

FINAL REPORT
FOREST SERVICE GRANT NO. NA-98-0331

Period covered by this report: July 29, 1998 through December 31, 2001

NOTE: Please review the following information and revise/complete as necessary.

Issued to: Delaware Center for Horticulture
Address: 1810 North Dupont Street, Wilmington, DE 19806

Congressional District Number: At Large

Project Name: Roadside Ecosystem Study

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Date of Award: July 29, 1998

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Date of Expiration: December 31, 2001

Funding: Federal Share: \$71,000 plus Grantee Share: \$200,630 = Total Project: \$271,630

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Please provide an abstract on your project and its results. This abstract will be posted on the NUCFAC internet site. (approximately 200 words or less).

The Roadside Ecosystem Study resulted in the development of working vegetation models and management strategies to create and preserve public landscape spaces in our transportation corridors that are biologically diverse and environmentally sound. The horticultural success and economic viability of these models was documented and continues to be monitored. Concepts advanced by this project are being implemented with Delaware Department of Transportation (DOT) support.

A 'Vegetation Concept and Design Manual' has been developed for the State DOT to guide road design professionals and community members in matching vegetation regimes to transportation rights-of-way. A key aspect of this manual is an illustrated step-by-step site evaluation process using an innovative visual priority matrix as well as physical site evaluation methodology.

A statewide survey and focus groups coordinated by University of Delaware Cooperative Extension confirmed public acceptance of tested vegetation regimes. The study identified the importance of education with respect to roadside enhancement proposals, especially with naturalistic styles. Color and order are highly valued aspects of roadside scenes, but do not necessarily equate with highly manicured styles. Mowed turf was rated poorly for attractiveness. The concept and design manual serves as the basis for a public education campaign to promote the value of ecologically sustainable and diverse highway plantings.

Project objectives:

The purpose of this study was to develop and examine a variety of roadside planting schemes that are economical, attractive and environmentally sound and can be replicated throughout the state of Delaware. Surveys and focus groups were planned to examine and evaluate the perceived aesthetic and environmental benefits of the various vegetation models. A promotional campaign is to be developed to educate the public about this new method of roadside management.

Objectives met successfully:

Thirty-four vegetation research plots are in place representing a variety of roadside conditions throughout Delaware. An additional thirty-four plots are currently being planned based on the success of the initial research plots. The new plots will advance the project from research to actual implementation of the enhancement concepts developed. The vegetation regimes customized for each of the 34 research plots are thoroughly detailed in a ninety page 'Research Plot Notes' document, available upon request. The strategies studied on these plots provided the basis for the 'Roadside Vegetation Design and Concept Manual,' currently in draft stages and to be produced as part of the Delaware Department of Transportation (DeIDOT) design documentation. This manual will provide direction to develop economically efficient, environmentally sound and regionally appropriate vegetation regimes for DeIDOT engineers, designers and consultants, as well as community groups, embarking on roadside vegetation enhancement and care. The matrices developed by the team and put to use in the manual to evaluate each enhancement situation provide an innovative and consistent method of instituting appropriate vegetation approaches for professional designers and interested community members alike. Illustrations of each vegetation regime and strategy provide clear examples of how horticultural enhancements might be put into practice. Most importantly, the documented process will become part of the design standards and considered as part of the general operating procedures when Delaware builds, renovates, or otherwise evaluates highway transportation systems.

The research plots continue to be inspected on a regular basis and data is being collected regarding the horticultural success of each of the plant species that was installed. Data on maintenance will be compiled and used in the development of a 'Roadside Vegetation Maintenance Manual.' DeIDOT has employed the project team to continue

research through 2004, complete maintenance policy development and consult as part of design teams to incorporate the concepts developed into several ongoing enhancement projects.

Working with Delaware Cooperative Extension, an initial survey was conducted and will be carried out again in future years to continue to evaluate public support for the roadside enhancement initiatives. The results of this survey along with focus group results have reinforced the importance of landscaping along roadways, the types of vegetation most desired, including the importance of color and order, the perception of turf areas as less attractive, and the relative willingness to have tax dollars spent on improving roadside vegetation.

A graphic display board with photographs and text has been updated and is being used to convey project concepts to the public at community events and professional meetings. A web site has been established to describe and promote the project. The address is www.dehort.org/edh.htm

Objectives not met:

Objectives set out as part of the original Roadside Ecosystem Study have been fully met except distribution of a manual to state departments of transportation. The roadside vegetation concept and design manual will be distributed by the end of 2002, as it is produced at the end of the DeIDOT manual review process. This manual outlines vegetation models that use regional flora, are environmentally sound, economically feasible, and attractive to the traveling public and outlines a process of site evaluation and installation of the appropriate vegetation.

List the major research or policy findings of your project?

- a) Roadside design professionals should follow a specific assessment process to determine the appropriate vegetation for roadside sites (as outlined in the 'Roadside Vegetation Design and Concept Manual').
- b) Departments of Transportation (DOT's) must incorporate this assessment process into the standard operating procedures of highway design and maintenance.
- c) Roadside vegetation design professionals and community members can use a matrix to determine where along the continuum from regional to ornamental style of vegetation their particular application belongs.
- d) Practical strategies for roadside vegetation can include 1) release to existing vegetation with active invasive control, 2) editing and minimal adding or enhancement of existing vegetation, 3) carefully timed periodic cutback of various vegetation---including woody on 3-5 year intervals---to achieve desired height and spread parameters.
- e) DOT's can achieve positive returns in cost, biological heritage and public approval by embracing regional vegetation regimes where appropriate and obliging community involvement when an ornamental vegetation style is appropriate. DOT's can also take advantage of increasing public interest in using native plants and in controlling invasive exotic plants.

If not apparent in the above, or if your project did not involve research, how did the project increase the knowledge we have about urban forestry? How did (will) the public benefit?

Information collected from research plots provided transferable tools and techniques to establish regional roadside vegetation regimes throughout the state and the country. The planting models and vegetation strategies (e.g., editing and

adding, cutback and release, etc. as mentioned above) have been evaluated for horticultural success, installation and maintenance costs, environmental impacts and public acceptance. Final analysis of these criteria provides the basis for models of regionally appropriate roadside landscape regimes as outlined in the 'Roadside Vegetation Design and Concept Manual.' The manual provides a step-by-step, illustrated process for selection of site specific vegetation regimes.

What recommendations might you make for community foresters or others who might benefit from your project?

Consider the acres of roadside right-of-way as a potential resource to expand or improve the quality of the open space in your state. Work with roadside vegetation professionals from the your DOT to incorporate regional vegetation regimes and strategies similar to those outlined in the 'Roadside Vegetation Design and Concept Manual.'

Attach copies of reports, publications, or videos. If your work has been published (journals, popular press, etc.), provide where they have been published or reported and how copies can be obtained.

Occurrences of publication attached

How were your results disseminated to the public?

- 1) A Design and Concept Manual has been compiled in draft form based on the success or failure of practices employed during the project and on roadside enhancement installation and maintenance recommendations from other DOT experiences and existing literature. The manual provides a resource for Delaware and regional departments of transportation to further develop their state roadsides. One copy of the manual will be mailed to each state Department of Transportation. Single copies will be available free-of-charge upon request.
- 2) Further documentation of research plots is available upon request and is noted through announcements on the web site www.dehort.org connected by links with the web sites of the various organizations that are involved with this project, including www.state.de.us/deldot.
- 3) Highway signs are scheduled to be posted in 2002 at the 34 research plots as well as new enhancement projects to be installed under the concepts developed in this project. Travelers will be referred to the website listed above.
- 4) The project has thus far been presented at the following national scientific and industry meetings: New York Native Plant Society Conference, Delaware Community Forestry Council Annual Meeting, Delaware Invasive Species Council Workshop, USFS Review of Delaware Urban Forestry Program, Southern Nursery Association Annual Conference, Mid-Atlantic and Federal Highway Administration Roadside Workshop, International Society of Arboriculture Annual Convention, National Roadside Vegetation Management Association Annual Meeting, American Forests Restoring Native Ecosystems Conference. Further submissions and presentations are anticipated as additional stages of the project are completed in both trade conferences and industry meetings and research and trade journals.
- 4) Submissions and presentations were made to the Delaware General Assembly, to regional media and to communities involved with the actual research/enhancement plots. Training sessions are planned for De1DOT personnel.

List the active partners (key individuals or organizations) involved in the project:

Delaware Center for Horticulture
University of Delaware
Delaware Department of Transportation
Frederick P. Darke, Consultant

Andropogon Associates
Mark Gormel, Brandywine Conservancy
Delaware Cooperative Extension

Photo or Illustration: If possible, please provide a photo or illustration for our use that summarizes or represents the project. Indicate how this illustration should be credited.

Illustrations to be sent under separate cover, credit Rick Darke, photographer.

If a no-cost time extension was granted for this project, why was it needed?

A no-cost time extension from our original expiration date of September 30, 2000 to December 31, 2001 was requested and approved. Twenty trial plots were installed during the first two years of the research project, an additional forty plots continue to be installed and are at various stages of maturity. Herbaceous treatments from seed normally take three years before they reach their full potential of flowering. In a herbaceous plot that was dormant seeded in the fall of 1998 and spring seeded in 1999, we are just starting to see flowering on some of the early successional species (i.e. Coreopsis, Rudbeckia and Oenothera). Our woody plots have been slow to develop as well. In order to keep costs of roadside vegetation reasonable, we installed small container plants in the fall of 1998 and each succeeding season and continue to plan for additional installations through 2003. They will not achieve the desired aesthetic and horticultural effect for at least two to three years after installation when they colonize the plots and are viewed as a mass.

We have completed several preliminary focus group style surveys to gauge public opinion using slides of existing highway vegetation. We will continue to assess public opinion survey using photographs from our own plots as they mature, incorporating the concepts of environmental impact and costs associated with each roadside treatment. The extension helped to provide a more complete and accurate assessment of the complicated issue of public perception of the roadsides.

We have received a grant from the Delaware Department of Transportation to continue this work through 2004. We expect to document this work in the form of reports and manuals to the Delaware Department of Transportation, other DOT's and trade conferences and journals.

How would you evaluate the grant process? What changes, if any, would you recommend?

The NUCFAC grant process was straight-forward with good administrative support.

Comments considered of importance but not covered above:

This report was prepared by:

Name: Gary Schwetz

Title: Greening Program Manager

Phone Number: (302) 658-6265

Date: January 11, 2002

ports no soil development; large patches of unvegetated sand are common. The dunes are colonized by *Hudsonia tomentosa* (beach spurge) in discrete patches that may coalesce into a more stabilized dunes. A number of other species may occur but are low in abundance and include *Asperula sp.* (heather), *Myrica cerifera* (pitch pine), *Spartina patens* (salt marsh cordgrass), and *Prunus pennsylvanica* (chokeberry). Other common grasses of this community include *Panicum capillare* (poison ivy), *Setaria sp.* (crabgrass), *Digitaria sp.* (buttonweed), *Rafanum sp.* (seaside spurge), *Gnaphalium obtusifolium* (Canada goldenrod), and *Helianthemum canadense* (Canada goldenrod).

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GAMM
SCHWETZ

302 658 6267

be locally abundant on protected dune systems along the Delaware Bay, and from Cape Henlopen on the Atlantic Ocean to Fenwick Island on the North Carolina coast.

FROM A. DUNN

community is continually subjected to wind and water, the greatest threat to its development. Because of the intense demand for land and development, the remaining coastal areas are rapidly disappearing beneath the sea. Fortunately, the state of Delaware has been successful in protecting much of its beachfront. Delaware's 25 miles of Atlantic Coast State Parks include Cape Henlopen, Delaware Seashore State Park, and Fenwick Island.

FEATURE ARTICLE

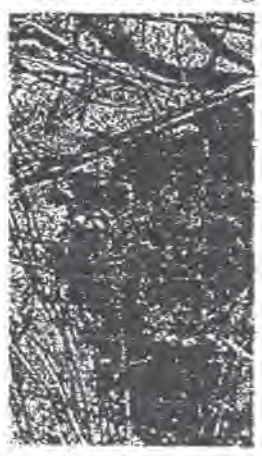
LESSONS FROM DELAWARE'S HIGHWAYS: LANDSCAPES FOR THE REGION

The Delaware Center for Horticulture and the University of Delaware initiated the research project "Enhancing Delaware Highways" (EDH) based on the premise that beautiful native vegetation and natural areas can coexist with highways. The original purpose was to trial regional strategies on a small scale with research plots throughout the state. The EDH project was initially funded by the National Urban Community Forestry Advisory Council and is now fully supported by the Delaware Department of Transportation (DelDOT). The plant species, methodologies and design strategies tested in the pilot plots will be documented into a series of roadside manuals for DelDOT. These manuals will guide both current management and new installation projects, and Delaware roadsides will be enhanced by these regional vegetation strategies in future years.

Initially, the EDH project collaborators worked to become familiar with Delaware's roadside ecology. Such a process is described in local plantsman Hal Bruce's book 'How to Grow Wildflowers and Wild Shrubs and Trees in Your Own Yard.' Mr. Bruce was preeminently qualified as a horticulturist and taxonomist, serving those functions at Winterthur Museum through the 1960's. Ironically, the perspective of his book turns out to be an enthralling descriptive ecology of Delaware roadsides. After his Winterthur assignment, Mr. Bruce had occasion to commute daily from Newark to Georgetown for years as a University of Delaware Professor and much of the book's experience is drawn from those travels. Instead of describing what you might expect—the boredom and monotony of traveling the same roads day after day—he narrates his intimate knowledge of the character of the changing seasons, and the succession of bloom and beauty he discovered on his daily trips.

A similar process has guided the development of EDH strategies. Three dozen research sites were selected from Newark to Delaware Seashore State Park that are representative of the ecological habitats of the state's roadsides. The key to regional landscape design is to understand the site and match the plant palette to the habitat or the ecology of the site. By visiting research sites in every season, evaluating the environmental factors, inventorying flora of each site, and documenting observations of the many miles of roads traveled in the process, the project team weighed installation and management decisions. This type of ecological understanding can be gained by carefully reading Mr. Bruce's book.

Designing the landscape from the driving perspective



DELAWARE NATIVE PLANT SOCIETY
NEWSLETTER - SUMMER 2001

is a unique challenge. Like Hal Bruce, we found it helps to imagine the travel corridors with the successional beauty of seasonal vegetation in a time-lapse sort of way. This article will provide a taste of the plant palette recommended for roadside plantings and describe some of the strategies for vegetation management. The goals of EDH read like the goals of personal and commercial gardening ventures any of us might face. Roadside vegetation should provide year-round interest and beauty, simple design, low cost maintenance, environmentally sound (i.e., using native species only), durability in adverse conditions and sustainability over a long period. Roadsides contain ecological niches that mirror many of the most adverse conditions you may encounter in your own garden or landscape.

The primary aim of the project, besides saving maintenance dollars and beautifying our travel corridors, has been to promote the advantage of using local indigenous plants; plants ecologically adapted to the region.

Seasonal interest is achieved with seasonal plant character; the successional beauty of spring flowering trees and shrubs, summer flowering forbs, and the autumn color of deciduous trees and other woody plants.

A huge challenge facing the project is to overcome the public perception of wildflowers. Wildflowers have come to mean plants that are not regionally appropriate or sustainable like bachelor buttons, oxeye daisy, bluebonnets, or cosmos. Too often, we try to borrow beauty from other regions that is not ecologically or economically practical or sustainable in our region. For example, the cosmos plantings that are presently in place require annual fumigation and reseeding for success.

Instead of relying on the traditional wildflower plantings, an EDH strategy is to mimic naturally occurring communities; incorporating warm season grasses in mixes with a few reliably flowering forbs to provide beauty.

The roadside-appropriate plants with spring interest tend to be shrubs or trees. Early flowering forbs are generally shade dwellers in the eastern deciduous forest and are not habitat appropriate for roadside conditions. We found many accidental compositions of beauty along our roadsides, including some early bloomers on the inventoried sites, one of the earliest being *Amelanchier canadensis*, or eastern serviceberry. One of the first native white-flowering shrubs to bloom, this excellent landscape plant adorns the forest edge even before dogwood and redbud. Other plants such as redbud (*Cercis canadensis*) and red chokeberry (*Aronia arbutifolia*) flower in early spring at a time when the prairie plants have very little interest. The brilliance of redbud really has no equal. The magenta buds are borne right on the older wood, providing a fascinating curiosity and then the flowers open to welcome spring.

Some of the plants in our experimental roadside palette are chosen to fit limiting environmental factors such as lack of fertility or abundance of moisture. Summersweet or sweet pepperbush (*Clethra alnifolia*) naturally creates an understory hedge fringing many miles of swampy woodland along DE highways. This plant and several others in our palette will thrive with excessive moisture to the exclusion of some of the undesirable invasives such as multiflora rose or autumn olive. *Clethra* has eye-catching yellow foliage in the fall and responds wonder-

Virginia sweetspire (*Itea virginica*) is a habitat mate of *Clethra*. It blooms a month earlier and like *Clethra*, is an excellent plant for wet spots in the garden but also tolerates dry conditions.

Delaware's only truly native magnolia, sweet bay (*Magnolia virginiana*), named for its beautiful, fragrant flower, has one of the widest distributions of the genus. Like many plants with wide distributions, it is adaptable and remarkably drought tolerant despite its natural preponderance for swampy sites.

The fringe tree (*Chionanthus virginicus*) is a small flowering tree that may be found in scattered locations, in moist woods, throughout the coastal plain and occasionally in the piedmont. We have reintroduced this plant in the I-95 corridor area hoping to take advantage of its beautiful fragrant flower and proven adaptability in urban environments.

Many plant treasures were identified already existing naturally along the roadsides like the deciduous holly, known as winterberry (*Ilex verticillata*). This is another plant indigenous to wet sites and becoming very popular as an ornamental shrub. It is obvious why, with an outstanding berry feature that often lasts until February.

Plants that have colonizing habits are useful for roadside planting because they out-compete other woody plants. This group includes sumac (*Rhus* spp.) and groundsel bush or tree (*Baccharis halimifolia*). Both have outstanding ornamental features and actually can be contained without too much trouble in a naturalistic setting. Michael Durr, an authority on woody plants and author of the book often used as the woody plant identification "bible", says no native is as flamboyant as sumac in the autumn and when groundsel bush is in full bloom, you find yourself saying, "what is that amazing white cloud"?

In the category of herbaceous plants, goldenrods (*Solidago* spp.) are an important provider of regional color. Other members of the sunflower family that can lend wonderful accents to our roadsides are native species of bonesets, thoroughworts (*Eupatorium* spp.) and garden asters, like New England aster (*Aster novae-angliae*). It is amazing that many of these fine garden plants spring up on their own on roadsides.

Regionally native plants are not always better for every garden situation. However, we are advocating a policy of natives first because there are an overwhelming number of reasons that naturally occurring plants and plant communities make sense on roadsides and in our gardens. Besides being culturally and ecologically appropriate, interesting and beautiful, native plants speak to our regional heritage. Regional native plants fit into the surrounding context; they look like they belong. There is a value connected to selecting from the regional gene pool of native plants that cannot be overemphasized. The ecological value of provenance, that is, geographic origin of germplasm, is coming to the forefront as an important criteria to consider in plant selection. The nursery industry should be applauded for moving toward regional plant material and urged to continue efforts to propagate, grow, specify and promote regionally and locally appropriate plants. ♣

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ST. GEORGES BRIDGE

DeIDOT, in conjunction with the General Assembly, continued its efforts to convince the U.S. Army Corps of Engineers to leave the old St. Georges Bridge in place and open to traffic. The Army Corps announced plans to close and dismantle the structure, even though traffic projections show a need for additional crossing capacity over the C & D canal within 15 years.

The Legislature passed HB 544 w/SA 1 in June 1998, authorizing the transfer of the bridge from the federal government to a private entity using the State as an intermediary. A private entity, the Hardcore Composites group, presented a proposal to the State to rehabilitate the bridge.

The proposal was reviewed for financial and engineering feasibility at the end of 1998, the proposed financial package was found to be short

of what had been calculated as necessary to move the proposal forward. While the review was underway, the Army Corps agreed to delay action on the removal of the bridge for a period of at least 18 months. As the year drew to a close, efforts continued to find a solution to this difficult issue.



PILOT PLANTING PROJECT

This project "will enable us to develop specific horticultural strategies to reduce ...high maintenance costs and maintain the environmental integrity of our roadways."

Senator Joseph Biden, Delaware Capital Review, July 13, 1998.

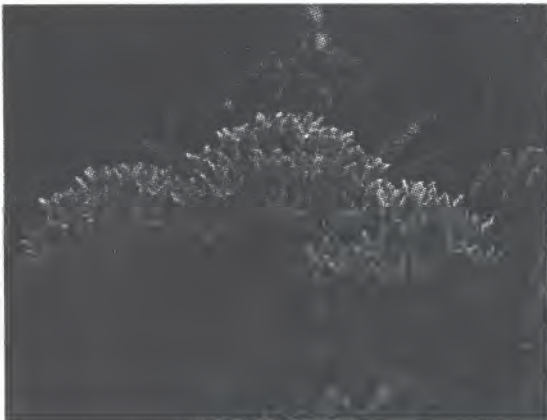


Photo by Rick Darke

Through its partnership with the Delaware Center for Horticulture, along with input from the horticulture community and the public, DeIDOT is trying a new approach to roadside beautification. Traditional ideas of beauty lean toward intensely cultivated landscapes, such as closely tended lawns or medians blooming with annual flowers. It has become important to alter this image for roadsides because the methods required, such as

weekly mowing, yearly plantings and soil treatments, are impractical and expensive on a large scale. Our goal is to develop plant communities that can be easily sustained under specific roadside conditions.

The DeIDOT Horticulture Advisory Committee is drawing upon native Delaware vegetation, in naturally occurring plant communities, to develop planting schemes that are more environmentally sound, less costly and potentially more beautiful than traditional landscaping. Advocating the use of sound ecological principles, the group is working to build upon, and in some cases reestablish, the biological heritage of Delaware along our highways. In 1998, sixteen pilot sites were identified along major roadways throughout the state.

Enhancing Del. highways

Roadsides to get beautiful blossoms

By **ROBERT LONG**
Staff reporter

Delaware's main highways — often monotonous concrete arteries flanked by grass, weeds and cluttered with invasive trees — could become colorful routes showcasing the state's native flora, a new study hopes to prove.

A group of horticulturists, funded by state and federal grants, are beginning a project this month to show that Delaware can make its roadways more attractive and save money doing it. The project involves landscaping 15 roadside sites from Wilmington to the Indian River.

"This is not the old wildflower regime, when you have to replant flowers every summer for instant gratification," said Rick Darke, a landscape consultant for the Delaware Center of Horticulture. "We're talking about planting a wide variety of flowering perennials, mixed grasses and woody plants for a long-term solution that will require little maintenance."

The Delaware Center for Horticulture, a nonprofit horticulture resource center that grew out of the Garden Club of Wilmington, is one of only 15 groups nationwide to receive federal funding for such roadside ecology projects.

During the two-year study, horticulturists will landscape 15 sites — most along Interstate 95 and Del. 1 — with gleaming orange flowers, tall bluish grasses, crimson sumac berries and foliage that will turn scarlet in fall.

"We want these sites to have color year-round and serve as a showcase for the state's attractive native plants," Darke said. "The idea is to make driving through Delaware a pleasant experience."

The native plants include early goldenrod, blue vervain, butterfly milkweed, little bluestem, and trees such as smooth sumac, winged sumac, redbud and black gum.

Some of these already appear naturally along roadsides, but are often overtaken by grasses, weeds and invasive trees, such as the "tree of heaven," a quick-growing tree that smothers other trees.

And in some locations, frequent mowing prevents the more attractive plants from growing, Darke said.

The state Department of Transportation, which spends more than \$1.4 million each year just to mow grass along roadways, hopes the study will show the state how to reduce maintenance costs while preserving native plants and trees, according to DeDOT spokeswoman Elizabeth Short.

DeDOT currently builds landscaping costs into new construction and reconstruction projects, but rarely makes much effort beyond that to landscape roadways, Short said.

Beautifying roadsides has always been a challenge for highway departments, often because road construction leaves behind compacted soil and little fertile topsoil. Road salt, exhaust and highway runoff also make it difficult for plants to survive.

"Part of what we are doing is to find that right mix that will survive the conditions, give people something nice to look at and take care of itself," said Gary Schwetz, the center's greening program manager.

The project is being funded with \$71,000 from the National Urban and Community Forestry Advisory Council, \$100,000 in a state legislative grant and in-kind contributions of \$78,500 from Del-



Special to The News Journal/ROBERT CRAIG
Susan Barton, extension specialist, measures a roadside study area.

DOT, \$9,600 from the University of Delaware and \$7,500 from the Delaware Center for Horticulture.

The center and DeDOT will landscape the sites this fall and next spring. They will monitor the sites for two years and conduct public surveys to develop a statewide roadside landscape plan.

"This is not something we're planning on rushing into," Short said. "We need to carefully study what's going to work best for Delaware's roads."

THE NEWS JOURNAL

SATURDAY, AUG. 29, 1998

'Tree of Heaven' has no future in Delaware if DelDOT plan works

By NAN CLEMENTS
Staff reporter

WILMINGTON — Every year, the "tree of heaven" tries to reach the heights associated with its name.

The fast-growing tree, *Ailanthus altissima*, covers the slopes on both sides of Interstate 95 in Wilmington, climbing to heights of 60 feet or more, choking out more desirable species like oak, elm and walnut trees.

But horticulture experts hope the locust-like *Ailanthus*' days are numbered. An impressive group has joined forces to eliminate the tree and other unwanted species, replacing them in a roadside planting program that will, if Mother Nature cooperates, make the land bordering the busy highway nearly maintenance-free and more attractive.

"I-95's right-of-way, between Pennsylvania and Lancaster avenues, has a lot of well-established and desirable plants, but *Ailanthus* and other invasive species, particularly some fast-spreading vines, are choking them out," said Elizabeth Short, a spokeswoman for the state Department of Transportation. "The slow-growers, like hawthorn and black cherry, get lost in the vines."

Two weeks ago, DelDOT crews began cutting *Ailanthus* and other undesirable plants along I-95 as the first step in a pilot program to control roadside growth.

"We had to do something, because the roadsides were so thickly overgrown that we couldn't even pick up the trash," said Gary Schwetz, greening program manager at the Delaware Center for Horticulture in Wilmington, who

is working with DelDOT on the planting project. "We had some money available for chemical treatment, but we chose to use it for this pilot program instead."

The vines and undergrowth had to be eradicated so meadow grass could be planted and allowed to establish itself on the slopes, Schwetz said. The grass, with the dead *Ailanthus* stumps left in place, will form a stable footing for future plantings.

"Now we're figuring out what to plant," Schwetz said. "We may not be placing new plants until the fall of 1998, and we may spend three or four years introducing new plants. Most of them will be plants readily found in Delaware."

The plants chosen must be drought-tolerant, able to survive pollution generated by motor vehicles and capable of clinging to a steep slope. "They'll be the toughest plants we can find for that particular environment," Schwetz said.

DelDOT is supervising the program and the horticulture center is supplying the expertise. Advice and assistance is also being given by Longwood Gardens, the Pennsylvania Horticultural Society, University of Delaware plant science experts and the U.S. Department of Agriculture, among others, Schwetz said.

If the pilot program is successful, it may be used in other areas, Schwetz said. Three sites scheduled for tree-plantings Sept. 13 — in the Bear-Glasgow area, in Middle Run Valley and in Brandywine Hundred — may also be used as test sites, he said.

Eventually, the program will be extended to all three of Delaware's counties, he said. The program is



The News Journal/MIKIO KAHN

Asplundh workers Al Rice (front) and Norman Rishel clear some of the dense brush along I-95 near North Adams Street on Tuesday. DelDOT plans a replanting program along the interstate.

already being used in 10-12 states, including Maryland.

As the project proceeds, highway officials will see if it reduces mowing and other maintenance costs, Short said. So far, the program has not cost anything, be-

cause the undesirable plants have been removed as part of DelDOT's regular brush removal contract.

Once planted, the areas will be sprayed periodically with chemicals to control growth, but otherwise will be left on their own.

Application Narrative & Summary

Official File Copy

National Urban and Community Forestry Advisory Council
1998 Challenge Cost-Share Grant Program

Roadside Ecosystem Study, Control No. 1-12

Challenge Cost-Share Grant

Control No. 1-12

Project Summary

The Roadside Ecosystem Study will investigate vegetation models conceived to restore public landscape spaces to a more natural state and evaluate the perceived aesthetic and environmental benefit of such restorations. The Delaware Center for Horticulture, Delaware Department of Transportation (De1DOT) and the University of Delaware will develop and analyze four planting models for Delaware roadsides with the goals of ecological sustainability, reduced maintenance activity and maximized aesthetic appeal. The horticultural success of the tree/shrub/herb associations or ecotypes will be documented over two growing seasons. Surveys and focus groups of stakeholders will be used to examine the perceived physical and sociological impacts of various roadside planting treatments.

Partnerships are in place for this project through the De1DOT Horticultural Advisory Committee, a standing committee representing public and private agencies and organizations concerned about the roadside treatments throughout the state. This study will build on existing naturalistic roadside planting projects initiated by De1DOT and the De1DOT Horticultural Advisory Committee. The cooperators will provide input on planting designs, installation and maintenance techniques and evaluation of horticultural success. The study will effectively consolidate resources of new initiatives and existing projects with the common goal of developing and documenting functional models of regionally appropriate vegetation ecotypes for roadside planting.

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	José Almiñana, Andropogon Associates Ltd.	
	Jim Baker, City Council President, Wilmington, DE	
	Joseph R. Biden, Jr., United State Senator, Delaware	
	Rick Darke, Landscape Consultant	
	Joseph DiPinto, State Representative, Delaware	
	John Gilbert, Director of Highway Operations, DeIDOT	
	Tom Ilvento, U of DE Department of Agricultural Economics	
	Donald Sparks, Chairperson, U of DE Department of Plant and Soil Science	
	Austin Short, State Forester, Delaware Department of Agriculture Forestry Division	

1) Scope

The purpose of this study is to develop and examine roadside vegetation prototypes or ecotypes conceived with the goals of ecological sustainability, decreased maintenance cost, and maximum aesthetic appeal. The proposed project will be a collaborative effort between the Delaware Center for Horticulture (DCH), University of Delaware Department of Plant and Soil Sciences, Delaware Department of Transportation (De1DOT), and the De1DOT Horticultural Advisory Committee (see details in Personnel and Partnerships section).

Vegetation ecotypes will be developed and planted on Delaware's roadsides. Plant species selection, establishment methods, maintenance procedures for each of the four ecotypes will be tested and refined. Costs incurred for installation and maintenance will be recorded for the grant period of two years. Funding will be identified to continue maintenance and cost documentation for a three-year period beyond this study. Comparison will be made to costs of traditional roadside treatments used by De1DOT. Public perception of the various roadside treatments will also be measured (see Project Evaluation.)

Roadside programs throughout the country are benefiting from advances in the science of vegetation management. Recent improvements in the areas of use of wildflowers and native plants, integrated pest management, and other vegetation management techniques have resulted in many state roadside managers developing holistic roadside management practices (see selected bibliography). De1DOT has a ten-year history of experimentation with perennial and annual flower ecotypes. This study will draw upon these experiences, current scientific knowledge and resources contributed by participating partners in developing the design and maintenance practices for the four vegetation ecotypes (see Experience / Adequacy of Resources).

II) Impact/Applicability

Thousands of acres of highly visible roadsides across the state and the country are treated with varying intensities of maintenance. In many cases the maintenance techniques result in unnatural, non-sustainable conditions, e.g., closely mowed grass, 'Bush-Hog' type brush maintenance, etc. In other cases a climate specific wildflower ecotype is imposed on a region that cannot support the cultural requirements of the selected plant species, e.g., lupines or poppies in the extremes of eastern summers. Abundant acreage of intensely disturbed and manipulated roadside landscape has the potential to become a more valuable environmental and aesthetic asset through the development of regionally appropriate vegetation ecotypes and management techniques. This study will be based on the thesis that restoring roadside areas with culturally appropriate indigenous species will conserve and increase regional diversity and beauty and reduce energy inputs to roadside maintenance. This project will identify the value and feasibility of regionally appropriate roadside restoration efforts and vegetation ecotypes.

III) Organization/Methodology

We propose to study the following factors of four roadside vegetation ecotypes: suitable design, methods of establishment, procedures for maintenance, costs of establishment and maintenance, public perception of suitability as roadside vegetation; and horticultural success of the vegetation ecotypes. The project team will begin by collecting data on suitable plant species, installation procedures and maintenance recommendations consulting existing research and roadside vegetation guidelines. Specific vegetation ecotypes will be developed with input from the De1DOT Horticulture Advisory Committee, the Delaware Center for Horticulture, the University of Delaware Department of Plant Sciences, and horticultural consultants (including Andropogon Associates, the landscape architect for 195 Corridor Project).

Recommended planting specifications and maintenance calendars will be developed for each vegetation ecotype. The ecotypes will be installed at the appropriate time for the species selected (see Timeline). Installation and maintenance will be provided by De1DOT crews and outside contractors with recommendations from the Horticultural Advisory Committee. Installation costs will be recorded for each vegetation ecotype. After planting, specific maintenance procedures will be implemented, documented and tracked to maintain an accounting of costs and techniques.

The four proposed vegetation ecotypes are as follows:

a) Cut back shrub and herb ecotype

This planting will include woody shrubs such as *Cornus sericea*, *Aronia arbutifolia*, *Itea virginica*, *Spiraea* sp., *Hypericum prolificum*, *Lagerstroemia indica*, *Kolkwitzia amabilis*, and *Hydrangea* sp. The species will be selected for bark, fruit, flower or fall foliage color and ability to tolerate cutback pruning. The woody shrubs will be combined with perennials such as *Eupatorium* sp., *Asclepias incarnata*, *Amsonia hubrechtii*, *Rudbeckia* sp., *Solidago* sp. and others that flower sequentially throughout the growing season. The bed will be planned for high interest display, but only a few species will be showy at any given time.

Three cut back plots, one acre each, will be planted along the roadside in Delaware during the fall of 1998. Woody and perennial species will be cut back yearly to remove old foliage and encourage maximum flowering on young wood. Weeds will be controlled with a combination of pre-emergent herbicides, selective post-emergent herbicides and spot removal.

b) Wildflower meadow ecotype

The wildflower meadow plots will include a combination of annual (with self-seeding capacity) and perennial wildflower seed. Possible annual species include but are not limited to *Centaurea cyanus*, *Cosmos bipinnatus*, *Gaillardia pulchella*, *Linum* sp. and *Papaver rhoeas*. Perennial species might include *Aster lateriflorus*, *Echinacea purpurea*, *Hesperis matronalis*, *Linum perenne*, *Vernonia noveboracensis*, *Verbena hastata*, *Monarda fistulosa*, *Solidago rugosa*, *Rudbeckia* sp., *Coreopsis* sp., and *Gaillardia* sp. The seed mixture will also include native perennial grasses to stabilize the soil and provide weed competition. While the meadow will include showy flowers at certain times during the season, it is not designed as a high-maintenance annual meadow. Species will be chosen to create a natural-looking meadow.

Three one-acre plots will be seeded in late summer of 1998. Prior to seeding, existing vegetation will be controlled with non-selective herbicides. Problem weeds will be controlled by selective removal (hand or post-emergent herbicides). Overseeding will be used, if required in subsequent years, to maintain a minimal color display.

c) Tree, shrub and herb ecotype

Plants which are well adapted to highway right-of-way site conditions will be selected. A complex planting will be designed to mimic native ecosystems that occur in coastal plain and piedmont regions. The tree canopy will include species such as *Acer rubrum*, *Amelanchier* sp., *Betula nigra*, *Diospyros virginiana*, *Juniperus virginiana*, *Nyssa sylvatica*, *Quercus prinus*, and *Taxodium distichum*. The shrub layer will include combinations of *Bacharis halimifolia*, *Clethra alnifolia*, *Fothergilla gardenii*, *Ilex glabra*, *Ilex verticillata*, *Itea virginica*, *Rhus* sp., *Viburnum* sp. and other shrubs adapted to the specific sites. The ground layer will include herbaceous plants such as *Amsonia hubrectii*, *Aster* sp., *Baptisia australis*, *Coreopsis* sp., *Monarda fistulosa*, *Oenothera* sp., *Phlox* sp. and *Solidago* sp..

Two plots, 1/2 and 2 acres respectively, will represent this planting ecotype. One plot was planted during the fall of 1997. It will be used to gather information about maintenance techniques and species suitability. The second plot will be planted as a component of a roadside revitalization project along 195 in Wilmington, DE. Andropogon Associates, a landscape architecture firm, is contracted to coalesce needs and concerns of citizens and the site into an overall design for the project. The study site will be isolated and clearly identified. Weeds will be controlled with a combination of pre-emergent herbicides, selective post-emergent herbicides and spot removal.

d) Flowering annual ecotype

High visibility annuals such as *Cosmos bipinnatus*, *Centaurea* sp. and *Papaver rhoeas* will be selected for maximum floral display. This ecotype is designed to be replanted each year. Two 1/2 acre beds of individual annual species will be planted during the springs of 1999 and 2000. Weeds will be controlled prior to spring seeding. Selective weed control will be conducted, as needed, during the growing season.

Horticultural assessments will be conducted for each ecotype. Public perception will be evaluated with a focus group study during the summer of 1999 and a mail survey in June 2000 (see Project Evaluation.)

IV) Product

Information collected from experimental planting plots will provide transferable tools and techniques to establish regional roadside vegetation ecotypes throughout the state and the country. Final analysis of the species selected, installation techniques employed, horticultural success of vegetation ecotypes, costs associated with installation and maintenance, and public perception will provide the basis for models of regionally appropriate roadside landscape ecotypes.

Project products will include:

- best management practices (BMP) manual (including cost data)
- journal article on cost data
- journal article on public perception
- popular articles for trade journals with overview of project
- NUCFAC interim and final reports
- presentations at national meetings
- all written publications available on World Wide Web

The BMP maintenance manual for the four vegetation ecotypes will be compiled based on installation and maintenance recommendations from existing literature and the success or failure of practices employed during the project. The BMP manual will include installation and maintenance cost comparisons for each of the vegetation ecotypes. The manual will provide a resource for Delaware and regional departments of transportation to further develop their state roadsides. Initial printing of 500 copies of the manual will be covered by grant funds. One copy will be mailed to each state Department of Transportation. Single copies will be available free-of-charge upon request. Multiple copies will be available at cost (\$2.50 - \$5.00). The manual will not be copyrighted and will be available for others to copy.

Two journal articles, one comparing installation and maintenance costs and one analyzing public perception of the four vegetation ecotypes will be submitted to the *Journal of Environmental Horticulture*, *Transportation Research Record*, and the *Journal of Forestry*. A popular article outlining the entire study will be submitted to various trade journals such as *Better Roads*, *Better Roads and Bridges*, *Environmental Management* and *American Nurseryman*. A report on the entire project will be submitted to the National Urban and Community Forestry Advisory Council upon completion of the project.

The project will be presented at national scientific and industry meetings, such as the National Urban Forestry Conference, the American Society of Horticultural Science's Annual Meeting, Northeast Weed Science Society Annual Meeting, and the National Roadside Vegetation Management Association Annual Meeting.

Submissions and presentations will also be made to the Delaware General Assembly and to regional media. The written documents will be available by links from collaborating organizations' web sites.

V) Project Evaluation

The four roadside vegetation ecotypes will be evaluated based on costs (installation and maintenance), horticultural success, and public opinion.

a) Cost comparison

Site preparation and installation costs for each ecotype will be recorded. Site-specific maintenance recommendations will be developed. Sites will be monitored regularly (weekly during the growing season) to assess conditions and determine the need for additional maintenance. Maintenance task costs will be recorded for each ecotype as the tasks are performed. Final analysis will include a comparison of installation and maintenance costs for each ecotype.

Additional funding support will be sought from public and private sources to continue evaluation for three years after the completion of the initial project. The additional information gathered will be compiled to accurately represent maintenance requirements of established landscapes. The ecotypes with woody vegetation will provide greater competition against weeds and consequently reduced maintenance costs as they mature. This information will be made available as addenda to the original reports.

b) Horticultural success

The horticultural success of each site will be evaluated during the summers of 1999 and 2000. Members of the DeIDOT Horticultural Advisory Committee and staff of the Delaware Center for Horticulture, the University of Delaware Department of Plant and Soil Science and independent horticultural consultants will evaluate the success of each planting including species chosen, effectiveness of employed maintenance procedures, and overall aesthetics of each site.

c) Public opinion

Public opinion will be evaluated using two methodologies. First, focus group interviews of 6 to 12 residents will be conducted to obtain insights and reactions to the roadside vegetation models. Most often focus group participants are selected at random or chosen to represent different groups within the community. Beginning with a small set of preselected questions, but allowing for flexibility, group interaction often stimulates discussion and produces insights (Ilvento, 1996). Focus groups are also highly effective strategy as a precursor to a survey to help identify key issues for further elaboration. We plan to conduct up to three focus group interviews in Delaware. During the interviews participants will be shown a series of images prepared by Rick Darke, horticultural consultant, illustrating the four vegetation ecotypes at various stages of establishment. A trained facilitator will lead discussions about the suitability of planting ecotype for roadside vegetation. The reactions and comments of the participants will be recorded and transcribed for analysis.

While focus group interviews are excellent tools to explore how people feel about an issue, they do not provide data that can easily generalized to the larger population. After the focus groups have been completed and analyzed, a mail survey will be administered to a random sample of Delaware residents. The survey will use color pictures of each planting site along with a questionnaire to evaluate the respondents' reaction to the sites, relate their preferences, and identify willingness to support different ecotypes. A Total Design Methodology will be used to insure quality of the questions, the survey instrument, and reasonable response rates (Dillman, 1978). The survey will use a random sample of residents so that statistical inferences to the population can be made. We will strive for a sample of 350 residents to provide a 95 percent confidence interval for a dichotomous yes/no question of $\pm .05$.

VI) Budget and Funding

As reflected by the attached Budget, grant funds (\$71,000 requested) will be used for the following expenditures (1) intern support (\$40,600) and consultant support (\$7,500) to research and develop planting designs, document installation and maintenance techniques, and coordinate and conduct evaluations of public perception, (2) focus group and survey expenses (\$10,400),

and (3) reports, photographic documentation and signage (\$12,500). In-kind support will be provided by DCH (\$7,500 non-fed. match) and University of Delaware (\$9,600 non-fed. match) for project administration and oversight and by De1DOT (\$78,500) and State of Delaware General Assembly (\$100,000) for installation and maintenance. Letters of intended support from representatives of the cooperating agencies are attached.

VII) Experience/Adequacy of Resources

The Delaware Center for Horticulture (DCH) will act as the lead agency for this project. DCH is a non-profit, 501(c)3 organization founded in 1977 for the purpose of improving the quality of life in Delaware by promoting knowledge and appreciation of gardening, horticulture and conservation. A staff of six full time and twenty seasonal and part time employees manage programs with an annual budget of \$600,000. Some of the organization's initiatives include: coordination of urban tree planting and management program for the City of Wilmington, administration of the New Castle County Tree Commission, facilitation of community gardening and greening projects throughout the State, and development of a Job Training Program in Horticulture which was voted by Delaware Private Industry Council as the "best youth job training program" in 1996. DCH serves as an active member of the Delaware Urban and Community Forestry Council.

This study will build on existing naturalistic roadside planting projects in Delaware. DCH, De1DOT and the De1DOT Horticultural Advisory Committee are currently cooperating on two separate naturalistic roadside planting projects. An ad-hoc sub-group of the Advisory Committee has begun planning with Andropogon Associates on a naturalistic replanting project for a one mile section of the 1-95 corridor through the city of Wilmington. DCH and the Advisory Committee have collaborated on a one-quarter mile roadside planting along State Road 897 south of Glasgow, Delaware planted by 100 volunteers in the fall of 1997. The Advisory Committee is monitoring this planting which will serve as one of the models of tree, shrub and herb ecotype. Documentation of processes used in these projects will be expanded upon and incorporated into the final analysis of the Roadside Ecosystem Study

De1DOT Horticultural Advisory Committee consists of representatives from public and private agencies and organizations concerned about the roadside treatments throughout the state. Members include Steve Castorani, owner of Gateway Landscape Nursery and past president of the Delaware Association of Nurseryman, Rick Darke, Consultant and former Curator of Plants at Longwood Gardens, Eric Goldstein, Public Landscape Project Manager for the Pennsylvania Horticultural Society, Joseph Lesley, De1DOT Roadside Development Coordinator, Dr. Richard Lighty, Director of Mt. Cuba Center for the Study of Piedmont Flora, Gary Schwetz, Greening Program Manager at DCH, James White, Delaware Nature Society and Connie Zipperrer, State of Delaware Urban Forester.

De1DOT has planted a variety of herbaceous pilot projects over the past five years. Some of the experimental wildflower studies have been carried out in cooperation with the University of Delaware. Knowledge gained from De1DOT's previous wildflower experience will be factored into the creation of workable vegetation ecotypes for Delaware's roadsides. De1DOT Department of Public Affairs has monitored reaction and response to past projects and will assist in coordinating a comprehensive evaluation of public perception of the experimental vegetation ecotypes. De1DOT will provide funding for maintenance and a portion of the installation of the pilot plantings (see Budget). Additional funding will be provided by the State of Delaware

General Assembly for installation of the tree, shrub and herb ecotype and the cutback shrub ecotype.

The University of Delaware will provide personnel support to develop the vegetation ecotypes, measure public perception and produce reports and presentations for the project (see attached letters of support). The University in conjunction with the Delaware Cooperative Extension is dedicated to improving the quality of peoples lives by providing research-based information, and informal educational opportunities focused on individual, family, and community needs. Susan Barton is one of the Delaware Cooperative Extension Specialists housed in technical departments in the College of Agriculture and Natural Resources at the University of Delaware. Faculty and specialists work together to conduct research and deliver programs that meet the needs of industry professionals in Delaware and throughout the country. The University of Delaware has a variety of critical resources including support staff in Agricultural Communications, Media Services, Center for Applied Demography and Survey Research.

VIII) Personnel and Partnerships

This study will utilize a number of partnerships currently in place. The public and private agencies represented on the De1DOT Advisory Committee will be engaged in the design, monitoring and analysis of the vegetation ecotypes. Relevant experiences of other partners involved in the study are as follows:

De1DOT: Joseph Lesley, Roadside Development Coordinator, will manage the project for De1DOT. Mr. Lesley will supervise installation, management and maintenance of the experimental vegetation plots. In addition to his capacity as vegetation manager for De1DOT, Mr. Lesley has served for 11 years on the National Transportation Research Board, was a founding board member of the National Roadside Vegetation Management Association and has presented De1DOT activities and research at a number of national professional meetings through the years.

Bud Freel, Director of Division of External Affairs will assist with measuring public perception through his office. Mr. Freel is also an elected member of the Wilmington City Council and will be involved with funding appropriation.

University of Delaware: Susan Barton is an extension specialist in horticulture in the Plant & Soil Sciences Department at the University of Delaware. She works closely with the nursery and landscape industry. She was the 1995 recipient of the Nursery Extension Award, sponsored by the American Nursery & Landscape Association. She teaches "Nursery and Garden Center Management" and "Urban Horticulture" in the Plant & Soil Sciences Department at the University of Delaware. Additionally, Ms. Barton coordinates the landscape horticulture internship program. Ms. Barton has conducted research in the area of plant establishment, and she used the focus group technique to evaluate the potential of a new industry product-- wildflower sod. She has conducted a series of garden center surveys that measure customer preferences and the relationship between customer expectations and perceptions. Ms. Barton is a member of the S-103 Regional Research Group entitled "Technical and Economic Efficiencies of Producing, Marketing, and Managing Landscape Plants." This group is comprised of horticulturist and agricultural economists. Their projects focus on the costs associated with producing, establishing and maintaining landscape plants.

Tom Ilvento is an Associate Professor in the Food and Resource Economics Department at the University of Delaware. His primary appointment is as an Extension Specialist in Community and Economic Development. He has worked in such areas as public policy issues (including land use and water quality); business retention programs; community needs assessment; and collaborative problem solving. Dr. Ilvento specializes in collaborative needs assessment projects where he involves industry and professionals in the design and implementation of needs assessment projects, such as surveys and focus groups. Dr. Ilvento is trained in facilitation, mediation, and collaborative problem solving and will supervise the public opinion evaluation in the project.

Private horticulture consultant: Rick Darke will provide additional horticultural expertise in reviewing designs for the vegetation ecotypes and documenting images of the models as they develop (see attached letter of support.) Mr. Darke served as Curator of Plants at Longwood Gardens from 1986 until 1998. He has specialized in regional landscape design, restoration, and enhancement. Mr. Darke has published numerous articles and three books and presented many lectures on horticultural subjects related to this study.

Andropogon Associates: José Alminana, Landscape Architect, will lead the design and development of the tree, shrub and herb ecotype in the 1-95 corridor (see attached letter of support.) Mr. Alminana specializes in naturalistic restoration projects. His firm has partnered on many similar naturalistic design projects with multiple collaborators including the Crosby Arboretum, Louisville's Olmsted Parks & Parkways Master Plan, and the 26th Street Corridor project in Philadelphia.

DCH: Gary Schwetz, Greening Program Manager at DCH will coordinate the study. Mr. Schwetz represents DCH on the Delaware Community Forestry Council. He holds a Master's Degree in Public Horticulture Administration completed his thesis in 1996 on the topic of regional landscapes. Mr. Schwetz manages public landscape and tree planting and education programs for DCH and takes an active role in managing and conducting public horticulture programs throughout the state. Mr. Schwetz leads DCH's role in administering the De1DOT Horticultural Advisory Committee.

These partnerships will serve this project to improve knowledge of the effects and practical use of regionally appropriate vegetation on public landscape spaces, specifically public roadsides. The final product generated by the partners in this project will provide enlightenment to develop improved roadside ecosystems throughout the nation.

IX) Timeline for Project Implementation and Evaluation

<u>Time planned</u>	<u>Activity</u>
Summer 1998	<ul style="list-style-type: none"> • select species for each vegetation ecotype • create planting designs • select installation methodology • develop projected maintenance calendar
August 1998	<ul style="list-style-type: none"> • prepare wildflower meadow sites for seeding • prepare cutback shrub and tree, shrub and herb sites for planting • document site preparation costs
Fall 1998	<ul style="list-style-type: none"> • seed wildflower meadow • install cutback shrub sites • install tree, shrub and herb sites • document installation costs • determine location of 10 planting sites
From Fall 1998 through Summer 2000	<ul style="list-style-type: none"> • implement planned maintenance • monitor required maintenance • document maintenance costs • communicate progress to DelDOT and State Legislators
Spring 1999	<ul style="list-style-type: none"> • prepare annual sites • seed annual flower sites • document preparation and installation costs
Summer 1999	<ul style="list-style-type: none"> • conduct horticultural assessment of all 4 vegetation ecotypes (10 sites)
August 1999	<ul style="list-style-type: none"> • conduct focus group session to assess public opinion
June 2000	<ul style="list-style-type: none"> • conduct mail survey to assess public opinion
Summer 2000	<ul style="list-style-type: none"> • conduct horticultural assessment of all 4 vegetation ecotypes (10 sites) • analyze data • write trade journal articles, refereed journal articles and recommendations manual
Summer 2000 through Summer 2003	<ul style="list-style-type: none"> • continue to collect maintenance data (seek additional funding)

X) Budget

Applicant: Delaware Center for Horticulture
 University of Delaware, Department of Plant and Soil Science
 Delaware Department of Transportation

Project: Roadside Ecosystem Study

Total Cost: \$271,600.

	Federal Funds (requested)	Non-fed cash	Match in-kind	Total	Source of Match
Personnel					
Project management					
U of DE 350 hours @ \$32			9,600.00	9,600.00	U of DE
DCH 250 hours @ \$25			7,500.00	7,500.00	DCH
Intern (2 yrs.)	37,000.00			37,000.00	
fringe benefits	3,600.00			3,600.00	
Horticulture consultant	3,500.00			3,500.00	
Volunteer- review & consultation (200 hrs @ \$25)			5,000.00	5,000.00	DelDOT Horticultural Advisory Comm.
Installation of Plots					
seeded wildflower meadow (3 plots, 1 acre each)		18,000.00		18,000.00	DelDOT
cut back (3 plots, 1 acre each)		25,000.00		25,000.00	DE General Assembly
tree, shrub and herb (2 plots, , 0.5 and 2 acres respectively)		75,000.00		75,000.00	DE General Assembly
design of I-95 (tree, shrub and herb) plot by Andropogon Assoc		7,500.00		7,500.00	DelDOT
annuals (2 plots, 0.5 acre each)		33,000.00		33,000.00	DelDOT
Maintenance of Plots					
seeded wildflowers		5,000.00		5,000.00	DelDOT
cut-back		8,000.00		8,000.00	DelDOT
tree and shrub		7,000.00		7,000.00	DelDOT
Evaluation & Documentation					
focus group expenses (site, meal, supplies, incentive)	2,900.00			2,900.00	
survey costs (printing, mailing, coding, mail list)	7,500.00			7,500.00	
reports and manual	5,000.00			5,000.00	
Internet design	2,500.00			2,500.00	
signage	3,000.00			3,000.00	
photographic documentation	2,000.00			2,000.00	
horticulture consultant (photography, presentations)	4,000.00			4,000.00	
Totals	<u>71,000.00*</u>	<u>178,500.00</u>	<u>22,100.00</u>	<u>271,600.00</u>	

* Note: Total funds requested have increased from the pre-proposal amount because of the addition of printing 500 copies of a manual and the inclusion of professional services in performing focus group and survey functions.

pre proposal 56,300 + 184,750 = 241,050

XI) Selected Bibliography

Roadside Vegetation Management Study

Ahern, J., C. A. Niedner, and A. Barker. 1992. "Roadside wildflower meadows: summary of benefits and guidelines to successful establishment and management." *Transportation Research Record* 1334: 46-53.

Article describes a four year research effort to study herbaceous meadows as an alternative to turfgrass in Massachusetts highway landscapes.

Ahern, J. 1988. "Achieving vegetative diversity on America's roadsides." *New Alchemy Quarterly*. Summer 1988. (32) p.7-8.

Airhart, Douglas L. 1980. "Revegetating Massachusetts Highways with an Array of Wildflower Sods." *Weeds, Trees & Turf* November 1980; p47-50.

Aitken James, B. 1995. "How South Carolina cut roadside maintenance costs." *Better Roads*. v 65 n 2 (Feb): p 30-31.

By reorganizing a fragmented herbicide program, the South Carolina Department of Transportation has reduced costs and labor.

Arnebeck, Rick. 1996. "Integrated vegetation management - is it for you?" *Public Works* v 127, no. 3 (March 1996); p. 51-52.

This article defines Integrated Roadside Vegetation Management (IRVM) as a plan that divides vegetation management into mechanical (cutting), chemical (spraying), and vegetation (planning) phases. It goes on to discuss the benefits of the IRVM approach using a question and answer format.

Beck, K. G., J. R. Sebastian, and R. G. Lym. 1993. "An integrated Canada thistle management system combining mowing with fall-applied herbicides." *Proceedings of the Western Society of Weed Science*, Held March 9-11, 1993 in Tucson, Arizona, p.102-4.

Field trials combining mowing during the growing season and selected autumn applications of herbicides on a sub-irrigated pasture dominated by problem weeds. Describes an integrated system with potential to manage Canada thistle in pastures and roadside areas.

Biesboer, D. D., B. Darveaux, and W. L. Koukkari. 1994. Controlling leafy spurge and Canada thistle by competitive species. Final Report. 93p. Report No. Minnesota DOT MN/RC-94/32. NTIS Order No. PB95182168XSP.

Report describes an integrated vegetation management program using grass treatments containing the native prairie grass little bluestem to control problem weeds,

Brown, C. 1994. "Establishment of native plants for roadside weed control". *Proceedings of the annual conference of the California Weed Society*. Environmental stewardship through weed control. Held Jan. 17-19, 1994 in San Jose, CA. p.113-19.

Brown, D. C. 1995. "Roadside maintenance shifts to contractors." *Transportation Builder*. 7(4): pp 14-16.

The article reports on the trend among states and counties to use private contractors in an integrated approach of planting, mechanical control, and chemical treatment of roadside vegetation.

Byler, B., G. Coorts, R. Cripps, and C. Swan. 1993. Landscaping with native plants and wildflowers on Tennessee interstates. Final report., TN-RES 1004. Tennessee Department of Transportation, Nashville, TN.

Research was conducted to determine the feasibility of using native plants and wildflowers to landscape Tennessee's roadsides.

Coleman, R., and L. Harris. 1996. "Case for planting native grasses and wildflowers." *Public Works* v.127 no. 11 (Oct): pps. 54, 83.

Describes Kansas DOT's approach of mixing native and non-native grasses for best results. Also discusses the DOT's concerns and approach to using wildflowers.

Corley, W. L. 1995. Enhancement of native wildflowers for roadside beautification, Report No. FHWA-GA-95-9206. Georgia Dept. of Transportation in cooperation with U.S. Department of Transportation, Federal Highway Administration.

During 1993-1994, 32 selected native wildflowers were evaluated for establishment and growth in nursery and backslope sites.

Corley, W. L., and A. E. Smith. 1991. Establishment and Management Methodology for Roadside Wildflowers. Final report. Report No. FHWAGA918909. Federal Highway Administration, Atlanta, GA. Georgia Div & Georgia Dept. of Transportation, Atlanta. NTIS Order No. PB91236414XSP.

During 1989 and 1990, research was conducted to determine optimum establishment methods, weed control techniques, fertility responses and mowing effects for adapted wildflower species.

Dana, MN, RD Kemery, and BS Boszor. 1996. Wildflowers for Indiana highways. Final report. Report No. FHWA/IN/JHRP-96/1, 158p. NTIS Order No. PB96209499XSP.

Questions concerning wildflower usage on Indiana highway rights-of-way were investigated. Native prairie wildflower seed quality, seeding and transplanting techniques were analyzed.

Darke, Rick. 1994. *Ornamental Grasses for you Garden*. New York: Little, Brown Co.

Darke, Rick, consulting ed., and Mark Griffiths, series ed. 1994. *The New Royal Horticultural Society Dictionary Manual of Grasses*. London: The Macmillan Press Ltd.

Darke, Rick. *The Color Encyclopedia of Ornamental Grasses*. Portland: Timber Press Inc. To be published February 1999. 500 color photographs by author.

Dillman, D. A. 1978. *Mail and Telephone Surveys: the Total Design Method*. New York: John Wiley.

Elhirst, J. F. 1990. Review of roadside wildflower programs and assessment of feasibility in Ontario. PC E07/MF E01. Ontario. Ministry of Transportation. Research and Development Branch, Toronto. NTIS Order No. MIC9005480XSP.

This report summarizes the findings of a 1987 feasibility study and includes some additional information on wildflower programs in other jurisdictions and relevant research.

Erusha, K. S., C. Fricker, R. C. Shearman, and D. H. Steinegger. 1991. "Effect of Preemergence Herbicide on Wildflower Establishment." *HortScience* v26(2): p209.

Flynn, L. (Editor). 1994. "CALTRANS' vegetation program seeks alternatives to chemical use." *Roads and Bridges*. 32(2) : pp56-61.

Gerhold, H. D., W. F. Elmendorf and R. G. Stahl. 1994. "Urban foresters and roadside managers meet at the crossroads." *Journal of Forestry*, Oct 1994. V. 92 (10) p.21.

Harper-Lore, Bonnie L. and B. Bryant. 1997. "Where flowers bloom, so does hope." *Public Roads*. V61 n3 p38 (2)

Harper-Lore, Bonnie L. 1996. "Using native plants as problem-solvers." *Environmental Management* v20, n6 (Nov-Dec): p827-831.

This article discusses FHWA policy change in favor of native plants. Minnesota DOT is used as a case study to describe the decision making process in selecting appropriate species for climate and soil conditions.

Harrington, J. A. 1994. "Roadside landscapes: Prairie species take hold. I midwest rights-of-way." *Restoration Management Notes*. Madison: Published by the University of Wisconsin Press for the UW—Madison Arboretum,. Summer 1994. v12 (1) p8(7).

Harrington, J. A. 1991. "Survey of landscape use of native vegetation on midwest highway rights-of-way." *Transportation Research Record* 1326: 19-30.

The author conducted a survey of 14 midwestern transportation departments located in the region of tallgrass prairies to determine their management and use of prairie species on roadsides.

Hipkins, P. L. and J. S. Coartney. 1987. "A case for direct seeding of woody species on highway roadsides." *Journal of Environmental Horticulture*. Washington, D.C.: Horticultural Research Institute. V.5 (4) p. 176-179.

Holt, H. A., and D. A. Breedlove. 1990. "Line-of-road herbicide tests: a review of the latest results." *Railway Track and Structures*. 86(2) : pp28-29.

The article discusses tests of several herbicides in a prairie type setting with dry vegetation.

Holt, H., R. McKenzie, and M. Johnson. 1995. "Enhancing right-of-way herbicide treatments." *Railway Track and Structures* v. 91 n.2, (Feb): p. 34-35. Johnson, L. A. 1995. Managing roadside vegetation in Alaska. Final Report. Report No. SPR-UAF-92-11; Report No. INE/TRC 94.27. NTIS Order No. PB95271144XSP.

This report focuses on the problems associated with controlling tall wood shrubs and trees recommending an integrated vegetation management program is recommended for long term maintenance.

Ilvento, Thomas W. 1996. *Focus Group Interviews, Needs Assessment: Taking a Closer Look*. October 1996, University of Delaware (9 pages).

Johnson, William D. 1995. "How to Establish Roadside Wildflowers." *Better Roads* v. 65, n9 (Sept): p27(2).

A step by step strategy for establishing wildflowers along the roadside is provided. Some of the issues that should be considered are discussed.

Kohlhepp, P. F., T. G. Sanders, C. C. Tackett, and R. W. Walters. 1995. Roadside Vegetation Management. Final Guidelines Document for the Colorado Department of Transportation's Maintenance Manual. Research rept., CDOT-R-CSU-96-5; Study No. 230.03, NTIS Order No. PB96172259XSP.

Langdon, P. 1997. "Noisy highways: noise barriers give essential protection to people who live near crowded roads — and a growing number of designers are showing that they needn't be eyesores." *The Atlantic Monthly*. v280 n2 p26(5).

Louisiana Department of Transportation and Development. 1990. "Herbicides stretch budget in Louisiana." *Better-Roads* v. 60 n 2 (Feb.): p 30-31.

This article discusses the Louisiana Department of Transportation and Development's (DOTD) migration from multiple mowings per season to herbicide use and the substantial savings that resulted from herbicide application.

Lyman, G. T., and A. E. Gover. 1990. "Pennsylvania State University-- PennDOT roadside research project: Wildflower evaluation." *Transportation Research Record* 1279: 86-95.

This study investigated and evaluated 50 different wildflower species for possible use on Pennsylvania roadsides.

Lyman, G. T., L. J. Kuhns and A. E. Gover. 1990. "Fall brush treatments for roadsides." Proceedings of Annual Meeting of the Northeast Weed Science Society, College Park, MD, v.44 p. 126-127.

Martin, D. L., L. M. Cargill, and D. P. Montgomery. 1996. Roadside Vegetation Management. Final Report for the Period December 1991-September 1996. , AG-91-EX-037; FHWA/ODOT-96/05. Dept. of Horticulture and Landscape Architecture, Oklahoma State University, Stillwater, OK. NTIS Order No. PB97124291XS.

Report on research, maintenance and training related to pesticide applications for roadsides.

Martin, D. L., L. M. Cargill, and D.P. Montgomery. 1991. Roadside Vegetation Management. Final report. July 1986-June 1991, FHWA-OK-91-10. Stillwater, OK. NTIS Order No. PB95261186XSP.

Results of a 1986 'Roadside Vegetation Management' project initiated as a cooperative agreement between Oklahoma State University and the Oklahoma Department of Transportation (ODOT).

Meyer, R. E., C. L. Benner, and W. G. McCully. 1995. Management of vegetation on the pavement edge and adjacent shoulder. Interim report. Report Number: TX-95/902-12; Res Rept 902-12; Report Number: TTI: 7-902. Texas Transportation Institute, Texas A&M.

Meyer, R. E., E. S. Motteram, and W. G. McCully. 1995. Influence of Roundup™ with adjuvants and other herbicides for control of Bermuda grass. Interim Report., Report Number: TX-94/902-11 & 94/902-10; Res Rept 902-10-11; Report Number: TTI: 7-902. Texas Transportation Institute, Texas A&M.

Meyer, R., E. S. Motteram, W. G. McCully, and S. G. Evans. 1994. Influence of adjuvants on Roundup™ Effectiveness. Interim report, Report No. RR-902-10. Texas Transportation Institute. NTIS Order No. PB95206256XSP.

Meyer, R. E., C. L. Simpkins, W. G. McCully, and S. G. Evans. 1994. Control of musk thistle (*carduus nutans* L.) with Transline™ and Escort™ along roadsides. Interim report., Report Number. Report No. TX-94/902-9; Report Number: Res Rept 902-9; Report Number: TTI: 7-902. Texas Transportation Institute, Texas A&M. NTIS Order No. PB95193561XSP.

This series of reports discusses extensive research on the application of to control roadside vegetation.

Monet, S. 1992. Review of integrated weed management for Ontario roadsides, MAT-92-03. Ontario Ministry of Transportation, Canada Editor, Technical Publications, 1201 Wilson Ave., Toronto, Ontario M3M 1J8 Canada. NTIS Order No. MIC9204313XSP.

This report reviews integrated weed management (IWM) techniques suitable for roadside vegetation management in Ontario conditions.

Morre, D. J. 1995. New treatment combinations for control of brush and vegetation management along Indiana roadsides. Final Report., FHWA/IN/JHRP-95/3. Joint Highway Research Project, Purdue Univ., West Lafayette, IN, NTIS Order No. PB96131396XSP.

This report presents the results from a research project to develop and implement new treatment mixtures for control of problem brush, trees and other woody species and herbicide-resistant weeds along Indiana roadsides.

National Roadside Vegetation Management Association, *How to develop and implement an integrated roadside vegetation management program.* 1997. Integrated Roadside Vegetation Management Program Task Force.

This guide serves as a planning document to assist in the development and implementation of a management plan to suit the needs and characteristics of a specific location.

Orange County Expressway Authority. 1995. "Natural vegetation cuts costs on expressway." *American City & County.* v110 n10 p48(1).

Putwain, P. D., B. E. Evans and S. Kerry. 1988. "The early establishment of amenity woodland on roadsides by direct seeding." *Aspects of Applied Biology.* Wellesbourne, Warwick: The Association of Applied Biologists. V. 16 p. 63-72.

Schwetz, Gary. 1996. *Regional Interpretation: Linking our Natural and Cultural Identities.* University of Delaware Master's Thesis.

Sherman, F. 1995. "Roadside vegetation management: Herbicides and beyond." *Transportation Builder* 7(4) pp18-20.

The article describes a preventive approach to vegetation management, including low maintenance plantings, and the integration of spraying and manual labor.

Skroch, W.A., L. Gallitano, G. Mahnken, and C. Catanzaro. 1995. Weed Control Management Plan for Wildflower Plant Beds. Final rept. (1 Jul 89-30 Jun 94). Report No. FHWANC94010. NTIS Order No. PB95182242XSP.

A large number of herbicides were evaluated in this research that have potential use with wildflowers. The manager can use this research as a basis to begin development of a weed management plan that will minimize wildflower injury and maximize reseeding potential.

Spraggins, H. Barry, Mike C. Mitchell. "Scenic byways planning." *Transportation Quarterly,* summer 1996 v50 n3 p95 (18)

Tatman, Robert E. 1993. "Ohio Native Wildflower Seed Nursery." *Transportation Research Record* 1409: pps. 95-98.

Ohio DOT's initiative in formulating an agreement with the Dayton and Montgomery County Park District to establish a production nursery for wildflower seeds is described. The article also discusses technical problems such as seed harvesting, breaking wildflower seed dormancy, and weed control .

Tauter, C., K. Giles and D.C. Slaughter. "Machine Vision Control of Offset Highway Spraying." Paper No. 94-1507. Building our future through engineering and technology: Proceedings of the

1994 ASAE International Winter Meeting. Held Atlanta, Georgia, Dec. 13-16, 1994. St. Joseph, MO: American Society of Agricultural Engineers.

The authors developed a research prototype, funded by Caltrans under their Advanced Highway Maintenance and Construction Technology Program.

Texas Transportation Institute. 1996. "Weed control geotextile tried in Texas." *Better Roads* v. 66, no. 10: pp 23-24.

On behalf of the Texas Department of Transportation, the Texas Transportation Institute has been experimenting with different products and approaches for roadside landscape maintenance near Austin, TX.

Uecker, D. N. and W. A. McGinty. 1995. Low impact, selective control of mesquite on rights-of-way. Objective 1: Economic thresholds for honey mesquite regrowth control with selected individual plant treatments. Interim Report. Texas A&M University and Texas Dept. of Transportation, Report no. 2953-1. 30p.

Four treatments were tried for honey mesquite regrowth to measure the most economically effective and least labor intensive.

University of Northern Iowa. Roadside Management Program. 1992. Integrated roadside vegetation management. Technical manual. Funded by Iowa Department of Transportation.

Utah State University. 1997. Utah rural roadsides for wildlife program. Technical manual.

Walton, C. D. 1994. "Using Sustainable Vegetation Management on Maine Roads." *Better Roads* v. 64, n7 (July): p21(2).

The use of low maintenance, dominant plant community species such as crown vetch and roseacacia as alternatives to mowing and herbicides in safety clear zones is discussed. Based on field trials, appropriateness of the two species is analyzed.

Walvatne, P. 1996. How MNDOT handles IRVM training. *Better Roads* 66:10: pp 18-20.

The article discusses Minnesota DOT's integrated roadside vegetation management training program.

Walvatne, Paul. 1994. "Implementing Sustainable Vegetation Management". *Better Roads* v. 64, n10 (Oct): p23(2).

The author discusses strategies for improving the sustainability of roadside maintenance practices, including use of vegetation requiring less care.

Washington State Department of Transportation and Bio-Integral Resource Center. 1997. Integrated vegetation management for roadsides.

Watschke, T. L. 1990. "Low-maintenance grasses for highway roadsides." *Grounds Maintenance*. v. 25 (8) p. 40, 42.

RESEARCH IN PROGRESS

Murphy, T. R., Georgia University, Athens, GA. (Funded by Georgia Department of Transportation). Strategies for problem weed control on grass roadsides, Start date: Jan. 15, 1995; Estimated completion date: Jan. 15, 1998.

Purpose of this study is to develop controls for new problem weeds. In addition, roadside vegetation management programs with minimal impact on Bermuda grass will be developed,

Oregon Department of Transportation. Infrared vegetation management, Contract No. 5276.

The objective of this study, sponsored by FHWA, is to determine if infrared technology is a biologically, economically and environmentally viable component of an Integrated Pest Management strategy for roadside vegetation management.

Wright, S. Alaska Plant Materials Center, Division of Agriculture, Palmer, AK (Funded by Alaska Department of Transportation and Public Facilities) Development of seed stocks.

Research start date: March 1, 1995.

Project involves seed collection and species success evaluation studies, with an emphasis on the possibility of commercial production. Goals of the research are to improve roadside vegetation survival, prevent slope erosion, and enhance the roadsides.