

2008

08 D6 11083150-017

**The National Urban and Community Forestry Advisory Council  
2008 Challenge Cost-Share Grant Program  
Full Proposal Cover Sheet**

CONTROL NO. 11-R8-C5-01 (Previously assigned to your proposal by this office)

PROJECT TITLE: Developing a Practical Income Approach in Urban Forest Benefit Valuation

NAME OF ORGANIZATION: Clemson University

MAILING ADDRESS: 300 Brackett Hall, Box 345702, Clemson, SC 29634-5702 Fax:864-656-0881  
Email: osp-L@clemson.edu

PROJECT CONTACT: Thomas J. Straka, Professor, Dept. Forestry & Natural Resources

PROJECT CONTACT'S: PHONE NO. 864-656-4827 FAX NO. 864-656-3304  
E-MAIL tstraka@clemson.edu

Is this project being developed to reach a minority or underserved population?  Yes  No

Is this project being submitted by a minority or underserved population (owned/operated/direct) business, organization, or college/university?  Yes  No

Pre-Proposal Request: \$ 44,678.00 + MATCHING: \$ 44,678.00 = TOTAL PROJECT: \$ 89,357.00

Full Proposal Request: \$ 46,400.00 + MATCHING: \$ 46,401.00 = TOTAL PROJECT: \$ 92,801.00

Summarize the proposed project in 100 words or less.

Identification of benefits and costs of urban forestry is a major need and a practical problem. Appraisal of large trees is commonly accomplished using a valuation formula or market comparison methods. These methods have been inconsistent and do not allow for consideration of the total array of benefits. A third standard method, income capitalization, is seldom used because cash flows are difficult to obtain and capitalization methods difficult to apply. This proposal is for developing a framework to use existing forest valuation software to value urban forests using the income approach and allowing for improved cost-benefit analysis.

**REMINDER: Submit thirty (30) copies of your full proposal and E-mail an electronic version to [nstremple@fs.fed.us](mailto:nstremple@fs.fed.us)**

**NUCFAC 2008 Challenge Cost-Share Program**  
**Developing a Practical Income Approach in Urban Forest Benefit Valuation**  
**Narrative**

**1. Scope and Applicability/Justification.** This is a Category Five project (Research) that addresses economic and environmental benefits of urban forests. An understanding of the value of the urban forest is crucial if managers and planners desire to evaluate programs for managing urban trees and forests (Novak, Crane, and Dwyer 2002). A huge gap exists in valuation procedures that quantify and describe these benefits and a practical urban forest valuation model is a serious need. This project will develop an application-based financial valuation model that incorporates standard methodology and criteria to produce practical defensible results. There are various approaches in common usage to value timber and forests (cost, comparable sales, and income capitalization (Appraisal Institute 2001).

The cost and comparable sales approaches have well-developed methods for application in single-tree and urban forest situations. Valuation or the income capitalization approach is not well-developed and seldom used in urban forestry and single tree valuations. While discussing other appraisal methods, Novak, Crane, and Dwyer (2002) described the great need for a practical valuation method for urban forests and single trees: "To more effectively estimate the functional values of urban forests, research is needed on how urban forest structure affects functions (e.g., how differing amounts species, locations, sizes, and other factors of trees affect air pollution) and what value society places on these functions." They indicate some functional benefits like air pollution removal, carbon storage, and energy conservation are fairly well-developed, while other like aesthetic and wildlife values are still being developed. They use carbon sequestration as an example where value can be easily determined and determine a value of \$14,300,000,000 for carbon storage of urban trees in the conterminous United States with \$460,000,000 of value being added annually. As they indicated, these values exist as fixed points in time and the income capitalization approach would take these values and determine a "discounted" or present value of the net benefits (benefits net of costs). The valuation or income capitalization approach is highly-respected and would complement and reinforce values obtained in the other approaches. It would also allow for greater analysis of how various benefits contributed to overall value (sensitivity analysis). The research they suggest is needed is the research proposed here. The strength of the income approach is that it incorporates standard discounted cash flow analysis methodology and criteria to produce practical definable results (that is, it is considerably less subjective than the other common methods to determine value).

The National Research and Technology Transfer Agenda emphasized 32 technical disciplines and three of these related to valuing economic benefits of urban forests, valuing environmental benefits of urban forests, and strengthening benefit-cost analysis in this area (Makra and Watson 2003). This is exactly what his project does. The Executive Summary calls for "a greater understanding of the economic value of the benefits resulting from urban forests" and "developing models and methods" to do this. They specifically recognize the need for models that will be respected by general audiences. That is, not "pie in the sky" theoretical models, but ones that follow standard valuation and appraisal approaches and that will be respected by the general public. This research does just that. Benefits are identified as annual streams in monetary

equivalents and these are valued using discounted cash flow analysis. This is how appraisers and valuation experts typically value assets. It is called income capitalization or the income approach. It is well-established and respected as a method. It is seldom used in benefit valuation of urban forests as no model exists to apply it to the sometimes elusive benefits these forests produce. This research will allow for the benefits of the urban forest to be quantified in a practical manner that the general public will understand and appreciate and allow for better benefit-cost analysis of urban forest alternatives and options.

**2. Literature Review.** Benefits of urban forests have been valued in the literature (Dwyer, Schroeder, and Gobster 1991; Dwyer et al. 1992; Wolf 2004). However, many benefits are intangible and difficult to value. Even a single tree is difficult to value (Mooter et al. 2004). Replacement cost is the most practical method, but as the tree becomes large the method starts to fail (Scott and Betters 2000). Concepts like contributory value are also used when pure valuation approaches are not viable (Martin, Maggio, and Appel 1989). Appraisers use a formula method based on size and adjusted for other conditions like location and species (Neely 1988; Council of Tree and Landscape Appraisers 2000). The method produces large differences in value estimates. The income approach is not used for large tree appraisals (and valuation of other benefits) because the value of the benefits over time is not easily quantified in monetary terms. This is unfortunate as the income approach is considered one of the strongest foundations in valuation (Appraisal Institute 2001). A thorough literature review shows almost no use of the income approach in benefit analysis of urban forests.

Valuation methods like the income approach have been used in valuing urban forests and single trees. Maco and McPherson (2003) used these type calculations to produce benefit-cost ratios and McPherson et al. (1999) performed a benefit-cost analysis of a municipal urban forest. However, full-scale income approach valuation has not been applied to urban forest and single tree situations because of difficulties in modeling benefit and cost components. Often it is applied to single benefits, like aesthetics (Thompson et al. 1999). The models and procedures used for urban forest and single tree valuation are exactly the same as those used in traditional timberland and timber valuation and involve discounted cash flow analysis. The formulas are present in the literature, but rarely applied to practical problems. Scott and Betters (2000) discuss net present value and even land expectation value (a fundamental timber valuation concept). Chen and Jim (2007) discuss how discounted cash flow analysis might be applied to urban forests.

Benefits and costs of urban forests are well-identified in the literature. For single trees benefits include (1) architectural, (2) engineering, (3) esthetic, (4) and climate control (Neely 1988). Over forty "sub-benefits" are identified for those four benefits. For urban forests Kane and Kirwan (2006) defines urban forest benefits as (1) ecological services, (2) social benefits, and (3) aesthetic value. Dwyer et al. (1992) use more detail and define benefits as (1) physical/biological environment and processes, (2) energy and carbon dioxide conservation, (3) air quality, (4) urban hydrology, (5) noise reduction, (6) ecological benefits, (7) desirable environments, (8) medical, (9) psychological, (10) real estate values, (11) local economic development, and (12) societal. Even though benefits and costs are well-defined, the need for models to apply them to standard discounted cash flow analysis is great.

## Literature Cited

- Appraisal Institute. 2001. *The Appraisal of Real Estate, 12<sup>th</sup> edition*. Chicago, IL: Appraisal Institute. 759 p.
- Bullard, S. H., and T. J. Straka. 1998. *Basic concepts in forest valuation and investment analysis, second edition*. Preceda Education and Training: Auburn, Ala. 270 p.
- Chen, W.Y., and J.Y. Jim. 2007. Assessment and valuation of the ecosystem services provided by urban forests, p. 53-83 in Carriero, M.M., Y.C. Song, and J. Wu, *Ecology, Planning and Management of Urban Forests*. New York: Springer. 468 p.
- Council of Tree and Landscape Appraisers. 2000. *Guide for Plant Appraisal, 9<sup>th</sup> edition*. Champaign, IL: International Society of Arboriculture. 143 p.
- Dwyer, J.F., E. Gregory McPherson, H.W. Schroeder, and R.A. Rowntree. 1992. Assessing the benefits and costs of the urban forest. *Journal of Arboriculture* 18(5):227-234.
- Dwyer, J.F., H.W. Schroeder, and P.H. Gobster. 1991. The significance of urban trees and forests: Toward a deeper understanding of value. *Journal of Arboriculture* 17(10):276-284.
- Kane, B., and J. Kirwan. 2006. *Value, Benefits, and Costs of Urban Trees*. Virginia Cooperative Extension Publication No. 420-181. 5 p.
- Maco, S.E., and E.G. McPherson. 2003. A practical approach to assessing structure, function, and value of street tree populations in small communities. *Journal of Arboriculture* 29(2):84-97.
- Makra, E., and G. Watson. 2003. *A Revised National Research and Technology Transfer Agenda for Urban and Community Forestry*. Champaign, IL: Tree Research and Education Endowment Fund. 68p.
- Martin, C.W., R.C. Maggio, and D.N. Appel. 1989. The contributory value of trees to residential property in the Austin, Texas metropolitan area. *Journal of Arboriculture* 15(3):72-76.
- McPherson, E.G., J.R. Simpson, P.J. Peper, and Q. Xiao. 1999. Benefit-cost analysis of Modesto's municipal forest. *Journal of Arboriculture* 25(5):235-248.
- Mooter, D.P., M.O. Harrell, R.A. Allison, and J.C. Morrow. 2004. *Landscape Tree Appraisal*. Lincoln, NE: University of Nebraska-Lincoln Extension Publication G-1533. 4 p.
- Neely, D. 1988. *Valuation of Landscape Trees, Shrubs, and Other Plants, 7<sup>th</sup> edition*. Champaign, IL: International Society of Arboriculture. 50 p.

- Novak, D.J., D.E. Crane, and J.F. Dwyer. 2002. Compensatory value of urban trees in the United States. *Journal of Arboriculture* 28(4):194-199.
- Scott, J.L., and D.R. Betters. 2000. Economic analysis of urban tree replacement decisions. *Journal of Arboriculture* 26(2):69-77.
- Straka, T.J. 2007. Valuation of bare forestland and premerchantable timber stands in forestry appraisal. *Journal of the American Society of Farm Managers and Rural Appraisers* 70(1):142-146.
- Straka, T.J. 1991. Valuing stands of precommercial timber. *Real Estate Review* 21(2):92-96.
- Straka, T.J., and S.H. Bullard. 1996. Land expectation value calculation in timberland valuation. *Appraisal Journal* 64(4):399-405.
- Straka, T.J., and S.H. Bullard. 2002. FORVAL: Computer software package for forestry investment analysis. *New Zealand Journal of Forestry* 46(4):8-11.
- Straka, T.J., and S.H. Bullard. 2006. An appraisal tool for valuing forest lands. *Journal of the American Society of Farm Managers and Rural Appraisers* 69(1):81-89.
- Straka, T.J., R.L. Ridgway, R.H. Tichenor, Jr., R.L. Hedden, and J.A. King. 1997. Cost analysis of a specialized gypsy moth management program for suburban parks. *Northern Journal of Applied Forestry* 14(1):32-39.
- Thompson, R., R. Hanna, J. Noel, and D. Piirto. 1999. Valuation of tree aesthetics on small urban-interface properties. *Journal of Arboriculture* 25(5):225-234.
- Wolf, K.L. 2004. What could we lose? Economic values of urban forest benefits. Paper presented Sixth Canadian Urban Forest Conference, October 1-23, 2004, Kelowna, B.C. 8 p.

**3. Organization/Methodology.** The project will have four phases over two years. First, the benefits of single tree and urban forests must be identified and classified. Second, ranges of values for these benefits must be obtained. This information is generally available and most of the information in the first two phases will come from a literature review and other existing sources. Compiling, analyzing, and classifying the available data will not be easy. But this is necessary to provide the basis of the temporal benefit streams for the valuation model.

The third phase will be the development of the valuation formulas and analysis techniques. Standard formulas and techniques exist, but will have to be modified to accomplish these specific results. To maintain credibility all modeling will be based on widely accepted valuation techniques (Bullard and Straka 1998). Also, a computer software valuation package currently exists, FORVAL that will be the computational basis of valuation modeling (Straka and Bullard 2002; Straka and Bullard 2006). The principal investigator is a co-developer of that software and

has unlimited use of it. FORVAL is not copyrighted and was designed for public use. FORVAL is on-line and can be seen at [www.cfr.msstate.edu/forval](http://www.cfr.msstate.edu/forval). Notice FORVAL is designed to perform any sort of discounted cash flow analysis and has sections dealing with financial criteria, payments, valuation, and prices. FORVAL was designed for use in valuing timberland and timber investments. However, all standard formulas are contained in the program. FORVAL can be easily converted to single tree and urban forest valuation. Instruction manuals exist to format traditional forestry investments and this project will develop a similar manual for use in urban forest situations. A new model is not proposed; FORVAL will be adapted to this new situation.

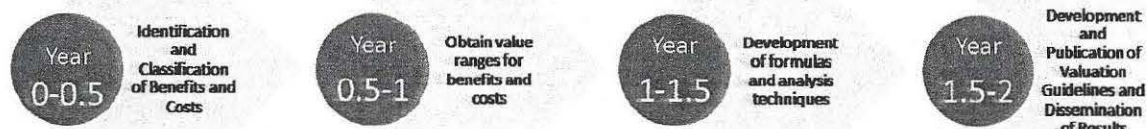
Finally, a published set of benefit guidelines for use in the model and a set of instructions on how to apply the methodology to the user-friendly FORVAL model will be produced. The principal investigator has significant experience in forest valuation (Straka 1991; Straka 1996; Straka 2007). For example, he has performed benefit-cost analysis for suburban parks (Straka et al. 1997). The advantage of this project is that the software already exists. It is in the correct format to perform timberland investment analysis. No modification of the software is necessary to perform urban forestry analyses. New methodology must be developed and a new set of guidelines and procedures will be developed. These will explain how to use the existing model to perform the new analysis techniques.

**4. Product.** All products would be produced by a land-grant university and thus would be “free” to users. The primary product will be a university publication describing the benefits and costs of an urban forest, how the project classified benefits and costs, a range of values for each benefit and cost (with guides for where in the range specific situations occur), a description of the methodology used for the income capitalization approach used, and specific directions on how to use the methodology and existing FORVAL model to quantify these benefits into an estimate of urban forest value. FORVAL model can be viewed (and actually used to value an income stream) at <http://www.cfr.msstate.edu/forval>.

FORVAL is an existing software package. Note that FORVAL has four functions: financial criteria: annual or monthly payments, precommercial timber stands, and future stumpage price. The financial criteria function allow for six types of calculations: rate of return, net present value, equivalent annual income, benefit/cost ratio, land expectation value (bare land value) and future value. Under cost/revenue type FORVAL allows for the four standard discounting formulas: single sum, terminating annual cash flow series, perpetual annual cash flow series, and perpetual periodic cash flow series. Thus, the “hard part” of the development process is already complete; the project builds on the foundation of an existing valuation model. Guidelines on how to use this model for a different purpose (urban rather than timber production forests) must be developed. New calculations based on existing formulas will be the basis of the guidelines.

The product would be the publication that described urban forest benefits, classifies them, presents value ranges, and presents instructions on using the income approach (via FORVAL) to value an urban forest. The budget includes printing costs. This would be for an extension-type publication with detailed guidelines and simple to follow instructions for standard urban forestry and single tree valuation situations. The guideline publication would be distributed free. The new software application and guidebook would be described in journals (*Arboriculture and Urban*

*Forestry*) and trade magazines. There is money in the budget for presentations at urban forestry and arboriculture meetings. The target audience would be arborists and urban forestry professionals who need to value single trees or urban forests. The model would support forest benefit calculations of urban forestry professionals. Often urban forest and single tree value is determined by one of the other available methods; having discounted cash flow analysis as a tool to confirm these calculations will prove invaluable to urban forest professionals. Each phase will last six months and the project will terminate in two years as seen in the time line below.



### Time line for Project.

5. National Distribution/Technology Transfer. The primary technology transfer vehicles will be the journal *Arboriculture and Urban Forestry*. The principal investigator has published three articles in that journal in last two years. Also important will be development of material for the many Community and Urban Forestry websites that are heavily used by professionals and the general public. Articles will also be written for the three main trade journals concerned with urban forestry. The principal investigator has an extremely strong record of assuring results are widely-disseminated. Key words would be: benefits, urban forest, benefit-cost analysis, valuation, discounted cost flow analysis. It would also be critical to attend national and regional urban forestry meetings and present the model to the general and professional public. The extension guidebook will be readily available on a free-basis; these other activities will “advertise” this availability.

6. Project Evaluation. Methodology developed in this project should quickly become established in the literature for use in benefit valuation. Even those that might use alternative methods would be required to present valuations using other credible methods (appraisers often use two or three methods to obtain the same valuation and then explain why there might be differences). Within in a year of publication, success would be measured by increasing use of the methodology in the literature. Distribution of the publication manual is a secondary indication of success.

7. Experience/Personnel/Adequacy of Resources. The principal investigator regularly publishes in refereed valuation journals and is co-author of a standard forest valuation textbook. He consults regularly on valuation projects at the national level. He co-developed the FORVAL model to be used in this project. He consistently produces promised final products from research projects on time and has a record of maximizing publication results from the research. Time and other resources are not an issue. Dr. Straka loves this type of valuation research and has a long-track record of producing useful practical results. The literature cited shows just a few of the prior publications produced in this general area.

**Budget**  
**Itemized Budget for 2-year Project**

**Applicant:** Clemson University

**Project:** Practical Income Approach in Urban  
Forest Benefit Valuation

**Total Project:** \$92,801.00

**Project Duration:** 2 years

| Cost Item                        | Federal Requested | Non-Federal Match |             | Total Cost  | Source of match    |
|----------------------------------|-------------------|-------------------|-------------|-------------|--------------------|
|                                  |                   | Cash              | In-Kind     |             |                    |
| Personal                         | \$0.00            | \$0.00            | \$7,250.00  | \$7,250.00  | Clemson University |
| Graduate Student                 | \$26,000.00       | \$0.00            | \$0.00      | \$26,000.00 |                    |
| Research Associate               | \$8,500.00        | \$0.00            | \$0.00      | \$8,500.00  |                    |
| Fringe Benefits                  | \$4,400.00        | \$0.00            | \$2,378.00  | \$6,678.00  | Clemson University |
| Travel                           | \$4,500.00        | \$0.00            | \$0.00      | \$4,500.00  |                    |
| Printing Cost                    | \$3,000.00        | \$0.00            | \$0.00      | \$3,000.00  |                    |
| Grad Student Tuition Remission   | \$0.00            | \$0.00            | \$10,160.00 | \$10,160.00 | Clemson University |
| Facilities & Administrative Cost | \$0.00            | \$0.00            | \$26,613.00 | \$26,613.00 | Clemson University |
|                                  | \$0.00            | \$0.00            | \$0.00      | \$0.00      |                    |
|                                  | \$0.00            | \$0.00            | \$0.00      | \$0.00      |                    |
|                                  | \$0.00            | \$0.00            | \$0.00      | \$0.00      |                    |
|                                  | \$0.00            | \$0.00            | \$0.00      | \$0.00      |                    |
|                                  | \$0.00            | \$0.00            | \$0.00      | \$0.00      |                    |
| <b>Totals:</b>                   | \$46,400.00       | \$0.00            | \$46,401.00 | \$92,801.00 |                    |
| <b>Total Match</b>               |                   |                   | \$46,401.00 |             |                    |

**Budget Comments & Footnotes**

The budget above represents a two year project. Graduate Student=\$13,000 per year. Research Associate=\$4,250 per year. Personal Match is for Dr. Straka's time on the project. Fringe benefits are calculated as 32.8% for Dr. Straka, 6.2 % for Graduate Student, and 32.8% for the Research Associate. Travel charges represent attendance at appropriate meetings and presentations of the model. Printing charges represent 1,000 printed copies at \$3.00 each.

Non-Personal Match: Graduate Student Tuition Remission at \$4,952 in year 1, and \$5,204 in year 2. Facilities and Administrative Costs are matched at the federally negotiated rate of 47.5% of direct costs.



**DEVELOPING A PRACTICAL INCOME APPROACH IN URBAN FOREST  
VALUATION**

**7/1/08 – 6/30/10**

**\$46,400**

**Submitted To:**

Nancy Stremple / Robert Prather  
Executive Staff to NUCFAC  
USDA Forest Service  
201 14<sup>th</sup> Street, SW MS-1151  
(Sidney Yates Building 1 Central)  
Washington, SC 20250-1151  
202-205-1054

**Submitted By:**

Clemson University  
Sponsored Programs  
300 Brackett Hall  
Box 345702  
Clemson, SC 29634

**PI Information:**

Thomas J Straka  
[tstraka@clermson.edu](mailto:tstraka@clermson.edu)

**Authorized Official:**

Dr. Christian E. G. Przirembel  
Vice President for Research & Economic Development  
Phone: (864) 656-2424  
Fax: (864) 656-0881  
[Osp-L@clermson.edu](mailto:Osp-L@clermson.edu)

  
SIGNATURE

1/22/08  
DATE