al., 2006).

A better understanding of how tree cover and tree populations are changing can aid managers in developing regeneration or canopy protection plans to sustain adequate tree cover through time and space. Photo-interpretation of paired digital images offers a relatively easy, quick and low-cost means to statistically assess changes among various cover types. To help in quantifying the cover types within an area, a free tool (i-Tree Canopy) is available (www.itreetools.org) that allows users to photo-interpret a city using Google images. This program automatically quantifies the percent cover and associated standard error for each cover class based on user interpretations. Cover data on a city can provide a baseline for developing management plans, setting tree cover goals, and for monitoring change through time. Future analyses on cover distribution or change by land use type or geographic region are needed to investigate patterns and causes of tree and impervious cover changes between and within cities.

The paired digital image analysis offers a relatively quick, easy and cost-effective means to assess cover change, but it does have some limitations. Though Google offers high-resolution imagery in many parts of the world, paired image analysis with Google images is limited by the varying dates among images and varying image resolution. In urban areas, many of the Google images are of sufficient resolution for accurate photo-interpretation and images are continually updated. Obtaining local digital images with known and consistent dates across an area of analysis can overcome the problems associated with varying dates across a study area. Sometimes paired city data also had different image resolution between years, but most images were 1 m or less. As image interpretation was paired, information from the higher resolution image could aid in interpreting the lower resolution image. Another limitation of the paired image approach is the ability of the interpreter to correctly classify sample points. Interpreter error can lead to inaccurate results, but proper training and testing can produce accurate results. Satellite cover maps also have inherent inaccuracies due to classification errors and can cost tens of thousands of dollars to produce a cover map for a city. The paired photo-interpretation method offers a more cost effective means to assess change, but does not produce a detailed map of cover attributes or cover change across a city.

The results of this study illustrate recent changes in tree and impervious cover in cities and urban areas that can be used to inform planners and policy makers. To determine whether similar trends occurred in the 1990s or early 2000s, and whether these trends will continue in the future, more paired image analyses can be conducted using older paired imagery or by comparing future imagery with contemporary images. More paired image analyses can help better determine both spatial and temporal patterns and rates of landscape cover change. Photo-interpreted data on cover in urban areas and elsewhere can provide an accurate means of assessing cover types and changes in cover through time to help managers and planners make informed decisions on how to better improve local landscapes and the environment.

Conclusion

Tree cover provides a simple means to assess the magnitude of the overall urban forest and its environmental effects. Despite various and likely limited tree planting and protection campaigns, tree cover tends to be on the decline in U.S. cities while impervious cover is on the increase. While these individual campaigns are helping to increase or reduce the loss of urban tree cover, more widespread, comprehensive and integrated programs that focus on sustaining overall tree canopy may be needed to help reverse the trend of declining tree cover in cities. Net tree cover change is the result of the combined influences of tree planting and natural regeneration, tree growth and tree mortality. Developing coordinated healthy tree canopy programs across various land ownerships can help sustain desired tree cover levels and better manage cover change. Monitoring of tree cover changes is essential to determine current trends and whether desired canopy levels or program effects are being attained. Photo-interpretation of digital aerial images can provide a simple and timely means to assess urban tree cover and how it is changing.

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References

Chapman, E.L., Chambers, J.Q., Ribbeck, K.F., Baker, D.B., Tobler, M.A., Zeng, H., White, D.A., 2008. Hurricane Katrina impacts on forest trees of Louisiana's Pearl River basin. Forest Ecology and Management 256, 883–889.

City of New York, 2011. MillionTreesNYC (retrieved 01.06.11) http://www.milliontreesnyc.org/html/home/home.shtml.

City of Los Angeles, 2011. MillionTreesLA (retrieved 15.06.11) http://www.milliontreesla.org/.

City of Pasadena, 2011. Pasadena Tree Protection Ordinance (retrieved 15.06.11) http://ww2.cityofpasadena.net/publicworks/PNR/TreeOrdinance/default.asp.

City of Seattle, 2011. Seattle's Canopy Cover (retrieved 01.06.11) http://www.seattle.gov/trees/canopycover.html.

Cumming, A.B., Nowak, D.J., Twardus, D.B., Hoehn, R., Mielke, M., Rideout, R., 2007. Urban Forests of Wisconsin 2002: Pilot Monitoring Project 2002. USDA Forest Service, Northeastern Area State and Private Forestry Report, NA-FR-05-07. USDA Forest Service.

Dwyer, J.F., McPherson, E.G., Schroeder, H.W., Rowntree, R.A., 1992. Assessing the benefits and costs of the urban forest. Journal of Arboriculture 18 (5), 227–234.

Google Inc., 2011. Google Earth (retrieved 15.01.11) http://earth.google.com.

Hansen, M.C., DeFries, R.S., Townshend, J.R.G., Carroll, M., Dimiceli, C., Sohlberg, R.A., 2003. Global percent tree cover at a spatial resolution of 500 meters: first results of the MODIS vegetation continuous fields algorithm. Earth Interactions 7 (10), 1–15.

Heisler, G.M., Brazel, A.J., 2010. The urban physical environment: temperature and urban heat islands. In: Aitkenhead-Peterson, J., Volder, A. (Eds.), Urban Ecosystem Ecology (Agronomy Monograph). Soil Science Society of America, Madison, WI, pp. 29–56.

Kates, R.W., Colten, C.E., Laska, S., Leatherman, S.P., 2006. Reconstruction of New Orleans after Hurricane Katrina: a research perspective. PNAS 103 (40), 14653–14660.

Kuo, F.E., Sullivan, W.C., 2001. Environment and crime in the inner city: does vegetation reduce crime? Environmental Behavior 33 (3), 343–365.

Lindgren, B.W., McElrath, G.W., 1969. Introduction to Probability and Statistics. Macmillan, London.

Lunetta, R.L., Knight, F.K., Ediriwickrema, J., Lyon, J.G., Worthy, L.D., 2006. Land-cover change detection using multi-temporal MODIS NDVI data. Remote Sensing of Environment 105, 142–154.

Maryland Department of Natural Resources, 2011. Cheasapeake Bay Urban Tree Canopy Goals (retrieved 01.10.11) http://www.dnr.state.md.us/forests/programs/urban/urbantreecanopygoals.asp.

National Research Council, Committee on Hydrologic Impacts of Forest Management, 2008. Hydrologic Effects of a Changing Forest Landscape. The National Academies Press, Washington, DC.

Nowak, D.J., 1993. Historical vegetation change in Oakland and its implications for urban forest management. Journal or Arboriculture 19 (5), 313–319.

Nowak, D.J., Buckelew Cumming, A., Twardus, D., Hoehn, R.E., Brandeis, T.J., Oswalt, C.M. Urban Forests of Tennessee. Gen. Tech. Rep. U.S. Department of Agriculture, Forest Service, in press-a.

Nowak, D.J., Buckelew-Cumming, A., Twardus, D., Hoehn, R., Mielke, M., 2007. National Forest Health Monitoring Program, Monitoring Urban Forests in Indiana: Pilot Study 2002. Part 2: Statewide Estimates Using the UFORE Model. Northeastern Area Report, NA-FR-01-07.

Nowak, D.J., Dwyer, J.F., 2007. Understanding the benefits and costs of urban forest ecosystems. In: Kuser, J. (Ed.), Urban and Community Forestry in the Northeast. Springer Science and Business Media, New York, pp. 25–46.

Nowak, D.J., Greenfield, E.J., 2008. Urban and Community Forests of New England. USDA Forest Service, Northern Research Station, General Technical Report NRS-38, Newtown Square, PA.

Nowak, D.J., Hoehn, R., Crane, D.E., Bodine, A. Assessing urban forest effects and values in the Great Plains States: Kansas, Nebraska, North Dakota, South Dakota. USDA Forest Service, Northern Research Station, Resource Bulletin NRS, Newtown Square, PA, in press-b.

Nowak, D.J., Rowntree, R.A., McPherson, E.G., Sisinni, S.M., Kerkmann, E., Stevens, J.C., 1996. Measuring and analyzing urban tree cover. Landscape and Urban Planning 36, 49–57.

Oke, T.R., 1989. The micrometeorology of the urban forest. Philosophical Transactions of the Royal Society of London B 324, 335–349.

Parlin, M., 2009. Seattle, Washington Urban Tree Canopy Analysis. NCDC Imaging (retrieved 15.06.11) http://www.seattle.gov/trees/docs/NCDC_Final_Project_Report.pdf.

Schwarz, M., Waser, L.T., Zimmerman, N.E., 2006. Change detection based on fractional tree cover derived from MODIS data. In: Kerle, N., Skidmore, A.K. (Eds.), Proceedings of the ISPRS Mid-term Symposium. (retrieved 01.11.11) www.isprs.org/proceedings/XXXVI/Part7/PDF/022.pdf.

Sokal, R.R., Rohlf, F.J., 2003. Biometry: The Principles and Practices of Statistics in Biological Research. W.H. Freeman and Company, New York, NY.

Town of Chapel Hill, 2011. Tree Protection (retrieved 15.06.11) http://www.ci.chapel-hill.nc.us/index.aspx?page=879.

U.S. Census Bureau, 2007. U.S. Census Data (retrieved 15.01.11) www.census.gov.

U.S. Census Bureau, 2011. Population Estimates (retrieved 01.06.11) http://www.census.gov/popest/cities/SUB-EST2009-4.html.

U.S. Environmental Protection Agency, 1983. Results of the Nationwide Urban Runoff Program: Volume 1 – Final Report. U.S. Environmental Protection Agency, Water Planning Division, Washington, DC. NTIS Accession Number: PB84-185552.

U.S. Environmental Protection Agency, 2011. 2006 National Land Cover Data (NLCD 2006) (retrieved 01.11.11) http://www.epa.gov/mrlc/nlcd-2006.html.

US Forest Service, Michigan State University, Purdue University and Ohio State University, 2011. Emerald Ash Borer, Michigan Information (retrieved 15.06.11) www.emeraldashborer.info/michiganinfo.cfm.

Westphal, L.M., 2003. Urban greening and social benefits: a study of empowerment outcomes. Journal of Arboriculture 29 (3), 137–147.

Wolf, K.M., 2003. Public response to the urban forest in inner-city business districts. Journal of Arboriculture 29 (3), 117–126.

Yang, L., Xian, G., Klaver, J.M., Deal, B., 2003. Urban land-cover change detection through sub-pixel imperviousness mapping using remotely sensed data. Photogrammetric Engineering and Remote Sensing 69 (9), 1003–1010.

Zhou, W., Troy, A., Grove, M., 2008. Object-based land cover classification and change analysis in the Baltimore metropolitan area using multitemporal high resolution remote sensing data. Sensors 8, 1613–1636.

Summary of Selected Tree Laws in Other Jurisdictions

Fairfax County, VA
Chapter 122, Fairfax County Code
Section 12, Fairfax County Public Facilities Manual
http://www.fairfaxcounty.gov/dpwes/publications/pfm/chapter12.pdf

Overview	Requires the conservation or planting of trees on development sites such that, after ten years, minimum tree canopy ranging from 10-30% (depending on zoning) exists on the site.
Activities Covered	All land development requiring the submission of a site plan, preliminary subdivision plat, subdivision construction plan, conservation plan, grading plan, or a rough grading plan. Does not apply to construction of additions to existing residential structures or reconstruction of residential structures on existing foundations.
General Process	Requires the submission of a Tree Conservation Plan when a land disturbance has potential to destroy or degrade on-site trees or trees located on adjacent property. Tree Conservation Plans "shall contain all proposed engineering and layout information needed to conduct a thorough review of proposed tree preservation, tree planting and landscaping requirements," including information on: • the general composition and extent of existing vegetation • calculations and a statement of compliance with or a proposed deviation from the Tree Preservation Target requirements (and if necessary a narrative containing all the information and documentation to justify a deviation) • ten-year tree canopy calculations Example: The existing vegetation map shall accurately depict the location of the outer canopy edge of individual freestanding trees and forested areas at time of plan submission, and shall identify the percentage of the development site covered by tree canopy comprised of self-supporting tree and woody plants that exceed 5 feet in height at time of plan submission. The map shall provide a statement regarding the successional stage of the vegetation, a list of the primary tree species, and a statement regarding the general health and condition of the vegetation.
Mitigation	Subject to a variety of conditions, the tree canopy requirement may be met through the preservation or planting of trees on-site, or through off-site tree banking or through pro rata payment into the Tree Preservation and Planting Fund (currently $300 per 200 square feet of canopy required).

Attachment: 10-year Tree Canopy Calculation Worksheet

Table 12.10 10-year Tree Canopy Calculation Worksheet			
Step		Totals	Reference
A. Tree Preservation Target and Statement			
A 1	Place the Tree Preservation Target calculations and statement here preceding the 10-year tree canopy calculations		see § 12-0508.2 for list of required elements and worksheet
B. Tree Canopy Requirement			
B1	Identify gross site area =		§ 12-0511.1A
B2	Subtract area dedicated to parks, road frontage, and		§ 12-0511.1B
B3	Subtract area of exemptions =		§ 12-0511.1C(1) through § 12-0511.1C(6)
B4	Adjusted gross site area (B1 – B2) =		
B5	Identify site's zoning and/or use		
B6	Percentage of 10-year tree canopy required =		§ 12-0510.1 and Table 12.4
B7	Area of 10-year tree canopy required (B4 x B6) =		
B8	Modification of 10-year Tree Canopy Requirements requested?		Yes or No
B9	If B8 is yes, then list plan sheet where modification request is located		Sheet number
C. Tree Preservation			
C1	Tree Preservation Target Area =		
C2	Total canopy area meeting standards of § 12-0400 =		
C3	C2 x 1.25 =		§ 12-0510.3B
C4	Total canopy area provided by unique or valuable forest or woodland communities =		
C5	C4 x 1.5 =		§ 12-0510.3B(1)
C6	Total of canopy area provided by "Heritage," "Memorial," "Specimen," or "Street" trees =		
C7	C6 x 1.5 to 3.0 =		§ 12-0510.3B(2)
C8	Canopy area of trees within Resource Protection Areas and 100-year floodplains =		
C9	C8 x 1.0 =		§ 12-0510.3C(1)
C10	Total of C3, C5, C7 and C9 =		If area of C10 is less than B7 then remainder of requirement must be met through tree planting - go to D
D. Tree Planting			
D1	Area of canopy to be met through tree planting (B7-C10) =		
D2	Area of canopy planted for air quality benefits =		
D3	x 1.5 =		§ 12-0510.4B(1)
D4	Area of canopy planted for energy conservation =		

D5	x 1.5 =		§ 12-0510.4B(2)
D6	Area of canopy planted for water quality benefits =		
D7	x 1.25 =		§ 12-0510.4B(3)
D8	Area of canopy planted for wildlife benefits =		
D9	x 1.5 =		§ 12-0510.4B(4)
D10	Area of canopy provided by native trees =		
D11	x 1.5 =		§ 12-0510.4B(5)
D12	Area of canopy provided by improved cultivars and varieties =		
D13	x 1.25		§ 12-0510.4B(6)
D14	Area of canopy provided through tree seedlings =		
	x 1.0		§ 12-0510.4D(1)
D15	Area of canopy provided through native shrubs =		
	x1.0		§ 12-0510.4D(1)
D16	Percentage of D14 represented by D15=		Must not exceed 33% of D14
D17	Total of canopy area provided through tree planting =		
D18	Is an off-site planting relief requested?		Yes or No
D19	Tree Bank or Tree Fund?		§ 12-0512
D20	Canopy area requested to be provided through off-site banking or tree fund		
D21	Amount to be deposited into the Tree Preservation and Planting Fund		
E. Total of 10-year Tree Canopy Provided			
E1	Total of canopy area provided through tree preservation (C10) =		
E2	Total of canopy area provided through tree planting (D17) =		
E3	Total of canopy area provided through off-site mechanism (D19) =		
E4	Total of 10-year Tree Canopy Provided = (E1+E2+E3)		Total of E1 through E3. Area should meet or exceed area required by B7

http://www.fairfaxcounty.gov/dpwes/publications/pfm/chapter12.pdf

Summary of Selected Tree Laws in Other Jurisdictions

Washington, DC
District of Columbia Register LEXSEE 50 DE REG 888, D.C. ACT 4-614
http://ddot.dc.gov/DC/DDOT/Services/Tree+Services/Tree+Permits/Urban+Forest+Preservation+Act+of+2002

Overview	Requires fees or replacement of trees removed to mitigate for lost resources. Fees collected are used to plant trees on private and public property.
Activities Covered	Removal of trees 18 inches in diameter or larger and "special" trees on private property, or street tree of any size; as well as willful destruction of living trees.
General Process	Requires an application for permit and payment of mitigation fees based on diameter of trees. Applicant provides documentation from a qualified expert or request s inspection by DDOT arborists. Inspection must be completed prior to issuance of permit.
Mitigation	Fees to mitigate for lost resources are assessed. Fees collected are used to plant trees on private and public property. Mitigation options for trees 18" or larger and "special" trees removed from private property: • Plant a quantity of trees whose aggregated circumference equals or exceeds the circumference of the tree removed. For example, if a 20 inch diameter tree is removed, 10 trees of 2-inch caliper must be planted. • Pay $35 per inch of circumference • Any combination of both Mitigation fees when street trees removed: • For trees 2- to 6-inches, pay $90 per inch diameter • For trees 6.1- to 12-inches, pay $100 per inch diameter • For trees 12.1-inches and up, pay $110 per inch diameter Hazardous and non-native invasive species require a permit but are not subject to mitigation fees.

Attachments: District Department of Transportation Tree Permit Notice
Special Tree Permit Fund Planting Map

Tree Permits

tops.ddot.dc.gov | DDOT Permits Office - 1100 4th Street SW, 2nd Floor

Public Space Tree Permit

A Public Space Tree Permit is required to plant ($0 permit fee), prune ($75 permit fee) or remove ($100 permit fee) any tree in the public right-of-way. Once permitted, the fee schedule to remove a healthy tree, measured at 4.5 feet above grade, is as follows:

Total # of Inches Removed	Compensation
2-to-6 inch diameter	$90 per inch diameter
6.1-to-12 inch diameter	$100 per inch diameter
12.1 inch diameter and up	$110 per inch diameter

Special Tree Removal Permit

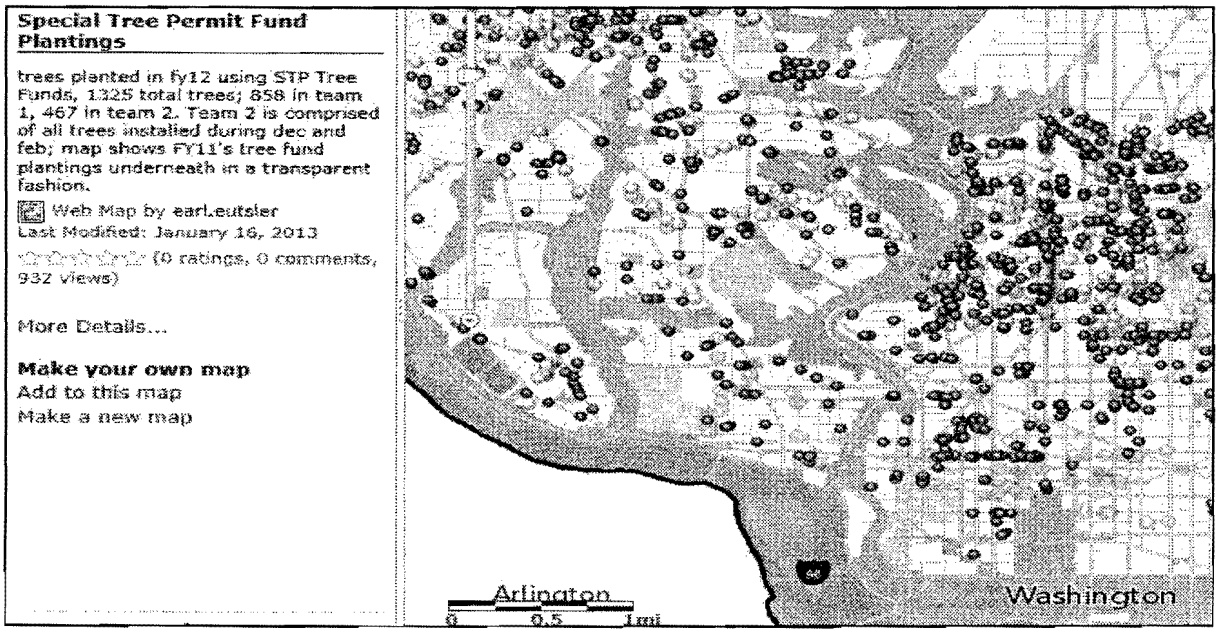
In order to protect the District's canopy and its largest trees, individuals must receive a permit to remove any tree in Washington, DC that is larger than 55 inches circumference (measured around the trunk at 4.5 feet from the ground). Permits are issued under at least one of the following conditions:

- An International Society of Arboriculture (ISA) arborist deems the tree is hazardous to life and/or property;
- The tree is of a species exempt from the law: Tree of heaven (Ailanthus altissima), mulberry (Morus species), or Norway maple (Acer platanoides);
- The property owner declares on the permit application to (a) plant a quantity of saplings whose aggregated circumference equals or exceeds the circumference of the Special Tree to be removed, (b) pay into the Tree Fund a tree replacement fee of $35 per inch of circumference for each Special Tree to be removed, or (c) perform a combination of both (a) and (b).

Failure to comply will result in a violation subject to a fine of not less than $100 per each inch of tree circumference.

For adjacent private property tree issues, contact the Multi-Door Dispute Resolution Division at DC Superior Court.

http://ddot.dc.gov/DC/DDOT/Publication%20Files/On%20Your%20Street/Urban%20Forestry/UFA_Laws-and-Permits.pdf



http://ddot.dc.gov/DC/DDOT/Services/Tree+Services/Tree+Permits/Special+Tree+Permit

Summary of Selected Tree Laws in Other Jurisdictions

City of Chesapeake, VA
CZO §19-600
http://www.cityofchesapeake.net/Assets/documents/departments/planning/ord-Landscape-Ordinance_adopted-0901608.pdf
Chesapeake Landscape Specification Manual:
http://vtod.frec.vt.edu/Documents/Chesapeake%20landscape_specifications_manual.pdf

Overview	The intent of the Landscape Ordinance is to provide minimum standards for the preservation, protection and enhancement of the ecologic and aesthetic environments of the City of Chesapeake.
Activities Covered	Any single-family or duplex residential construction requiring a building permit, any activity on a multifamily or nonresidential development requiring final or preliminary site plan, and major residential subdivision requiring a final subdivision plan.
General Process	Submissions and review require detailed information such as a site assessment; delineation of preservation areas; and details for preservation methods, planting locations, species, size and spacing of plants, and other treatments such as mulch, seed or sod. Approval by the City Arborist and field inspections are required. Requires the conservation or planting of trees on development sites to meet minimum tree canopy coverage ranging from 10-50% (depending on zoning). The area subject to a minimum percentage of canopy coverage does not include building footprints, sidewalks, patios, or driveways.
Mitigation	Canopy coverage requirements can be met through a combination of on-site conservation and on-site planting. Additional credit for protecting specimen trees and clusters of trees is provided. Planting requirements for lots larger than 36,000 sq ft are capped at 18 trees.

Attachments: Canopy Requirement Calculations

Summary of Selected Tree Laws in Other Jurisdictions

Non-CBPA Site Residential Tree Canopy Landscape Plan (CZO 19-01.A.2)

Lot Size _____sf X 20% =_____sf Canopy Required

Note: Canopy credit is 400 sf per Large Canopy Tree (LCT), 200 sf per Small Canopy Tree (SCT).

Canopy Provided (Number of LCT or SCT X sf Credit) = _____ sf

Note: A maximum of 18 LCT only for lots 36,000 square feet or larger. Total Canopy provided must meet or exceed canopy required. All trees must be a minimum 6' fall at planting, planted in accordance with CZO 19-600.

CBPA Site Residential Tree Canopy Plan (50% for RPA, 20% for RMA) (CZO 19-601.A.2)

Lot Size _____sf X (50% for RPA, 20% for RMA =_____sf Canopy Required

Note: Canopy credit is 400 sf per Large Canopy Tree (LCT), 200 sf per Small Canopy Tree (SCT).

Canopy Provided (Number of LCT or SCT X sf Credit) = _____ sf

Total Canopy provided must meet or exceed canopy required. All trees must be a minimum 6' tall at planting, planted in accordance with CZO 19-600.

http://www.cityofchesapeake.net/Assets/documents/departments/development_permits/SFR-Landscape-Plan-for-Tree-Canopy-Requirement-2009.pdf

Summary of Selected Tree Laws in Other Jurisdictions

Portland, OR (and portions of Multnomah County)
Title 11, Trees; Amendments to Other City Titles; Multnomah County IGA 2nd Amendment
http://www.portlandoregon.gov/bps/article/350786
Citywide Tree Policy and Regulatory Improvement Project FAQs
http://www.portlandoregon.gov/bps/article/353328

Overview	Portland adopted the Citywide Tree Project ordinance in April 2011. Included in the ordinance is a phased implementation strategy that defers the effective date of many of the adopted rules, including the new Title 11, Trees, until July 2013. The new ordinance standardizes tree laws in the city.
Activities Covered	For activities with no associated development (general removal of trees): • City and street trees 3 or more inches in diameter • Trees 12 or more inches in diameter on private lots (or 6 inches or greater in overlay zones and plan districts) For development activity: building permits, zoning permits, site development permits, public works permits and capital improvement projects.
General Process	For non-development activity on private property, a Type A or Type B permit may be required. Type A permits include pruning in certain overlay zones, as well as requests to remove dead, dangerous, or dying trees, requests for removals of nuisance species trees, trees located within 10' of a building, or 4 or fewer trees that are each smaller than 20" diameter. On developed single dwelling properties that cannot be further divided, a Type A permit is only required to remove trees at least 20 inches in diameter. Type B permits are required for the removal of trees at least 20 inches in diameter, or removal of more than four trees at least 12 inches in diameter. For development activity, required tree plans must include information on: • existing improvements • proposed alterations including structures, impervious area, grading, and utilities • existing trees, proposed tree activity including trees to be retained and proposed tree protection measures, trees to be removed, and trees to be planted Minimum projected canopy coverage of 10-40% (depending on zoning) is required, which may be met through tree preservation, tree planting, or payment into the Tree Planting and Preservation Fund.
Mitigation	Type A permits – tree-for-tree replacement for trees that are removed. Type B permits – up to inch for inch replacement; determined on case-by-case basis by City Forester Development activity – required tree protection, tree planting, or payment of fee in-lieu (expected to be about $600 per tree).

Attachments: Summary of Type A and Type B Permits
Example of Applying On-Site Density Requirements

Summary of Selected Tree Laws in Other Jurisdictions

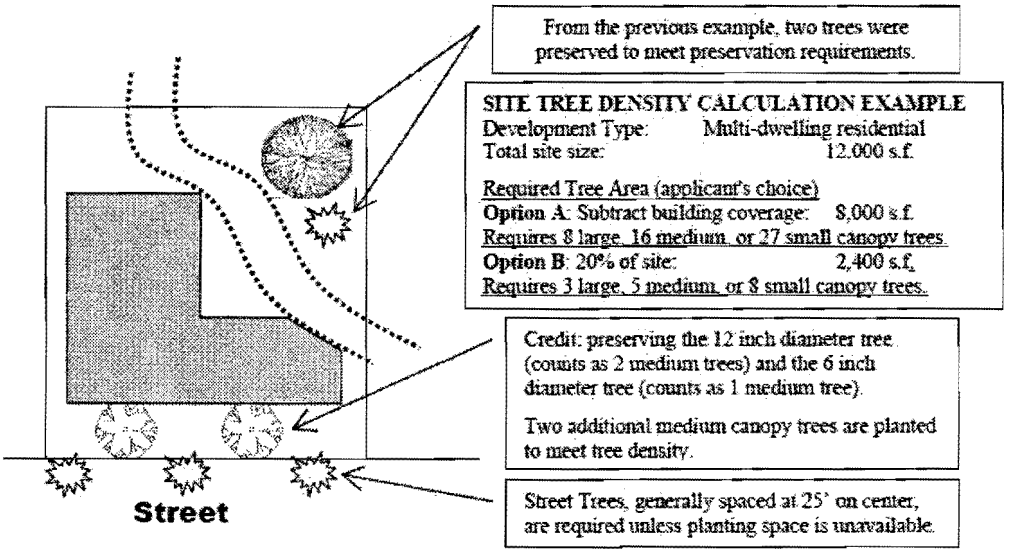
Summary of Permit Requirements for Private Trees

Permit Type Required	Activity	Required Replacement (See Section 11.40.060)	Public Notice Required?
No permit required	**Planting** **Pruning:** Outside of c, p, or v overlay zones **Removal:** Trees smaller than the size regulated by this chapter (see 11.40.020 B.) **Other:** Activities that are exempt from the requirements of this chapter (see 11.40.030)	None	No
A	**Pruning:** Native trees in c, p, or v overlay zones	n/a	No
	Removal [1]: Regulated trees that are: • Dead, dying, dangerous • Nuisance species • Within 10' of a building or attached structure • Up to four healthy non-nuisance trees per year that are less than 20" diameter.	1 tree for every tree removed	No
B	**Removal [1]:** Regulated trees that are: • Healthy non-nuisance trees ≥ 20" diameter • More than four healthy non-nuisance trees ≥ 12" diameter per site per year	Up to inch for inch replacement; determined on case-by-case basis by City Forester	Yes [2]

Note [1] Tree removal may be otherwise regulated by an overlay zone or plan district. See Table 40-1.
[2] No public notice or opportunity for public appeal is required for removal of one healthy non-nuisance tree ≥ 20" diameter per lot per year in any residential zone.

http://www.portlandoregon.gov/bps/article/350786

Applying On-site Tree Density and Street Tree requirements



http://www.portlandoregon.gov/bps/article/350786

Summary of Selected Tree Laws in Other Jurisdictions

Miami-Dade County, FL
http://www.miamidade.gov/development/permits/tree-removal.asp#5

Overview	Requires a permit to remove or move some trees. Standards are set for pruning.
Activities Covered	Privately-owned trees that are part of natural forest communities; some trees on lots larger than 1 acre; most specimen trees, or trees larger than 18 inches in diameter, wherever they stand; and street trees. Exemptions include individual trees on single-family lots including for construction; nurseries; and hazardous trees; as well as effective destruction of living trees. Fruit trees and mangroves are regulated separately.
General Process	Application for permit is followed by inspection by City/County Arborist. Follow up inspections occur when trees are moved. Mitigation fees are charged for each tree along with administrative fees for the permits and inspections.
Mitigation	A fee is charged for each tree removed. The fees are capped a $660 for an acre of canopy removed. Invasive species require a permit but are not subject to mitigation fees.

Attachment: Tree Removal/Relocation Permit Fee Schedule

Summary of Selected Tree Laws in Other Jurisdictions

MIAMI-DADE COUNTY

TREE REMOVAL/RELOCATION PERMIT FEE SCHEDULE

Zoning of Property	Before Inspection (insp.) (must be submitted with the tree removal/relocation application (appl.))	After Inspection (insp.) (must be paid before PERA signs/executes the tree removal/relocation permit)
Single-Family/Residential	$63 appl. + $35 initial insp. = $98	$35 final insp. + $12 per tree up to max. of $320
Multi-Family	$80 appl. + $35 initial insp. = $115	$35 final insp. + $12 per tree up to max. of $395/(acre)(canopy)
Business	$105 appl. + $35 initial insp. = $140	$35 final insp. + $12 per tree up to max. of $395/(acre)(canopy)
Commercial	$105 appl. + $35 initial insp. = $140	$35 final insp. + $12 per tree up to max. of $660/(acre)(canopy)
Agricultural	$55 appl. + $35 initial insp. = $90	$35 final insp. + $6 per tree up to max. of $265/(acre)(canopy)
Right-of-Way/Swale	$28 appl. + $35 initial insp. = $63	$35 final insp. + $6 per tree up to max. of $265/(acre)(canopy)

Inspection fees listed above are based on applications to remove and/or relocate and assess 20 trees or less. For projects with more than 20 trees, the inspection fees are adjusted as follows:

21 - 100 trees to be inspected: $65
101 - 200 trees to be inspected: $135
More than 200 trees to be inspected: $265

For all new application submittals, the application and the initial inspection fee are required for processing.

For After-the-Fact (ATF) tree removal/relocation permits, the application and the per tree(s) fee are doubled (x 2). The fees listed above are based on voluntary (not ATF) applications.

For relocation only permits, there is no per tree(s) fee charged, only the application and inspection fees.

In order to renew/extend a permit you will be required to pay the original application fee amount prior to the expiration of the current permit.

Please be advised that the application and the initial inspection fee are required upon permit application submission and are non-refundable if cancelled, withdrawn or denied.

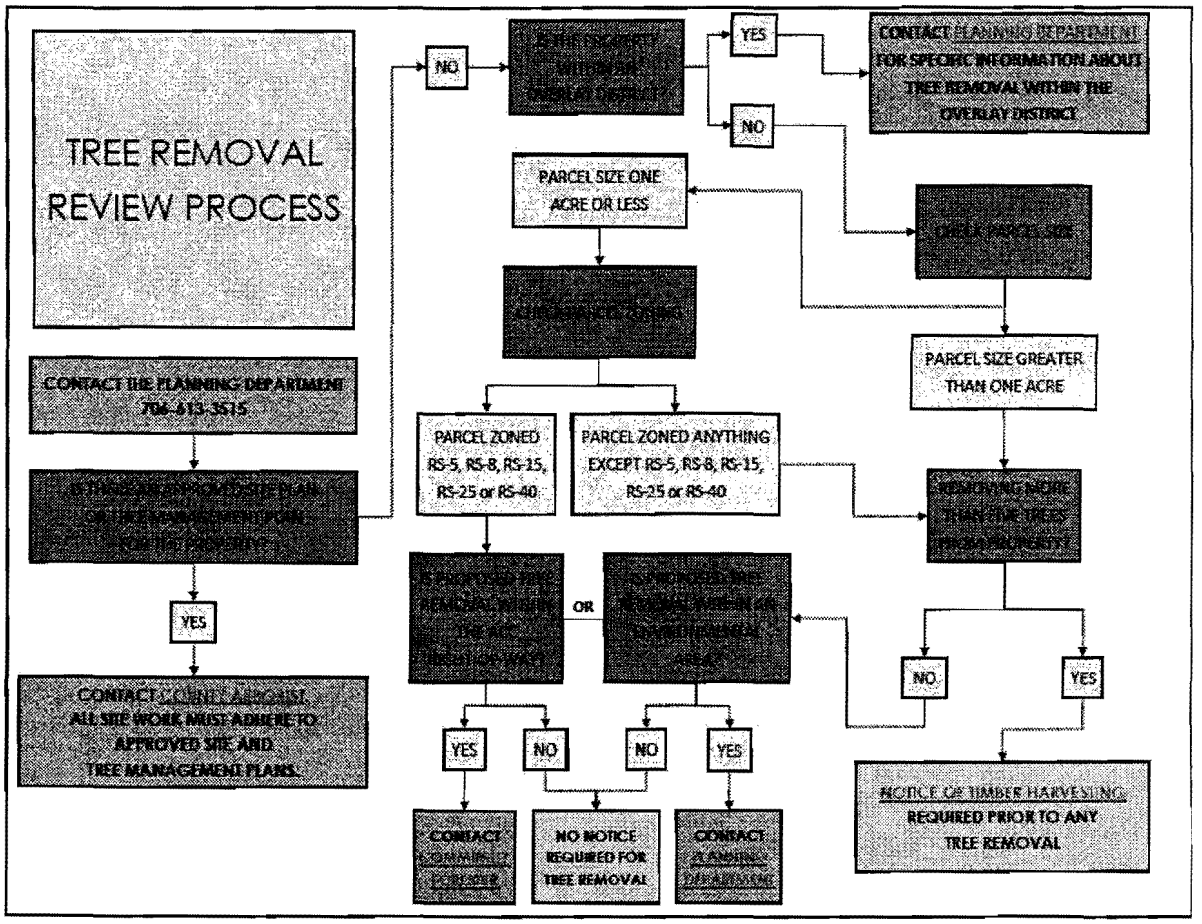
http://www.miamidade.gov/development/library/fees/tree-permits.pdf

Summary of Selected Tree Laws in Other Jurisdictions

Athens-Clarke County, GA
Chapter 8-7, Athens-Clarke County Code of Ordinances
http://library.municode.com/HTML/12400/level3/PTIIICOOR_TIT8PL_CH8-7COTRMA.html
Section 12, Fairfax County Public Facilities Manual
http://www.fairfaxcounty.gov/dpwes/publications/pfm/chapter12.pdf

Overview	Athens-Clarke County tree laws are intended to "regulate the quantity, quality, and distribution of trees within Athens-Clarke County...through the establishment of minimum requirements for conserved and planted tree canopy, to regulate the quality of trees through adoption of technical standards for species selection, tree planting, tree maintenance, and tree protection, and to regulate the distribution of trees so that their function is maximized."
Activities Covered	New developments and existing developments under Sections 9-25-2 or 9-26-2 of the Athens-Clarke County Code (generally residential subdivisions, multi-family developments, and non-residential development), and developments for which a land development/land disturbance activity permit is required (disturbance of more than one acre).
General Process	Tree management plans are required prior to the issuance of a site review permit, the issuance of a land development/land disturbance activity permit, or the issuance of a building permit for lots that appear on a preliminary plat. The tree management must include the amount, location, and type of tree canopy cover currently existing on the site or lot, and that which is to be conserved and planted on the site, and the percent to be included on each individual lot within a subdivision. Minimum projected canopy coverage of 0-60% (depending on zoning) is required, which may be met through tree preservation, tree planting, or payment into the Tree Planting and Preservation Fund. On lots greater than 12,500 Square feet, a minimum percentage of existing tree canopy must be preserved unless an administrative waiver is granted.
Mitigation	Protection of existing canopy and planting of new trees to meet canopy coverage requirements. Variances can be granted via a hearing before the Athens-Clarke County Hearings Board.

Attachment: Tree Removal Review Process Flowchart



http://athensclarkecounty.com/DocumentCenter/Home/View/3107

Bill 35-12, Tree Canopy Conservation
General Outline of Proposed Tree Protection and Planting Credit Programs
March 28, 2013

(a) A credit may be given against the square footage of the tree canopy within the limits of disturbance (LOD) for qualifying tree protection and tree planting that occurs on site subject to the conditions below.

(b) All plans submitted to document qualifying tree protection and tree planting must be prepared by a qualified professional as defined in the proposed bill.

(c) Tree protection and tree planting plans must be submitted along with the information required to document the limits of tree canopy disturbance under proposed section 55-7(c).

Tree Protection Measures

(d) One square foot of credit shall be provided for each square foot of canopy within the LOD of a tree that is properly protected. Proper protection of a tree may include protection of the CRZ beyond the canopy.

(e) Credits may be given for up to 100 percent of the area of tree canopy within the limits of disturbance.

(f) Approved tree protection measures shall be consistent with the most current industry standard such as the ANSI A300 standards.

(g) Approved tree protection measures must be installed and maintained in accordance with sequence of construction on the approved sediment control plan.

(h) Inspections for compliance must be specified in the plan and completed by a qualified professional at critical times during construction.

(i) The applicant must submit a tree protection plan which includes:

(1) A map delineating:
- (A) the location of the stem of each tree to be protected
- (B) the aerial extent of the canopy of each tree to be protected
- (C) the diameter (dbh) of each tree to be protected
- (D) the critical root zone of each tree to be protected

(2) A table summarizing the following for each tree to be protected:
- (A) the area of canopy within the LOD
- (B) the percentage of the CRZ not protected
- (C) the diameter (dbh) of each tree to be protected
- (D) the tree protection measure(s) planned for each tree

(3) Plan details showing the tree protection measures for each tree to be protected.

(4) A table showing the sequence of events for installing, maintaining, and inspecting the tree protection measures for the entire period of time the sediment control permit is valid.

(j) Any tree with more than 30 percent of the entire CRZ not protected cannot be counted as a protected tree.

(k) The area counted for credit for any protected tree does not include any overlapping canopy from unprotected or removed trees.

Tree Planting

(l) Credit shall be provided for trees planted on-site subject to the conditions below.

(m) Credits may be given for up to 25 percent of the area of tree canopy within the limits of disturbance.

(n) Trees must be installed while the sediment control permit is valid.

(o) Planting shall be consistent with the most current ANSI A300 and ANSI Z60 standards.

(p) Only approved species and sizes of planting stock shall be used.

(q) Species of trees planted will be grouped into three size categories (small, medium, and large) consistent with current research and existing regulations. The amount of credit provided for a tree in each size category will be based on the expected size of the crown at a specified time (e.g. 20 years).

A minimum amount of open soil surface area, free from impervious cover or other obstructions, must be provided for each tree receiving credit to provide a reasonable expectation that the tree canopy will reach the anticipated size. The minimum amount of open soil surface area needed will be determined for three size categories of trees (small, medium, and large).

Category of Tree Size	Square Footage Credit	Minimum Open Soil Surface Area
Small	TBD	TBD
Medium	TBD	TBD
Large	TBD	TBD

(r) The applicant must submit a tree planting plan which identifies the tree(s) planted for which credit is being sought. The tree planting plan must include:

(1) A map delineating:
- (A) the location of the stem of each tree to be planted
- (B) the area of open soil surface needed for each tree to be planted
- (C) the location of any building, structure, or impervious surface existing on the post-development lot

(2) A table showing:

(A) the species of each tree to be planted

(B) the size of each tree to be planted

(C) the area of open soil surface around the tree unobstructed by any building, structure, or impervious surface existing on the post-development lot

(D) the assumed square footage credit for each tree to be planted