Public Perception and Attitudes about Roadside Vegetation: Pre- and Post-Environmental Education

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Overview

The following thesis “Influencing Public Perception of Sustainable Roadside Vegetation Management Strategies” was submitted by Anne Lucey as meeting the requirements for the degree of Master of Science in Plant and Soil Science. The thesis was completed under the supervision of Professor Susan Barton and Professor Jules Bruck. The thesis serves as a final report for the University Transportation Center project “Public Perception and Attitudes about Roadside Vegetation: Pre- and Post-Environmental Education.”

INFLUENCING PUBLIC PERCEPTION OF SUSTAINABLE ROADSIDE VEGETATION MANAGEMENT STRATEGIES

by

Anne Lucey

A thesis submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Master of Science in Plant and Soil Sciences

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EPIGRAPH

"The earth's vegetation is part of a web of life in which there are intimate and essential relationships between plants and the earth, between plants and other plants, between plants and animals. Sometimes we have no choice but to disturb these relationships, but we should do so thoughtfully, with full awareness that what we do may have consequences remote in time and place."

-Rachel Carson, *Silent Spring*, 1962.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Sustainably managed roadsides limit non-native turf grass and include meadows of native warm season grasses and flowering perennials, native shrubs, and trees. Sustainable roadside vegetation management strategies contribute to a matrix of economically conservative, environmentally responsible and aesthetically pleasing landscapes. Implementation of sustainable strategies result in cost savings, better water quality and conductivity, increased diversity of insect life and benefits to the socioeconomic health of the state. Lacking an awareness of associated benefits, the public is often hesitant to accept sustainable, but less manicured roadsides, causing many Departments of Transportation to revert to traditional management regimes. This research assessed perception and determined that acceptance could be increased with an awareness of associated benefits. An Internet survey was administered to three groups of participants. A control group rated eleven roadside images from least to most desirable and completed a brief survey. An experimental group read a list of information about traditional and sustainable strategies of roadside vegetation management before rating the images and completing the survey. Another experimental group viewed a 6 ½ minute video that delivered the same information as the list, but engaged the respondent differently. This group then rated the images and completed the survey, as did the previous two groups. Among those who read the list, a significant change in perception occurred for three of the images when compared to those in the control group. Among those who viewed the video, a significant change in

perception occurred for four of the images when compared to those in the control group. When all images were compared to the baseline image (mown turf), Delaware's current default vegetation management strategy, each response distribution was significantly different than that of mown turf. Respondents rated images of flowering meadows, meadow with a mown turf margin, turf with a wooded edge, shrubs and trees more desirable than mown turf and images with grassy meadows less desirable. When strategies were grouped according to similar attributes and compared to mown turf, respondents rated images with flowers (flowering meadows, shrubs & trees), and images with a mown turf margin more desirable than turf and grass meadows less desirable.

INTRODUCTION

Roads consume many miles of land and leave in their path vast tracts of rights-of way that must be safely and efficiently managed and maintained in compliance with state and federal regulations. When managed for sustainability, roadside rights-of-way limit the amount of non-native turf-grass and include meadows of native warm season grasses and flowering perennials, and masses of native shrubs and trees. Sustainably managed roadsides are more cost effective, reduce routine maintenance and provide benefits to the environment (Johnson, 2000).

Land held for rights-of-way by the Delaware Department of Transportation (DelDOT), accounts for over 10,000 acres of Delaware's landscape. Sustainable management of this complex system strives for safe, environmentally responsible and cost-effective strategies while contributing to an aesthetically pleasing transportation corridor.

In 1996, Delaware launched Enhancing Delaware Highways (EDH) to examine the benefits and liabilities of an alternate roadside vegetation management strategy. Since the EDH project began, Delaware has replaced large swaths of turf along roadside rights of way with a variety of sustainable vegetation strategies including: meadow, meadow with a mown margin, meadow supplemented with native flowering perennials, and native shrub and tree masses. While some Delaware residents have embraced the

sustainably managed roadsides, there remains evidence of a lack of acceptance for this new roadside aesthetic based on recent articles in the popular press, letters to the editor, personal communication with DelDOT officials and the results of the Comprehensive Mail Survey (Barton 2005). A New York Times journalist interviewed several people who did not support Delaware's forward thinking roadside vegetation efforts. One reader commented, (the native grasses) "just look awful" (Barringer, 2007). Several of The News Journal's letters to the editor, blasted DelDOT for their reductions in mowing along the roadside (Goverts, 2009). This research explores whether an awareness of associated benefits can alter public perception of sustainable roadside vegetation management strategies.

Currently, Delaware's default vegetation along rights-of-way is mown-turf. Turf is a ubiquitous ground cover that requires expensive routine maintenance, results in low biodiversity and allows for minimal water infiltration into the soil (Forman, Sperling, Bissonette, Clevenger, Cutshall, Dale, Fahrig, France, Goldman, Heanue, Jones, Swanson, Turrentine, & Winter, 2003). When managed for sustainability, roadside vegetation contributes to better water quality and conductivity (KCI Technologies, 2007; Forman et al, 2003), increased diversity of insect life (Hopwood, 2008; and Ries, Debinski & Wieland, 2001) and cost savings (Barton, Darke & Schwetz, 2005; Forman et al, 2003), while benefiting the socioeconomic health of the state (Barton, 2005; Fisher, 1999). However, sustainable strategies only provide optimal cost savings and enhance environmental stewardship when implemented consistently. It is the goal of

this research to determine if an awareness of associated benefits can positively influence public perception and increase acceptance of sustainable, but less manicured roadside vegetation management strategies.

Research objectives include:

- Examine whether an awareness of associated benefits alters an individual's perception of sustainable roadside vegetation management strategies.
- Investigate whether an engaging video is a more effective tool for altering perception than a static written list.

Additional goals of this project include:

- Assess public perception of a variety of roadside vegetation strategies including: mown turf; grassy meadow; meadow with a mown margin; meadow supplemented with native flowering perennials; and native shrubs & tree masses.
- Provide DelDOT with accurate information about public perception of select roadside strategies to help guide in their planning, design, operating and maintenance strategies along transportation corridors.

This thesis explores these objectives and goals through a literature review, an experiment involving the delivery of information about traditional and sustainable roadside vegetation management strategies and a survey of public perception. This paper is organized as follows:

1. Abstract
2. Introduction
3. Literature Review
4. Materials and Methods

5. Results
6. Discussion
7. Conclusions

LITERATURE REVIEW

This literature review seeks to explore background information and prior research relevant to both the roadside landscape and the methodology used in this project. Particular areas of focus examine the surface transportation system in the United States including: roads and their rights-of-way, the history of roadside vegetation management strategies, legal actions and roadside vegetation, public perception of roadside landscapes, the impact of information relevant to the roadside landscape and benefits associated with sustainable vegetation management strategies on public perception. Additional research into the methodology used in this project includes: the use of photos as surrogates for field observations and the validity of Internet surveys.

Background Research

Roads and their rights-of-way

More than 8 million acres of land in the United States are devoted to roadways and an additional 12 million more are devoted to their rights-of-way (Delucchi & Murphy, 1998), positioning U.S. departments of transportation (DOT's) as leaders in stewardship of public land. Individual state DOT's are charged with responsibly managing and maintaining roads and their rights-of-way in a safe and efficient manner, while adhering to federal and state laws.

In their most utilitarian form, roads facilitate the transport of people, goods and services. However, they also play a pivotal role in community and economic development by connecting people and places. The 20th Century triumph of the automobile eased movement along greater distances with a convenience not previously afforded. The birth of suburbanization, an influential byproduct of the automobile's success, resulted in the need for more roads. These contributing factors influenced the creation of the complex web of primary, secondary and tertiary roads that comprise the surface transportation system in the U.S. today (Webber, 1992).

History of roadside vegetation management strategies

Efficient roadside vegetation management strategies have been desired since roads assumed their place as a dominant feature on the modern landscape. In the 1930's, *Roadsides, The Front Yard of the Nation*, proposed a front yard approach to roadside vegetation management, which advocated the use of large swaths of mown turf along rights-of-way (Bennett, 1936). Bennett's ideas gained momentum as roads began to carve their paths across America, yielding an expensive, resource and labor-intensive, unsustainable cycle of management that persists eighty years later.

In the 1960's highway beautification and conservation of natural resources joined the list of objectives required of roadside vegetation managers as President Lyndon Johnson announced his beautification initiative by stating, "I want to make sure that the America we see from these major highways is a beautiful America." Alongside his wife,

Ladybird Johnson, the President and First Lady crusaded for roadside enhancement. Mrs. Johnson's voice became a preeminent force stressing the fundamental importance of regionally appropriate materials, including native plants. Her cause was more than just a movement to promote aesthetic beauty for highway travelers (Harper-Lore, 1999). Her ideas sparked a transcendent movement emphasizing the ecological necessity of roadside conservation. Mrs. Johnson played an integral role in the successful passage of the Highway Beautification Act of 1965, which emphasized natural beauty and ecological stewardship in federally funded projects (FHWA, 1965). The Highway Beautification Act was the inaugural event that placed significance on the vitality of the natural world as it relates to the vein of transportation, the multifaceted system that carries us in our daily activities.

Currently, national trends of sustainable roadside vegetation management strategies encourage: reduction of expenditures, minimization of maintenance, incorporation of regionally appropriate vegetation and utilization of context sensitive design. Context sensitive design promotes the preservation of scenic, aesthetic, historic and environmental resources while maintaining safety and mobility along transportation corridors (FHWA, 2003). The desired result of these objectives is the protection and enhancement of the overall corridor, which includes roadside rights-of-way.

A related strategy that has garnered significant attention among roadside managers is Integrated Roadside Vegetation Management (IRVM). IRVM incorporates the use of

native plants and contextually appropriate management strategies including controlled burns, competitive plantings and selective use of herbicides to manage invasive weeds (Quarles, 2003). IRVM has produced successful results in many states including, Arkansas, California, Florida, Illinois, Iowa, Maryland, Minnesota, New York, Ohio, Pennsylvania, Washington, Wisconsin and Texas (NCHRP, 2005).

Legal actions and roadside vegetation

More than ever before, environmental managers are required to consider the aesthetic character of their landscape decisions in order to comply with federal, state and local legislation (Gobster & Chenoweth, 1989). The National Environmental Policy Act of 1969 (NEPA) requires Federal Agencies:

> Use all practical means to: fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; assure for all Americans safe, healthful, productive and aesthetically and culturally pleasing surroundings; and preserve important historic, cultural, and natural aspects of our national heritage, and maintain, whenever possible an environment which supports diversity, and a variety of individual choice (NEPA 101b).

This act clearly outlines the obligation placed upon Federal Agencies to act as responsible stewards of public land. Many of the laws enacted since the NEPA and the Highway Beautification Act have further emphasized use of native plants, control of invasive species, minimization of ecological impact and promotion of regionally appropriate vegetation (FHWA, 1999).

In 1987, the Surface Transportation & Uniform Relocation Assistance Act (STURAA) decreed, 0.25% of landscape budgets for highway construction shall be used in planting native wildflowers (FHWA, 1987).

A 1994 Executive Memorandum on Landscaping Guidance called for the use of regionally native plant species whenever possible. This memorandum also placed significance on environmentally and economically beneficial practices on federally landscaped grounds and federally funded projects including: the design, use or promotion of construction practices that minimize adverse affects on natural habitat; and, the prevention of pollution by reducing fertilizer and pesticide use & minimizing runoff (FHWA, 1994).

In 1999, Executive Order 13112 decreed Federal Agencies must:

> Provide for the restoration of native species and habitat conditions in ecosystems that have been invaded; conduct research on invasive species and develop technologies to prevent their introduction and to control them using environmentally sound methods; and, promote public education regarding the issue of invasive species and the means to address it (USDA, 1999).

Forman et al stress that road transportation is a critical component in the fight against invasive species because roads can facilitate the spread of plants in the landscape (Forman et al, 2003).

In July 2002, Delaware passed Senate Bill #324, Chapter 351, which promotes:

> Increases in forested land in the State, together with landscape features such as trees, shrubs and ground covers other than or in addition to grass, not only improve the aesthetic value of Delaware, but also carry with them valuable benefits to the health and welfare of citizens and the environment. In addition, DelDOT is considered a leader in replacing forested acres previously cleared for building projects and in providing travelers through the State with scenic vistas along its roadways while maintaining safe design and construction standards (State of DE, 2009).

These statutes highlight a few of the key regulations passed for ecological conservation and environmental stewardship since the Johnsons brought their roadside enhancement message to the forefront of objectives required of roadside managers and into the public spotlight.

Public perception, education and roadside landscapes

Public acceptance of the roadside landscape is crucial to the success or failure of a roadside enhancement project. Lacking an awareness of the benefits associated with sustainable, but less manicured roadsides, the public is often quick to issue criticism with letters to the editor (Goverts, 2009), popular press articles (Barringer, 2007), or complaint phone calls (Roumillat, Personal Communication 2009).

Most state DOT's have close ties to the public and political communities of their state and have bowed to the wishes of the public whenever appropriate (Harper-Lore, 1998a). In the past, DelDOT has tried to reduce maintenance expenditures by mowing roadside vegetation less frequently. However, they often receive complaint phone calls from the

public and from legislators when they try this alternative method of management (Roumillat, Personal Communication 2009). In response to negative publicity and feedback, DOT's frequently revert to more traditional regimes of management (Rosan, Personal Communication 2009). In June 2009, DelDOT spokesman Darrel Cole was quoted in The News Journal as saying, "A couple of weeks ago, we had a call from someone who complained about tall grass, so we went ahead and cut the grass. People are noticing and they're calling" (Cole, 2009). This is not surprising based on the results of the Comprehensive Mail Survey (Barton, 2005). The least preferred scene was an un-mown roadside edge. While a green, mown turf infield received a moderately desirable rating; respondents rated an un-mown roadside with a mown edge, as equal in desirability. This strategy allows many acres of land to be released form the constant pressure and expense of routine mowing, so long as the public sees some evidence of maintenance and order; an important component that allows many people to appreciate this strategy of highway vegetation management.

Since it is important for DOT's to be able to respond to criticism and provide explanations of the environmental and economic benefits associated with sustainable management strategies, an understanding of which factors influence public perception is valuable.

Many factors contribute to influence the public's reluctance to embrace sustainable landscape strategies. Native plantings may take two or more years to reach an attractive

state, looking like a failure at first while plants are allocating energy towards establishment of healthy root systems. The ecological disturbance caused by development renders roadsides rights-of-way harsh and inhospitable environments in which to grow, resulting in failed plantings unless care is taken to select adapted species. And finally, many people are simply not used to the style of less manicured landscapes. Public awareness of the establishment process of sustainable plantings, and the benefits provided by a natural landscape, are crucial for public support (Harper-Lore, 1998a). Without public support, DOT's are challenged in their move towards alternative, yet sustainable management strategies.

Aesthetically, sustainable landscapes often represent a divergence from the traditional expectation of how a landscape should appear. Without knowledge of the intrinsic values associated with this atypical, and oftentimes, less manicured aesthetic, public response is frequently critical. Koh espoused the virtues of an 'ecological aesthetic' in sustainable landscapes where aesthetics incorporate ecological quality as well as visual beauty (Koh, 1987). In support of this ecological aesthetic, research suggests intellectual engagement of the public is necessary to assist in their understanding and appreciation of the environment and an awareness of the ecological functions performed with sustainable landscapes; all of which will ultimately contribute to wider acceptance of sustainable landscape practices (Gobster, 1999; White, 1999).

Interpretation, a method of communicating information to an audience, has garnered attention in recent years. The National Association for Interpretation (NAI) defines it as "a mission-based communication process that forges emotional and intellectual connections between the interests of the audience and the meanings inherent in the resource" (NAI, 2009). Brochu and Merriman suggest that interpretive strategies can vary. Strategies can involve personal interpretation in which the interpreter communicates directly to the audience, or non-personal interpretation, which includes media such as signage, brochures, exhibits, websites, social media and audiovisual materials (Brochu and Merriman, 2002).

The impact information imparts on perception should not be undervalued. This study seeks to determine if public engagement and information about traditional and sustainable roadside vegetation management strategies can lead to a shift in the paradigm of perceived aesthetic expectation of landscape management strategies.

Recent research has confirmed that people notice the roadside landscape. In 1999, Delaware Speaks Out, a statewide Cooperative Extension survey, revealed that Delawareans notice the impact of roadside plantings. Fifty-eight percent of the respondents surveyed agreed plantings along the roadside have a moderate, significant or major impact on short trips and seventy-eight percent believed this to be true for long trips (Barton, 2005).

A 2003 assessment of the scenic beauty of roadside vegetation, found that eighty-three percent of respondents surveyed described the scenic quality of roadside vegetation as an important feature of the roadside environment indicating awareness among the public about the roadside landscape (Akbar et al, 2002).

A 1999 study on consumer viewpoints of native grasses and wildflower plantings found that consumers had a high level of interest in reducing landscape inputs and a keen interest in native warm season grasses and forbs along with a desire for more information (Davis and Schimelfenig, 1999).

A considerable body of research on visual perception of landscapes exists to support people's preferences for natural versus man-made scenes (Ulrich, 1986; Kaplan and Kaplan 1989; Kearney, Bradley, Petrich, Kaplan, Kaplan, & Colebank, 2008). While it is not practical to expect development of roads and man-made structures to halt, the question becomes how to remediate the disturbances caused by existing development and plan for new development in a way that minimizes the negative aesthetic quality of the landscape (Akbar et al, 2002). It is therefore essential that DelDOT establish guidelines that balance the aesthetic desires of the public with the ecological and economic goals of the state.

The next step in widespread implementation of more sustainable roadside vegetation management, which will save money and enhance the environment, is to determine and secure public acceptance.

Sustainable roadside vegetation management and associated benefits

Adherence to economic, environmental and contextual goals set forth in state and federal policy insures that roadsides, managed for sustainability, contribute to a matrix of shared benefits for present and future generations including: cost savings, better water quality and conductivity, increased bio-diversity and an improved socioeconomic health of the state.

Economic benefits

In 2009, Delaware was one, among many states, required to trim their mowing budget as a result of reduced income generated from fuel taxes amid an economic recession and, a shift towards more fuel-efficient vehicles. Since DelDOT relies heavily upon the revenue generated from fuel taxes for their operating budget (DelDOT, 2010), this strain contributed to a 25% reduction of mowing along roadside rights-of-way (Roumillat, Personal Communication, 2009). By diversifying their strategy, including the release of turf from routine mowing, establishment of meadows- either of warm season grasses or native flowering perennials, or stands of native shrubs and trees, DelDOT can decrease or redirect their mowing expenditure while increasing the aesthetic value of areas released. One acre of turfgrass mown eight times per year costs

approximately $3480 to maintain; while one acre of meadow, mown annually costs $435 to maintain and $870 if mown biannually as some meadows require (Barton et al., 2005). DelDOT could save $2610 to $3045 per acre in maintenance costs for every acre currently vegetated with turfgrass. If DelDOT took 500 acres of roadside out of routine mowing, the state could save $1,305,000 per year, which would allow DelDOT to substantially reduce or redirect their operating budget.

The financial advantages gained with sustainably managed roadsides warrant judicious consideration given the contemporary economic climate. In 2008, DelDOT spent over $3.4 million dollars mowing roadside rights-of-way (Appendix A). There exists sufficient evidence to support the economic practicality of varying mowing practices, however, a paradigm shift among roadside engineers and managers must first occur (Sauer, 1998). Maintenance staff, trained to mow turf, must be retrained to develop the skills necessary to manage un-mown rights-of-way, such as species identification and selective herbicide application (Barton, 2005).

Improved hydrology and erosion control

Recent ecological goals of roadside vegetation management strategies have called for reducing erosion and sediment flow and improving hydrology (Forman et al. 2003). Vegetation serves as a cost effective yet, aesthetically pleasing way to achieve these two objectives.

Appropriately chosen vegetation, such as native warm season grasses, help stabilize the soil surface to reduce stormwater erosion and sedimentation activity from occurring. These two phenomena continue to present a serious problem throughout the state, resulting in water quality problems, which damage not only fish and wildlife, but also threaten public health, welfare and safety (DNREC, 2000). Because of the deep and/or fibrous root systems present in many native grasses and forbs, they act as an efficient soil stabilizer and increase infiltration more efficiently than shallow-rooted turf grass (Harper-Lore, 1998b).

Although the Chinese have been using soil bioengineering since 28 B.C., modern solutions have relied on concrete and steel to control erosion (Lewisky, 2002). Soil bioengineering relies on the use of plant materials to provide erosion control, slope and stream bank stabilization, landscape restoration and wildlife habitat (WSDOT, 2010). Each of these contributes to the safety and efficiency of a balanced transportation corridor. Unlike plants, concrete and steel erode and break down over time with exposure to weather. Plants however grow stronger as vegetation becomes established. Even after their life cycle is complete, their roots and surface organic matter play an important function as new plants begin to re-establish (Lewisky, 2002).

In 2008, the United States National Research Council identified urban stormwater as a leading source of water quality problems in the US (EPA, 2010). When stormwater and snowmelt cannot percolate into the earth, it runs off onto roads where it absorbs

petroleum and other harmful toxins before making their way into the water supply. Native grasses have been shown to capture precipitation better than mowed turf and their deep roots absorb the runoff more efficiently (Harper-Lore, 1998). By increasing infiltration and decreasing surface runoff, fewer toxins are deposited into local water supplies.

Vegetation is the most critical factor influencing erosion and provides the following six major benefits: (Forman et al, 2003).

- Reduces raindrop impact
- Reduces runoff velocity
- Provides, via the fibrous root system, structural integrity to the soil
- Filters chemical pollutants and sediments from runoff
- Increases water infiltration into the soil
- Increases evapo-transpiration, the vertical movement of water to the air

Increased biodiversity

Marginal habitats, such as roadsides are particularly important for the conservation of biodiversity. These landscapes serve as an important ecological reserve for wildlife habitat. Animals can be attracted to transportation corridors for any number of reasons, but most are related to habitat, ease of movement and food availability (Forman et al, 2003; Harper-Lore, 1999; White, 1999).

A 2008 study found roadsides, when restored to native prairie vegetation, provided valuable habitat for bees, our most important group of pollinators. Significantly greater bee abundances and increased species diversity were found in prairie roadsides when compared to weedy roadsides due to floral abundance and floral richness. Hopwood suggests that native plant restoration will positively affect bee communities and roadside restoration may add valuable bee habitat (Hopwood, 2008).

A similar study conducted in 2001, found the *Conservation Value of Roadside Prairie Restoration to Butterfly Communities*. This study showed a two-fold increase in species richness of habitat sensitive butterflies in prairie compared with grassy or weedy roadsides ($p < 0.0001$) and a five-time increase in abundance in prairie, compared with grassy roadsides ($p < 0.02$). This study further concludes that roadside restoration benefits butterfly populations despite instances of road-killed butterflies. Relative numbers indicated that mortality risk was more than double along grassy corridors (mown-turf) ($p<0.0001$) than along weedy or prairie roadsides. Tracking studies showed that butterflies were less likely to exit prairie roadsides than they were weedy or grassy roadsides (Ries et al, 2001).

By efficiently utilizing land already precluded from development, DOT's could significantly help restore ecological balance to disturbed areas, a fundamental element of a diverse and functional ecosystem (Hopwood, 2008).

Socio-economic health

Aesthetically pleasing, native roadside environments can help identify Delaware's individual sense of place. While many different definitions about sense of place abound, most agree it is primarily reflective of the landscape experience and the human influenced impact upon the land.

The roadside environment is one of the most frequently experienced landscapes in this country (Morrison, 1999). Roadside rights of-way are often the first and last views a traveler sees of a state. So, in order to promote the visual appeal of Delaware, and to attract and encourage visitors to the state, attractively managed roadsides are imperative. Fisher found that if the roadside environment does not provide an aesthetically pleasant travel experience, tourists would not stay and spend their money in the communities along the way (Fisher, 1999).

A significant portion of Delaware's economy is dependent upon tourism and hospitality. In 2008, Delaware experienced more than 8.1 million visitors who contributed about $1.5 billion dollars to the state's economy (Delaware Economic Development Office Annual Report, 2010). Attracting and maintaining this vital source of revenue ensures the livelihoods of many Delawareans and contributes to the overall socioeconomic health of the state.

Safety and roadside vegetation

DelDOT's mission is to provide a safe, efficient, and environmentally sensitive transportation system (DelDOT, 2010). Roadside landscapes are designed with safety as the top priority, while roadside aesthetics and environmental stewardship play an important role within safety parameters. Within the right-of-way of transportation corridors, vegetation can provide a wealth of safety functions, in addition to creating an attractive and functional groundcover (Barton et al, 2005). The following list outlines safety functions that can be provided by appropriately placed roadside vegetation:

- Properly sited, shrubs or tall grasses can shield headlight glare from oncoming vehicles while larger plants such as trees, can help block sun glare during certain times of the day.
- Recent studies have actually shown shrubs can absorb some of the kinetic energy of errant cars and reduce the chance of human injury or fatality (Forman & McDonald, 2007).
- Diverse types of woody vegetation reduces the monotony of mown turf roadsides (Forman & McDonald, 2007)
- Plantings that reduce monotony can provide a visually varied experience and help drivers remain alert and aware (Barton et al, 2005; Forman & McDonald, 2007; Tiffault, & Bergeron, 2003)
- Vegetation that does not require routine mowing eliminates the need to operate heavy machinery on steep or difficult to mow sites.
- Vegetation can provide a physical and visual buffer between pedestrian and vehicular traffic.
- Properly sited plants can indicate a change in direction along roads before a turn is visibly evident giving drivers time to anticipate the turn and slow to a safe speed.

A body of research exists to support the restorative effects roadside vegetation can have on stress and fatigue. Fatigue related crashes are responsible for the deaths of about 1,500 people per year and are the cause more than 56,000 accidents annually (NHTSA, 1996). A 1979 study found vegetation has been shown to improve mood, reduce stress, and facilitate recovery from attention fatigue (Ulrich, 1979).

Anger and frustration can trigger road-rage and lead to aggressive and inattentive driving. AAA reports between January 1990 and September 1996 cite 10,037 known incidents of aggressive driving related accidents that claimed the lives of 218 people and injured an additional 12,610 (AAA, 1996). A 2003 study tested the frustration levels of subjects after experiencing video stimuli of a built-up highway, a garden highway and a scenic parkway. Results indicated that participants had greater frustration tolerance after viewing roadways with more vegetation relative to built structures along the edges. The effect was most pronounced for the scenic parkway condition and emerged despite higher traffic density. The scenic parkway respondents showed a four times greater frustration tolerance than for the garden highway respondents and a six times greater tolerance than for those experiencing the built-up highway condition (Cackowski & Nasar, 2003). This research points to an important role roadside vegetation plays for the safety and well being of drivers, their passengers and others occupying the road.

Methodology

Use of photos as surrogates

The use of photographs as surrogates for field observations is common in landscape perception and psychological studies. Their use as environmental surrogates is practical because photographs can include more subjects, provide control over external stimuli and make affordable extensive sampling of environments and people (Stewart, Middleton, Downton & Ely, 1984). A still image allows respondents to pace themselves and eliminates some of the experimental noise that would be present at an actual site visit (Kaplan and Kaplan, 1989).

In a "Study on the Use of Photographs as an Environment Presentation Medium in Landscape Studies," Shuttleworth found evidence for the validity and effectiveness of photographs in representing landscapes. The results of this study indicated that there were very few significant differences between the reactions to and perceptions of landscapes either when viewed three-dimensionally in the field or two-dimensionally as photographs (Shuttleworth, 1980). Similar findings support the results of Shuttleworth's research (Russell and Mehrabean, 1976; Zube, Simcox & Law 1987).

In 1984, Stewart et al examined the "Judgments of Photographs vs. Field Observations in Studies of Perception and Judgment of the Visual Environment" and found, in the case of visual air quality, photographs provide a good representation of the visual environment (Stewart et al, 1984).

In a study on the "Validity of Photo-Based Scenic Beauty Judgments", Hull and Stewart found that despite differences observed at an individual level, average on-site scenic beauty ratings were similar to the average photo-based ratings (Hull & Stewart, 1992).

Based on the evidence reviewed in these studies, photographs may be seen as reasonable landscape surrogates in perception studies.

Validity of Internet surveys

Since the late 1990's, the Internet has developed swiftly, becoming a staple in many American homes. According to 2003 U.S. Census data, only eighteen percent of households were connected to the Internet in 1997, fifty percent were connected by 2001 and fifty-five percent of American households were connected by 2003 (U.S. Census, 2003). Although current Census data has yet to be released, The Neilson Company reports that more than eighty percent of Americans have computers in their homes and of those, ninety-two percent have Internet access (Neilson, 2009). These accelerated advances have the potential to transform the way survey sampling is traditionally done.

Since the 1970's, telephone surveys have been accepted as a valid mean for sampling populations. However, an increasing number of Americans are eliminating their landlines in favor of using cell phones exclusively. Popular consensus reports that 20-

23% of American households have dropped their landlines in recent years due to the popularity of cell phones, the Internet, and Skype (CBS, 2009; USA Today, 2009; DMW Media, 2009; Digital Trends, 2009). It would thus seem a natural progression to shift from telephone surveys to Internet surveys; however, questions remain about the validity of Internet sampling due, in large part to the percentage of homes not connected.

In 2007, Dillman found the potential offered by Web surveys for conducting innovative surveys to be substantial. Internet surveys offer multiple possibilities that cannot be realized within the more limited confines of paper or interview questionnaires (Dillman, 2007).

- They can be designed to provide a dynamic interaction between respondent and questionnaire.
- Difficult skip patterns can be designed in ways invisible to the respondent.
- Pop-up instructions can be provided.
- Drop-down boxes with long lists of answers to questions usually asked in an open-ended question can be used to provide immediate coding and lead respondents to a unique set of questions relative to their answers.
- Pictures, video clips, animation and audio can be easily scanned into a Web survey.
- The low cost relative to telephone, mail or paper surveys makes Internet surveys far more affordable.
- The quick turn around time of Web surveys makes them more efficient than traditional means of survey sampling.

- The worldwide reach of the Internet makes larger and more diverse samples affordable and feasible.

Wherrett, who found that Internet surveys are easier to alter, have the flexibility to run only one version or many versions simultaneously and allow for easy automation of response collection, revealed similar results for the benefits of Internet surveys (Wherrett, 2000).

A 2006 study found that scenic quality categories of visual variety, beauty, visual naturalness and overall scenic quality could be validly recorded on the Internet (Roth, 2006). To test the validity of the online survey and its results, Roth used convergent validity by correlating the results of the 2006 study with results of a previous on-site survey and a color print-based survey (Roth and Gruehn, 2005).

The popularity and reach of the Internet is unlikely to diminish but will likely expand in coming years. In order for survey research to remain a viable means of collecting data, it is important for this current trend, when implemented according to the goals of scientific rigor, be validated and accepted.

Summary

Roadsides are unarguably challenging environments; however, they provide an opportunity to allow DelDOT to serve as leaders of environmental and economic sustainability, and to serve as respectful stewards of public land utilized by all Delawareans as well as those who travel in or through the state.

As roadside vegetation management objectives have evolved from simple highway beautification initiatives to sustainable management strategies, dictated by legislation and economic necessity, DOT's have a new role in raising awareness, assessing perception and informing the public about the benefits of sustainable roadside vegetation management strategies; the benefits of which have been well documented. The next step forward in this process to convince the traveling public of these benefits and engage them with informational opportunities that heightens awareness of why roadsides, managed for sustainability are an essential link to the environmental and economic health of the state.

MATERIALS AND METHODS

This research was designed to assess perceptions of various roadside vegetation management strategies and determine if an awareness of benefits could improve public perception of sustainable strategies. A survey was used to gauge respondent's level of commitment to and concern for the environment. Images were used to assess respondent's perception of desirability for specific strategies and two different forms of materials were used to present information about traditional and sustainable roadside vegetation management strategies.

An Internet survey (Appendix B) was conducted from January 8-19, 2010 on a population of adults, 18 and older from all three of Delaware's counties (New Castle, Kent & Sussex), and from seven counties in Maryland (Cecil, Kent, Queen Anne's, Caroline, Dorchester, Wicomoco & Worcester), one county in New Jersey (Salem) and two counties in Pennsylvania (Delaware & Chester), all of which lie adjacent to Delaware.

Survey Sampling International (SSI) (Shelton, CT) hosted the survey and provided the random sample population according to quotas set forth by the US Census breaks. SSI's broad scope reaches more than 6 million panelists in 54 countries worldwide and more

than 1.2 million in the United States. To become a panelist for SSI, one must complete an online registration and provide a valid email address. Panelist's accounts are correlated with an identification number that is used to prevent duplicate participation in any given survey. Once registered with SSI, panelists receive email invitations requesting optional participation in surveys. Panelists do not receive monetary compensation for their participation in SSI surveys however, they receive points, which are allowed to accrue and later exchanged for prizes. SSI was selected as the survey company based on experience with academic research, their vast pool of panelists and the fact that their fee of $6,404 ($3,900 to host the survey and $ 2,504 for the sample) for 400 guaranteed complete responses and appropriate survey set up, met the project budget and criteria.

Eight thousand and seven invitations were emailed to a pool of SSI panelists requesting participation in the survey. Panelists who chose to participate clicked on a link provided and were randomly assigned to one of three groups (one control group and two experimental groups). The first 419 responses, representative of the population, according to US Census breaks for age, race, gender and income, were selected for the sample set. Participants in Group 1 (n=147), the control, viewed an introductory screen that thanked them for taking the time to participate in the survey and provided the following information:

- Your voice is an important contribution to help the Delaware Department of Transportation (DelDOT) manage and maintain their roadsides in the most cost

effective and environmentally sensitive manner, while revealing Delaware's natural beauty.

- Please keep in mind this survey is targeting roadside vegetation only and not the roads themselves.

- Your contribution is also helping a graduate student at the University of Delaware conduct the research necessary to produce a thesis and obtain a masters degree.

- Please be assured that all personal and demographic information will be kept anonymous and nothing will be released in reference to a person's name or e-mail address.

- If you have any questions about this survey, please contact Anne Lucey at aklucey@udel.edu

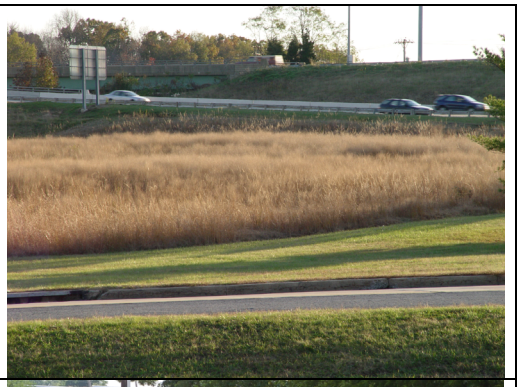
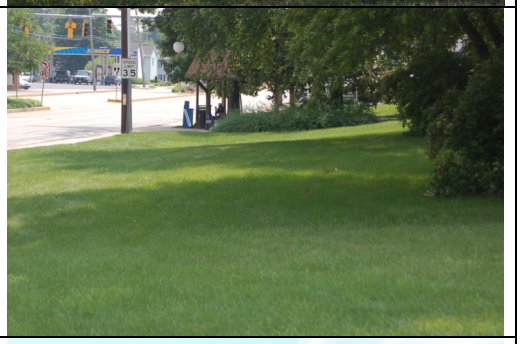
After viewing the introductory page, participants in Group 1 were led directly to the survey, which contained 11 photographic images depicting various models of roadside vegetation in Delaware (Table 1). Images were chosen based on their ability to depict the desired roadside vegetation management strategies: mown turf, grassy meadow, meadow with a mown turf margin, meadow with native flowering perennials and stands of native shrubs and trees. At least 2 images were chosen to represent each of the outlined strategies. Careful attention was given to minimize external factors that could influence respondents' ratings such as, overcast skies, water views, trash, rainbows, et cetera. Respondents were asked to rate each image on a 7 point-Likert scale for desirability, where 1 corresponded with "least desirable", 4 with "neutral" and 7 with "most desirable". Participants were also given the option of qualifying "Why" they

rated each image as they did by adding text in a blank box (Appendix C). Questions were posed to gather additional information regarding environmental and roadside concerns. Basic demographic information about age, gender, income, and level of education completed was also requested.

Table 1 Eleven images presented in the online survey, vegetation management strategy portrayed by each image and images shown to survey participants.

IMAGE #	STRATEGY	IMAGE
1	Neatly mown turf	
2	Meadow with native flowering perennials	
3	Meadow with warm season grasses, flowering perennials & mown margin	

4	Meadow with native flowering perennials	
5	Native flowering shrubs with mown margin	
6	Tan warm season grass	
7	Sloppy, un-mown turf	

8	Tan warm season grass with mown margin	
9	Neatly mown turf with shady tree edge	
10	Flowering shrubs and trees with mown margin	
11	Green warm season grass with mown margin	

After reading the introductory page, participants in Group 2 (n=139) were asked to read a one-page bulleted list of facts about current roadside vegetation management practices, in addition to information about cost effective, environmentally responsible, safe and sustainable regimes (Figure 1). After reading the brief list, participants were asked to rate the images, answer the additional environmental and roadside questions and answer the demographic questions (in the same manner as participants in Group 1).

Figure 1 One-page bulleted list of facts about roadside vegetation management practices presented to Group 2 prior to survey

FACTS ABOUT ROADSIDE VEGETATION & MANAGEMENT

- Delaware has over 10,000 acres of roadside rights-of-way to maintain.
- In 2008 the Delaware Department of Transportation (DelDOT) spent over 3.4 million dollars mowing roadside rights-of-way.
- A change in roadside vegetation & management can reduce DelDOT's mowing budget by 50%.
- The clear zone within the rights-of-way must be kept free of trash, obstacles and tall vegetation.
- Mowers release hydrocarbons and carbon monoxide into the air we breathe.
- Changing the way we vegetate & manage the roadsides can make them beautiful and reflective of our local and native vegetation.
- Roadside mowing reduces plant species richness.
- Roadsides that aren't subject to the constant pressure of mowing are important for the conservation of biodiversity.
- Roadsides, allowed to grow as meadows, provide food for bees, our most important group of pollinators.
- In 2008 the US National Research Council identified urban stormwater as a leading source of water quality problems in the US.
- Water that runs off onto the roads picks up petroleum and roadway toxins before making its way into streams and ultimately our drinking water supply.
- Mixed roadside vegetation (a combination of indigenous herbaceous & woody plant materials) increases the infiltration of water and snowmelt into the soil and decreases runoff, far more efficiently than mown turf.
- Vegetation is the most cost effective and visually pleasing way to improve hydrology and control erosion.
- Plants can shield headlight glare from oncoming traffic
- Vegetation that does not require mowing eliminates the need to operate machinery on difficult and dangerous sites. Reduced mowing reduces the chance of workers being injured.
- Interesting roadside vegetation has been shown to reduce highway hypnosis and helps drivers stay awake and alert.
- Shrubs have been shown to absorb some of the kinetic energy from cars that run off the road.

After reading the introductory page, participants in Group 3 (n=133) were asked to watch a short, fast paced, documentary-style video, that presented the same facts regarding current and potential roadside vegetation management practices as were presented in the written list; however, the information was presented in a much more entertaining and vibrant manner (APPENDIX D). After viewing the video, participants were asked to rate the images, answer the additional environmental and roadside questions and answer the demographic questions (in the same manner as Groups 1 & 2).

The video, created using Microsoft Photo Story 3 for Windows, contained a combination of photographic images and cartoons used to illustrate narration that provided facts about current roadside vegetation management strategies in addition to information about cost-effective, environmentally responsible, safe and sustainable regimes. The majority of photos used in the video were compiled by the research team throughout years of involvement with highway vegetation research. The remainder of the images, and all of the cartoons, were downloaded from the Internet. Images were loaded into Photo Story 3, and voice was recorded directly into the program file while viewing the images in their intended sequence. This allowed for an accurate pairing of the voice with the intended image, seamlessly linking the transition of voice between images. The voice was recorded frame by frame, which allowed for greater ease in editing after the video was audience tested. The final product was created entirely on a laptop computer with a microphone-equipped headset.

An initial draft of the video was presented to three undergraduate (PLSC 100, 232 & 330) and two graduate level classes (STAT 617 & CIEG 611) at the University of Delaware. Student feedback included concerns that the tone was too serious, the tempo too slow and an overwhelming adversity to a particular slide. Many students also voiced their concerns about job security for workers who regularly mow the roadsides. A phrase was added to inform the audience that the same workers who routinely mow "can focus on fixing a few pot-holes instead." Changes were also made to produce a more conversational tone, an upbeat tempo and to replace the particular slide that many students found "annoying".

The Human Subjects Protocol Document, images, survey and video were submitted electronically to Internal Review Board (IRB), through IRBNet, requesting exemption, based on the minimal risk involved in the survey. After internal review by the Human Subjects Review Board (HSRB) and a brief one-hour training session, the project was given an expedited review and granted exemption (Appendix E).

On November 24, 2010, SSI was sent a PDF containing the images and survey, a Microsoft Word file containing the bulleted fact sheet and the video published in Photo Story 3 as a .wmv file. SSI was made aware that it was important a.) The video be embedded directly into the survey to allow for greater ease of return to the survey when viewing was complete, and b.) The video be compatible to both Mac and Windows systems. The following challenges arose during this phase of the project:

- The size of the view frame was too small (about 2 square inches), when the size was increased, the frames per minute shifted and caused discord between images and dialog.
- The video file was not compatible with version #9 of the Windows media player, found on most PC's.
- Some of the images were superimposed on top of one another in a process called "bleeding".
- Pauses for buffering capacity caused the pictures and dialog to fall out of sync.
- Large file size of the video and the varying capacity of different computers created buffering problems.
- The programming for Mac systems had to be outsourced at an additional cost ($250).

The problems in video programming delayed the launch of the survey by approximately three weeks. However, after repeated alterations in the programming process, the video was able to run with its integrity intact. The only change that was made to the video was an added message asking participants not to continue with the survey if the video did not play fluidly. SSI was patient, professional and expedient in all communication throughout the process. SSI's responsibilities included formatting the survey, outsourcing the formatting of the video, delivering the survey to participants, hosting the survey and returning the data to the researcher in Microsoft Excel (2007) files. The survey launched January 8th 2010, quotas were met and the survey concluded eleven days later on January 19th. Materials received from SSI upon completion of the survey included the raw data, dates and times that surveys were started and finished, cross-tabulations and frequencies.

Analysis Methodology

Ratings for all images were summarized in frequency tables using Microsoft Excel (2007). A Chi-square test for independence was used to evaluate the existence of a significant relationship between treatment (control, list, video) and the participant responses. The data was condensed to a 3-point Likert scale (undesirable, neutral and desirable) to allow for an accurate assessment of clear differences in respondent opinions. Values were considered significant at a 0.1 significance level. Computations were performed using JMP Software (JMP, 2008).

Two-group pair-wise comparisons (Minitab) and Chi-square (JMP) were used to evaluate whether treatments (control, list or video) showed significant differences. In the two-group pair-wise comparisons, the list was compared to the video, the control was compared to the list and the control was compared to the video to determine an existence of significant differences. In the Chi-square test, the three groups were all contrasted against one another.

Additional Chi-square tests were run contrasting images 2-11 with image 1, the baseline representing the current default roadside vegetation strategy in Delaware. These computations were performed using JMP software.

The final method of evaluation for the data was a set of Chi-square tests contrasting the current default roadside vegetation strategy in Delaware (image 1) with various categories of vegetation types represented by the following images:

- Flowering meadows (images 2, 3 & 4)
- Warm season grass meadows (images 6 & 8)
- Shrubs and trees (images 5 & 10)
- Warm season grass with a mown margin (images 8 & 11)
- Various vegetation types with a mown margin (images 5, 8, 10 & 11)
- Various vegetation types containing flowers (images 2, 3, 4, 5 &10)

These computations used JMP software.

RESULTS

The majority of respondents rated the following images as desirable (5, 6 or 7 on a 7-point Likert-scale): image 10 (shrubs, trees & turf; 85%), image 5 (shrubs, trees & mown-turf edge; 80.5%), image 2 (flowering perennial meadow; 80.1%), image 9 (mown-turf with tree edge; 65.2%) and image 3 (flowering meadow with mown-turf margin; 60.4%). More respondents rated the following images as desirable than respondents who rated them as neutral or undesirable: image 4 (flowering perennial meadow; 43.7%) and image 1 (mown-turf; 37.9%). The largest number of respondents rated image 11 (tall turf with mown-turf margin; 34.1%) as neutral (4 on a 7-point Likert-scale). Many respondents rated the following images as undesirable (1, 2 or 3 on a 7-point Likert-scale): image 7 (un-mown turf; 65.6%), image 6 (grass meadow; 41.8%) and image 8 (grass meadow with mown-turf margin; 38.9%) (Table 2).

Table 2 Frequencies of response distributions for desirability of 11 roadside vegetation management strategies.

IMAGE	VEGETATION STRATEGY	DESIRABLE	NEUTRAL	UN-DESIREABLE
1	*Neatly mown turf*	37.9%	36.5%	25.5%
2	*Flowering meadow*	80.1%	12.6%	7.2%
3	*Meadow mix; warm season grasses; native flowering perennials; mown turf margin*	60.4%	17.9%	21.8%
4	*Flowering meadow*	43.7%	28.6%	21.0%
5	*Shrubs & trees; mown turf margin*	80.5%	13.6%	6%
6	*Grass meadow*	34.6%	23.6%	41.8%
7	*Unmown turf*	10.3%	24.1%	65.6%
8	*Grass meadow; mown turf margin*	25.3%	35.8%	38.9%
9	*Mown turf; tree edge*	65.2%	24.1%	10.8%
10	*Shrubs & trees; mown turf margin*	85.5%	10.7%	3.8%
11	*Tall turf; mown turf margin*	32.4%	34.1%	33.4%

Mown turf was selected as the baseline image because it represents the current default roadside vegetation strategy in Delaware. A Chi-square test of responses was performed to contrast images 2-11 to the baseline image (image 1: neatly mown-turf). This analysis was based on the original 7-point Likert-scale. Respondents rated all ten images differently from image 1 at a 0.01 significance level. Strategies (images) rated more desirable than neatly mown turf included: native shrubs & trees with a mown turf edge (image 10: p-value 0.000 & image 5: p-value 0.000), a flowering perennial meadow (image 2: p-value 0.000), mown turf with a tree edge (image 9: p-value 0.000), a meadow mix of warm season grasses and native flowering perennials with a mown turf edge (image 3: p-value 0.000), and a native flowering perennial meadow (image 4: p-value 0.000). Strategies (images) found less desirable than neatly mown turf included: tall turf with a mown turf edge (image 11: p-value 0.000), a warm season grass meadow (image 6: p-value 0.000), a warm season grass meadow with a mown turf edge (image 8: p-value 0.000), and unmown turf (image 7: p-value 0.000) (Table 3).

Table 3 Chi-square tests of responses for image comparisons: image 1 (baseline: mown-turf, Delaware's current default roadside vegetation strategy) vs. images 2-11 based on a 7-point Likert-scale.

COMPARISONS	CHI-SQUARE	P-VALUE
1-2	173.851	0.000
1-3	75.629	0.000
1-4	20.082	0.003
1-5	177.186	0.000
1-6	32.521	0.000
1-7	154.064	0.000
1-8	41.898	0.000
1-9	69.988	0.000
1-10	237.739	0.000
1-11	42.237	0.000

The response means for images 1-11 were used to evaluate desirability for all strategies (Table 4). They are listed in order of desirability from most to least desirable.

Table 4 Response mean and standard deviations for all strategies across all three groups.

	IMAGE	VEGETATION STRATEGY	MEAN (STDV)
Most Desirable	10	*Shrubs & trees; mown turf margin*	5.80 (1.21)
	5	*Shrubs & trees; mown turf margin*	5.49 (1.23)
	2	*Flowering meadow*	5.48 (1.31)
	9	*Mown turf: tree edge*	4.97 (1.42)
	3	*Meadow mix; warm season grass; flowering perennials; mown turf margin*	4.73 (1.51)
	4	*Flowering meadow*	4.19 (1.51)
	1	*Mown turf*	4.11 (1.63)
	11	*Tall turf; mown turf margin*	3.92 (1.36)
	6	*Grass meadow*	3.75 (1.71)
	8	*Grass meadow; mown margin*	3.70 (1.42)
Least Desirable	7	*Unmown turf*	2.89 (1.44)

A Chi-square test was used to analyze responses and compare education modes (control, list and video). In order to clearly see differences in how participants perceived the desirability, undesirability or neutrality of the eleven roadside scenes, the Likert-scale was collapsed to a 3-point scale (desirable, neutral and undesirable). The awareness of benefits provided by the list or video was shown to cause a significant shift in perception for images 1, 3, 4, 5 & 7 at a 0.1 significance level (Table 5).

Table 5 Chi-square Test of responses for all groups (control, list, video)

IMAGE	CHI-SQUARE VALUE	P-VALUE
1	8.370	0.079*
2	5.701	0.223
3	14.313	0.006*
4	8.836	0.065*
5	9.778	0.044*
6	2.017	0.733
7	14.835	0.005*
8	1.200	0.878
9	2.567	0.633
10	1.764	0.779
11	1.585	0.811

* Indicates significantly different response distributions at a 0.1 significance level.

To evaluate which form of communication was most effective in changing perception, two-groups pair-wise comparisons were run contrasting the list with the video, the control with the list and the control with the video (Table 6). A change in perception was detected most frequently when the control group was contrasted with the group who viewed the video before rating the images. The control and video groups rated the following images significantly different: image 1 (p-value=0.059), image 3 (p-value=0.002), image 4 (p-value=0.014) and image 5 (p-value=0.013). When the control group was contrasted with the group who read the list of facts before rating the images, significant differences in perception were detected for image 3 (p-value=0.015), image 5 (p-value=0.096) and image 7 (p-value=0.001). When the two experimental groups (list & video) were contrasted with each other, image 7 (p-value=0.027) was the only image to show a significant difference in perception.

Table 6 Two-group pair-wise comparison: List-Video, Control-List, Control-Video, indicating significant differences among treatments.
* Indicates significance at a 0.1 significance level

	List -Video	***Control-List***	***Control-Video***
IMAGE	p-value	p-value	p-value
1	0.132	0.181	0.059*
2	0.182	0.871	0.182
3	0.376	0.015*	0.002*
4	0.494	0.182	0.014*
5	0.701	0.096*	0.013*
6	0.48	0.884	0.14
7	0.027*	0.001*	0.239
8	0.816	0.553	0.904
9	0.939	0.479	0.322
10	0.736	0.855	0.42
11	0.633	0.626	0.78

To understand which relationships between treatments were responsible for overall significance in each of the significant images, Chi-square results are presented detailing which values differ significantly from the null hypothesis model. The null hypothesis assumes that the information received and the ratings for desirability are independent of one another.

For image 1, fewer respondents in the control group than the model predicted found the neatly mown turf undesirable and more respondents than the model predicted found it desirable. Among those who viewed the video before rating the images, fewer respondents than the model predicted found the neatly mown turf desirable (Table 7).

Table 7 Chi-Square test for image 1 (mown-turf).
Observed counts are on top. Expected counts are italicized.
Chi-Square contributions are printed below expected counts.
* Indicates a significant contribution to the Chi-square.

Rating	Control	List	Video	Total
1 Undesirable	29 *37.54* 1.943*	40 *35.50* 0.571	38 *33.96* 0.480	107
2 Neutral	55 *53.68* 0.033	43 *50.76* 1.185	55 *48.57* 0.852	153
3 Desirable	63 *55.78* 0.934	56 *52.75* 0.201	40 *50.47* 2.172*	159
Total	147	139	133	419

Chi-square = 8.370, DF = 4, P-Value = 0.079*

For image 3, more respondents in the control group than the model predicted found the flowering meadow with a mown turf margin undesirable, while fewer respondents than the model predicted found it desirable. Among those who viewed the video before rating the images, fewer respondents than the model predicted found the flowering meadow with a mown turf margin undesirable and more respondents than the model predicted found it desirable (Table 8).

Table 8 Chi-Square test for image 3 (flowering meadow with a mown-turf margin).
Observed counts are on top. Expected counts are italicized.
Chi-Square contributions are printed below expected counts.
* Indicates a significant contribution to the Chi-square.

	Control	**List**	**Video**	**Total**
1 Undesirable	46 *31.93* 6.204*	26 *30.19* 0.581	19 *28.89* 3.383*	91
2 Neutral	25 *26.31* 0.065	28 *24.88* 0.391	22 *23.81* 0.137	75
3 Desirable	76 *88.76* 1.835*	85 *83.93* 0.014	92 *80.31* 1.702*	253
Total	147	139	133	419

Chi-square =14.313, DF = 4, P-Value = 0.006*

For image 4, more respondents in the control group than the model predicted found the flowering meadow undesirable and fewer respondents than the model predicted found it desirable. Among those who viewed the video, before rating the images, more respondents than the model predicted found the flowering meadow desirable (Table 9).

Table 9 Chi-Square test for image 4 (flowering meadow).
Observed counts are on top. Expected counts are italicized.
Chi-Square contributions are printed below expected counts.
* Indicates a significant contribution to the Chi-square.

	Control	**List**	**Video**	**Total**
1 Undesirable	47 *40.70* 0.976	36 *38.48* 0.160	33 *36.82* 0.397	116
2 Neutral	49 *42.10* 1.131	40 *39.81* 0.001	31 *38.09* 1.320	120
3 Desirable	51 *64.20* 2.715*	63 *60.71* 0.086	69 *58.09* 2.050*	183
Total	147	139	133	419

Chi-square =8.836, DF = 4, P-Value = 0.065

For image 5, fewer respondents in the control group than the model predicted found the shrubs and trees with a mown turf margin undesirable. Among those who viewed the video, before rating the images, more respondents than the model predicted found the shrubs and trees with a mown turf margin undesirable (Table 10).

Table 10 Chi-Square test for image 5 (Native shrubs and trees).
Observed counts are on top. Expected counts are italicized.
Chi-Square contributions are printed below expected counts.
* Indicates a significant contribution to the Chi-square.

	Control	**List**	**Video**	**Total**
1 Undesirable	5 *8.77* 1.621*	9 *8.29* 0.060	11 *7.94* 1.183*	25
2 Neutral	29 *20.00* 4.053*	16 *18.91* 0.448	12 *18.09* 2.052*	57
3 Desirable	113 *118.23* 0.231	114 *111.80* 0.043	110 *106.97* 0.086	337
Total	147	139	133	419

Chi-square =9.778, DF = 4, P-Value = 0.044*

For image 7, more respondents in the control group than the model predicted found the un-mown turf desirable. Among those who viewed the video, before rating the images, fewer respondents than the model predicted found the un-mown turf desirable (Table 11).

Table 11 Chi-Square test for image 7 (un-mown turf).
Observed counts are on top. Expected counts are italicized.
Chi-Square contributions are printed below expected counts.
* Indicates a significant contribution to the Chi-square.

	CONTROL	LIST	VIDEO	TOTAL
1 Undesirable	97 *96.48* 0.003	87 *91.23* 0.196	91 *87.29* 0.158	275
2 Neutral	27 *35.43* 2.008*	36 *33.51* 0.186	38 *32.06* 1.101*	101
3 Desirable	23 *15.09* 4.152*	16 *14.26* 0.211	4 *13.65* 6.821*	43
Total	147	139	133	419

Chi-square =14.835, DF = 4, P-Value = 0.005*

Groups of strategies with similar attributes were combined and compared to image 1 (the baseline image of default vegetation). Images 2, 3 & 4 were flowering meadows. Images 6 & 8 were grass meadows. Images 5 & 10 were shrubs and trees. Images 8 & 11 were grass meadows with mown-turf margins. Images 5, 10, 8, & 11, all had a mown-turf margin. They are listed in order of mean for desirability from most to least desirable with the baseline image in italics. The images above the baseline image indicate the strategies respondents found preferable to neatly mown-turf. The images below the baseline image indicate the strategies respondents found less preferable than neatly mown-turf (Table 12).

A chi-square test of responses was performed to contrast the baseline image (image 1: neatly mown-turf) against groups of strategies with similar attributes. Based on the 7-point Likert-scale, the response for image 1 is distributed differently than the response from any other group at a 0.05 significance level (Table 12).

Table 12 Response means, standard deviations & Chi-square tests of response comparisons of image 1 (baseline: mown turf, Delaware's current default roadside vegetation management strategy) to groups with similar attributes based on the 7-point Likert-scale. Listed in order of desirability from most to least desirable. Images 5 & 10 were shrubs & trees with a mown turf margin. Images 2, 3 & 4 were flowering meadows. Images 5, 10, 8 & 11 all had a mown turf margin. Images 8 & 11 were grassy meadows with a mown turf margin. Images 6 & 8 were warm season grass meadows.

	COMPARISONS	**GROUP MEAN**	**GROUP STDEV**	**CHI-SQUARE**	**P-VALUE**
Most desirable	1 vs. (5, 10)	5.64	1.23	298.122	0.000
	1 vs. (2,3,4)	4.80	1.54	103.880	0.000
	1 vs. (5,10,8,11)	4.73	1.60	82.334	0.000
Baseline	*1*	*4.11*	*1.63*	-	-
	1 vs. (8,11)	3.81	1.39	53.249	0.000
Least desirable	1 vs. (6,8)	3.73	1.57	38.149	0.000

*Note: On the 7-point Likert scale, image 1 is distributed differently from any other image group at a 0.05 significance level.

Qualitative data, collected for each of the eleven survey images, revealed insight into which attributes of roadside vegetation management strategies respondents found desirable, neutral or undesirable. This data was categorized and coded according to comments most frequently recorded (Tables 13-23).

Table 13 Qualitative responses for a mown-turf infield.

IMAGE 1

	CONTROL	LIST	VIDEO
Pretty/Natural	21	9	8
Neat/Tidy	38	21	28
Boring	40	29	42
High Maintenance	8	7	16
Bad For The Environment	0	0	4
No Comment	33	18	33
Other	27	18	16

Table 14 Qualitative responses for a native flowering perennial meadow.

IMAGE 2

	CONTROL	LIST	VIDEO
Pretty/Natural	60	59	66
Neat/Tidy	3	2	4
Colorful/Flowers	70	48	47
Good for the Environment	0	10	15
Low Maintenance	3	5	5
Boring	5	2	0
Weedy/Messy	7	9	4
Too Expensive	1	1	1
No Comment	25	34	33
Other	18	10	4

Table 15 Qualitative responses for a meadow including: native flowering perennials, warm season grasses and a mown turf edge.

IMAGE 3

	CONTROL	LIST	VIDEO
Pretty/ Natural	44	42	36
Neat/Tidy	9	8	10
Colorful/Flowers	4	3	7
Good For The Environment	3	4	8
Boring	7	4	6
Weedy/messy	17	17	14
High Maintenance	6	2	1
Dislike Houses In The Background	12	1	1
No Comment	34	39	40
Other	33	26	17

Table 16 Qualitative responses for a native flowering perennial meadow.

IMAGE 4

	CONTROL	LIST	VIDEO
Pretty/Natural	33	34	38
Good For The Environment	8	2	11
Low Maintenance	0	0	5
18 Boring	9	8	7
Weedy/Messy	32	26	21
Allergies	7	9	3
No Comment	43	41	39
Other	20	20	14

Table 17 Qualitative responses for a stand of native trees and shrubs with a mown turf edge.

IMAGE 5

	CONTROL	LIST	VIDEO
Pretty/Natural	67	59	52
Neat/Tidy	15	9	9
Variety	14	25	19
Good For The Environment	4	5	11
Boring	10	9	5
High Maintenance/ Too Much Grass To Mow	0	13	11
No Comment	40	38	38
Other	17	7	17

Table 18 Qualitative responses for a warm season grass meadow.

IMAGE 6

	CONTROL	LIST	VIDEO
Pretty/Natural	32	15	12
Fall Color	14	10	9
Good For Environment / Low Maintenance	9	5	5
Boring	12	17	15
Weedy/Messy	15	14	12
Brown/Dead	24	24	16
Fire Hazard	2	4	5
No Comment	43	47	45
Other	16	11	13

Table 19 Qualitative responses for un-mown turf.

IMAGE 7

	CONTROL	LIST	VIDEO
Neat/Tidy	7	3	1
Boring	33	33	34
Weedy/Messy	57	41	42
Too Much Mowing/ Bad For The Environment	4	7	8
No Comment	35	41	41
Other	16	14	9

Table 20 Qualitative responses for a warm season grass meadow with a mown turf edge.

IMAGE 8

	CONTROL	LIST	VIDEO
Pretty/Natural	13	12	13
Neat/Tidy	18	13	15
Fall Color	1	4	1
Low Maintenance/ Good For Environment	3	4	6
Boring	23	30	26
Dead/Unattractive	11	19	11
Too Much Mowing	0	3	3
No Comment	51	45	49
Other	30	11	11

Table 21 Qualitative responses for mown turf with a tree edge.

IMAGE 9

	CONTROL	LIST	VIDEO
Pretty	30	42	32
Neat/Tidy	27	26	25
Relaxing	12	10	6
Community Feel-Traffic Calming	7	3	1
Boring	10	16	14
High Maintenance	3	9	12
No Comment	47	35	42
Other	12	5	10

Table 22 Qualitative responses for a stand of native trees and shrubs with a mown turf edge.

IMAGE 10

	CONTROL	LIST	VIDEO
Pretty/Natural	82	69	62
Neat/Tidy	19	10	12
Color	26	22	14
Good For The Environment	0	4	5
High Maintenance/ Too Much Grass	8	9	14
Negative b/c of construction	4	2	0
No Comment	43	38	40
Other	5	5	3

Table 23 Qualitative responses for un-mown turf with a mown edge.

IMAGE 11

	CONTROL	LIST	VIDEO
Pretty/Natural	36	27	23
Unfinished	13	3	6
Boring	24	28	30
Messy/Un-kept	6	12	6
High Maintenance	3	3	8
No Comment	50	48	47
Other	19	28	16

Additional survey questions

Additional survey questions were asked to gauge respondent's level of concern for, and commitment to, the environment. When asked if concerned about the current state of the environment, only three percent reported they were not at all concerned, twenty-four percent reported they were mildly concerned, thirty-eight percent were concerned and thirty-four percent of respondents were strongly concerned for the current state of the environment. Less than one percent had no opinion (Table 24).

Table 24: Responses to the question: "Are you concerned for the current state of the environment?"

	LEVEL OF CONCERN	PERCENT
	Not at all concerned	3.3%
	Mildly concerned	23.6%
	Concerned	37.9%
	Strongly concerned	34.4%
	No opinion	.7%
	Total	100.0%

When asked whether or not they recycled, eighty-seven percent of respondents reported they recycled and only thirteen percent did not. Of the thirteen percent who reported they did not recycle, twelve percent revealed is was because recycling was not a convenient option for them (Tables 25 & 26).

Table 25: Responses to the question: "Do you recycle?"

RESPONSE		PERCENT
	Yes	86.9%
	No	13.1%
	Total	100.0%

Table 26: Responses to the question: 'Why do you recycle or not recycle?'

RESPONSE		PERCENT
	Because it is important to me	80.9%
	Because it is mandatory	6.0%
	Because it is not important to me	1.2%
	Because it is not convenient	11.9%
	Total	100.0%

When asked whether they believed DOT's should spend money on roadside enhancement, only two percent of respondents strongly disagreed and eight percent disagreed. While sixty-three percent of respondents agreed and twenty-three percent strongly agreed that DOT's should spend money on roadside enhancement. Four percent had no opinion (Table 27).

Table 27: Responses to the question: "Do you believe DOT's should spend money on roadside enhancement?"

	RESPONSE	PERCENT
	Strongly disagree	2.1%
	Disagree	8.4%
	Agree	62.5%
	Strongly agree	22.7%
	No opinion	4.3%
	Total	100.0%

When asked to choose which factor, cost effectiveness, environmental stewardship or aesthetics was most important in roadside vegetation management decisions, environmental stewardship ranked first forty-six percent of the time. Cost effectiveness ranked first forty-three percent of the time and beauty ranked first ten percent of the time. Only thirteen percent of respondents chose environmental stewardship as the least important consideration (Table 28).

Table 28: Responses to the question: "There are numerous factors that influence the way departments of transportation manage roadsides including: cost effectiveness, environmental stewardship and aesthetics. Which of these factors is most important to you? Please order the following with 1 being the most important attribute and 3 being the least important."

RANK	COST EFFICTIVENESS	ENVIRONMENTAL STEWARDSHIP	BEAUTY
1	43.4%	46.3%	10.3%
2	34.8%	40.3%	24.8%
3	21.7%	13.4%	64.9%
TOTAL	99.9%	100.0%	100.0%

Demographic data

Demographic data for age showed .8% (n=4) of respondents were 80-89 years old; 4.6% (n=19) were 70-79 years old; 13.6% (n=57) were 60-69 years old; 28.9% (n=121) were 50-59 years old; 23.4% (n=98) were 40-49 years of age; 15% (n=63) were 30-39 years old; 11.6% (n=49) were 20-29 years old; and 1.9% (n=8) were 18 or 19 years old (Table 29).

Demographic data for gender showed 31.5% of respondents were males (n=132), and 68.5% were females (n=287) (Table 29).

Table 29: Age and gender of respondents.

CHARACTERISTICS	PERCENT
AGE (YEARS)	
18-19	1.9%
20-29	11.6%
30-39	15%
40-49	23.4%
50-59	28.9%
60-69	13.6%
70-79	4.6%
80-89	.8%
GENDER	
MALE	31.5%
FEMALE	68.5%

Demographic data for state of residence showed 35.8% (n=150) live in Delaware and 64.2% (n=269) live in Maryland, New Jersey or Pennsylvania (Table 30).

Table 30: Percentages of respondents who reside in either in Delaware, or a neighboring state (MD, NJ, PA).

STATE OF RESIDENCE	PERCENT
Delaware	35.8%
MD, NJ, or PA	64.2%
Total	100.0%

Demographic data for highest level of educational attainment reported 2.4% (n=10) did not complete high school; 24.1% (n=101) received a high school or equivalent degree; 29.6% (n=124) attended some college but did not complete a degree; 9.8% (n=41) completed an associates degree; 25.5% (n=107) completed a bachelors degree; and 8.6% (n=36) completed a post-college advanced degree (Table 31).

Table 31: Respondent level of educational attainment.

LEVEL OF ATTAINMANT	PERCENT
Did not complete high school	2.4
High school graduate or equivalent degree	24.1
Some college, but no degree	29.6
Associates degree	9.8
Bachelors degree	25.5
Post college advanced degree	8.6
Total	100.0

Demographic data for income reported 14.8% (n=62) earn less than $25,000 per year; 26.0% (n=109) earn between $25,000-$49,999 per year; 28.4% (n=119) earn between $50,000-$74,999 per year; 22.0% (n=92) earn between $75,000-$124,999 per year; 7.2% (n=30) earn between $125,000-$249,000 per year; and 1.7% (n= 7) earn more than $250,000 per year (Table 32).

Table 32: Respondent responses for income earned each year.

INCOME	PERCENT
Less than $25,000	14.8
$25,000-$49,999	26.0
$50,000-$74,999	28.4
$75,000-$124,999	22.0
$125,000 -$249,999	7.2
$250,000 or more	1.7
Total	100.0

DISCUSSION

With this research, we sought to determine if an awareness of benefits could improve public perception of sustainable roadside vegetation management strategies when compared to mown turf, Delaware's current default strategy. We also sought to determine the efficacy of two different styles of educational intervention, a static written list and a brief, yet engaging video.

This research revealed that the majority of respondents, with or without treatment, found strategies including shrubs and trees with a mown turf margin, and flowering perennial meadows to be their most preferred vegetation management strategy along roadsides. This research also revealed when compared to mown turf, each of the other strategies were rated significantly different.

Frequencies, response means and standard deviations

Over eighty percent of respondents surveyed found images with shrubs, trees & turf (image 10: 85%; image 5: 80.5%), and an image of a native flowering perennial meadow (image 2: 80.1%) as highly desirable. These results were not surprising based on the results of *Delaware Speaks Out*, a 1999 statewide cooperative extension survey,

which revealed color and order as attributes necessary to gain public acceptance of sustainable roadside vegetation strategies (Barton, 2005).

Most respondents found images of mown turf with a tree edge (image 9: 65.2%) and a flowering meadow with a mown turf edge (image 3: 60.4%) as desirable. More respondents found a flowering perennial meadow (image 4: 43.7%) desirable than found it neutral or undesirable (28.6%, 21.0%). The mown turf infield (image 1) was rated as desirable (37.9%) or neutral (36.5%) by an almost equal number of respondents.

Respondents found a cool season grass meadow with a mown turf edge (image 11: 34.1%) neutral. These results were surprising based on the results of the *Comprehensive Mail Survey,* which found turf, released from routine mowing while maintaining a crisp mown edge to be equal in desirability to a fully mown turf infield (Barton, 2005). One possible explanation for this discrepancy may be that the image used in the 2010 survey featured a grass margin that had not been freshly mown, portraying a somewhat shaggy appearance, while the image used in the 2005 survey featured a released turf meadow with a freshly mown edge, clearly portraying an appearance of maintenance and order. This explanation is supported by 24 comments referring to this image as "messy/un-kept" and by 22 comments referring to this image as "unfinished" (Table 23). In contrast, in the 2005 survey 16 respondents referred to turf with a mown turf edge as "well-kept". While 3 respondents commented that the image was "unfinished" or less

than desirable in some way (20), no respondents referred to the image as "messy/un-kept" (Barton, 2005).

Strategies that many found undesirable include those with un-mown turf (image 7: 65.6%), warm season grass meadow (image 6: 41.8%) and a warm season grass meadow with a mown turf edge (image: 8: 38.9%) (Table 2). Qualitative data revealed many respondents found the scenes boring, messy or had a negative response to the tan warm season grasses shown in the fall (Tables 18 & 20).

When ranked in order of response mean for desirability, the image of freshly mown turf, Delaware's current default strategy, ranked seventh out of eleven images, trailed only by un-mown turf, or grass meadows: with or without a mown turf edge. The largest standard deviation, indicating a wide variety of responses occurred for image 6, a warm-season grass meadow. Interestingly, more respondents in the control group than in either educational group, commented that they found this scene pretty/natural, had good fall color or was low maintenance and good for the environment (Table 18). Although the highest frequency of respondents rated this image undesirable (41.8%), a higher number of respondents rated it desirable (34.6%) than neutral (23.6%) (Table 2). So, although this strategy ranked below mown-turf as a desirable vegetation strategy, these results indicate the public's potential willingness to accept this as a form of vegetation along roadside rights-of-way.

Similar frequency responses for image 11, a tall turf meadow with a mown margin, reported 33.4% of respondents rated this strategy undesirable, 34.1% rated it neutral and 32.4% rated it desirable (Table 2). So, if overwhelming majorities are either neutral or agreeable to this strategy (66.5%) than are disagreeable (33.4%), DelDOT could use this strategy to save money and benefit the environment without the risk of intense scrutiny and criticism.

Chi-square test of responses: image 1 vs. images 2-11

A chi-square analysis combined the three treatment groups and contrasted mown turf (image 1) with each of the other strategies (images 2-11). When compared to mown turf, public perception for each strategy was rated significantly different. Strategies (images) rated more desirable than neatly mown turf included: native shrubs & tree with a mown turf edge (image 10: p-value 0.000 & image 5: p-value 0.000), a flowering perennial meadow (image 2: p-value 0.000), mown turf with a tree edge (image 9: p-value 0.000), a meadow mix of warm season grasses and native flowering perennials with a mown turf edge (image 3: p-value 0.000), and a native flowering perennial meadow (image 4: p-value 0.000). Strategies (images) found less desirable than neatly mown turf included: tall turf with a mown turf edge (image 11: p-value 0.000), a warm season grass meadow (image 6: p-value 0.000), a warm season grass meadow with a mown turf edge (image 8: p-value 0.000), and unmown turf (image 7: p-value 0.000) (Table 3).

Chi-square test of responses for treatment groups

Since a chi-square test of responses (based on a 3-point Likert-scale) reported significantly different response distributions based on whether respondents received an education intervention (list or video) compared to the control for (images of) five of the eleven strategies, we can go on to explore the possible source of these significant differences. This test confirms different response distributions for five of the eleven strategies viewed at a 0.1 significance level: neatly mown turf (image 1: p-value 0.079), a meadow mix of warm season grass and native flowering perennials with a mown turf edge (image 3: p-value 0.006), a native flowering perennial meadow (image 4: p-value 0.065), a stand of native shrubs & trees with a mown turf edge (image 5: p-value 0.044) and sloppy un-mown turf (image 7: p-value 0.005) (Table 5).

Two-group pair wise comparison

To understand which treatment method caused the most changes in perception, a two-group pair-wise comparison was used. This test contrasted the control group (no education) against each of the two experimental groups (list and video). The results showed that when compared to the control group, the group who first read the written list of benefits associated with sustainable roadside vegetation management strategies, found three of the eleven strategies (images) different in terms of desirability. Significant changes in perception occurred for strategies (images) that showed a meadow mix of native warm season grass and native flowering perennials (image 3: p-value 0.015), a stand of native shrubs & trees with a mown turf edge (image 5: p-value

0.096), and a sloppy un-mown turf edge (image 7: p-value 0.001) (Table 5). The results of this test confirmed the hypothesis that education, in the form of a written list, caused a change in perception, three out of eleven times.

When compared to the control group, the group who first viewed the video, showed the most changes in perception. Significant shifts occurred for strategies (images) of: a neatly mown turf infield (image 1: p-value 0.059); a meadow mix of warm season grass and native flowering perennials (image 3: p-value 0.002); a native flowering perennial meadow (image 4: p-value 0.014); and, a stand of native shrubs and trees with a mown turf edge (image 5: p-value 0.013). This test confirmed the hypothesis that education, in the form of a video, caused a change in perception, four out of eleven times. The two-group pair-wise comparison also confirmed the hypothesis that an engaging interpretative video is more effective than a static written list as a method of information delivery (Table 6).

Chi-square analyses

Chi-square tests for each strategy (image) exposed significant differences in desirability and changes in perception among the three different groups (control, list, video). In a chi-square test for independence, a model of expectancy is constructed based on the formula e=(RT/n)(CT/n)*n whereas RT=row total, CT=column total, n= number of observations and e=expected count. If the actual responses are significantly different than the predicted responses, a change has occurred. Chi-square was chosen as the

appropriate statistical test of independence based on the discrete response variable present in the Likert scale and the abnormal distribution of the responses.

Chi-square test for image 1 (neatly mown infield)

A chi-square analysis for the desirability of a fully mown turf infield (image 1: p-value 0.079) revealed the following group differences: among participants in the control group, fewer respondents than predicted rated this strategy undesirable, and among those in the video group, fewer than predicted found this to be a desirable roadside vegetation management strategy. These results indicate that upon learning of the environmental and economic costs associated with mown turf, the public is less likely to accept non-native turf-grass as a roadside vegetation management strategy (Table 7). Without the education, they are more likely to desire the fully mown turf strategy.

Qualitative data offered further insight into respondent's choices. Among those in the control group, twenty-one respondents commented they found this scene to be pretty or natural. However, only nine who read the list, and eight who viewed the video reported that they found the mown turf infield pretty or natural. Among those who commented on the maintenance concerns of large swaths of mown turf, only eight in the control group as compared to sixteen in the video group thought mown turf was a high maintenance strategy. No one in the control group indicated they thought the mown turf was environmentally damaging while 4 who watched the video voiced concern about the environmental risks this strategy presents (Table 13).

Chi-square test for image 3 (a meadow mix of warm season grass and native flowering perennials with a mown turf edge)

A chi-square analysis for the desirability of a meadow with warm season grasses, native flowering perennials and a mown-turf edge (image 3: p-value 0.006) revealed the following group differences: among participants in the control group, more than predicted rated this strategy undesirable and less than predicted rated it desirable. However, the results were reversed for the group who first viewed the video. In this group, less people than predicted rated this meadow-mix undesirable and more than predicted rated it as a desirable strategy for vegetation along the roadside. This test indicates that after viewing a video of current roadside vegetation management regimes and more sustainable alternatives, the public is less likely to disagree, and more likely to agree with a meadow-mix as an acceptable strategy of roadside vegetation. This test confirmed two examples of significant changes in perception once respondents were made aware of the benefits associated with sustainable roadside vegetation management strategies and the risks and expenses associated with traditional regimes (Table 8).

Qualitative data indicated that more people who watched the video than in the control group found this to be an environmentally beneficial solution. Responses also showed that those who viewed the video found this strategy to be less maintenance than those in the control group (Table 15).

Chi-square test for image 4 (meadow with native flowering perennials)

A chi-square analysis for the desirability of a meadow with native flowering perennials (image 4: p-value 0.065) revealed the following group differences: among participants in the control group, fewer respondents than predicted found this strategy desirable, yet, among those who viewed the video, more than predicted found the flowering perennial meadow desirable. This test illustrates public willingness to evaluate and accept a sustainable roadside aesthetic once they have learned about the intrinsic environmental and economic values present (Table 9).

Qualitative data indicated respondents were more likely to find a native flowering perennial meadow low maintenance once they viewed the video over those in the control group. Video respondents were also less likely to view the meadow as weedy or messy than the control group respondents. Nineteen negative responses were recorded (across all groups) indicating that respondents found this scene undesirable because of concern for allergies (Table 16). Interestingly, the plant pictured in this image, goldenrod (*Solidago* sp.) does not cause allergies. It has very heavy pollen and is pollinated by insects rather than wind. This is a common misconception because goldenrod blooms at the same time as the wind pollinated ragweed (*Ambrosia artemisifolia),* which does cause allergies (MOBOT, 2010). This response represents an opportunity for education that might help people accept flowering goldenrod meadows more readily.

Chi-square test for image 5 (native shrubs and trees)

A chi-square analysis for the desirability of stands of native shrubs and trees along the roadside (image 5: p-value 0.044) revealed the following group differences: among participants in the control group, fewer respondents than expected found this strategy undesirable. Among participants in the video group, more respondents than predicted found it undesirable. Across all three groups, image 5 had the second highest desirability rating in the survey (Table 10).

Qualitative data indicated an increase in respondents who watched the video, found this strategy environmentally beneficial over those in either the control or list groups. Interestingly, no one in the control group found this strategy to be high maintenance, whereas thirteen from the list group and eleven from the video group thought this to be true. Many of the maintenance comments focused specifically on the large grass sward in the foreground and commented that the grass could be minimized, and the plants extended closer to the road (Table 17). Comments about the large grass sward in the foreground may explain why more respondents who watched the video than expected rated this image as undesirable.

Chi-square test for image 7 (unmown roadside)

A chi-square analysis for the desirability of an un-mown roadside (image 7: p-value 0.005) revealed the following group differences: among participants in the control group, more than predicted found this strategy desirable and among those in the video

group, far fewer than predicted found it desirable. The unwillingness of the video group to find un-mown turf acceptable contributed 6.821 to an overall chi-square of 14.835, the greatest overall contribution to a chi-square of all the chi-square tests in this data set (Table 11).

Qualitative data indicated a decrease in respondents who found this scene neat or maintained from the control to the video group and an increase in those who thought this required too much mowing and was environmentally damaging (Table 19).

Additional qualitative responses indicated that among those who received one of the educational treatments, respondents were less likely to accept large areas of mown turf (images 7, 8, 9, 10 &11) (Tables 19, 20, 21, 22 & 23) and more likely to accept alternative strategies for the environmental benefits they provide (images 2 & 6) (Tables 14 & 18). One respondent commented, "I am not a huge fan because of all the brown…however, this may be the natural consequence of more environmentally friendly management of roadsides, and as such, I can deal with it (list: image 6)".

Chi-square test of responses: image 1 vs. groups with similar attributes

A chi-square analysis compared image 1 (mown-turf) to groupings of images with similar attributes. All showed significantly different response ratings. Ranking more desirable than mown-turf was native shrubs and trees (images 5 & 10: p-value 0.000),

meadows with native flowering perennials, either with or without a mown-turf edge (images 2, 3, 4:p-value 0.000), and a variety of strategies all with mown-turf edges (images 5, 10, 8, 11: p-value 0.000). Ranking below mown-turf was grass meadows with a mown margin (images 8 & 11: p-value 0.000), and warm season grass meadows (images 6 & 8: p-value 0.000). Responses from this analysis revealed respondents desire for stands of native shrubs and trees, flowering meadows, neatly mown edges, color and the appearance of maintenance. Responses also revealed respondents dislike for warm or cool season grass meadows (Table 12).

Additional survey results

Additional qualitative data revealed important information regarding respondent's attitudes about the environment and their opinions on roadside enhancement. Ninety six percent of those surveyed reported having concerns about the current state of the environment (Table 24). Many respondents expressed concern for the negative environmental ramifications brought about by the mowing regime required of turfgrass, Delaware's current default vegetation management strategy. A respondent from the group who read the list commented (image 7: unmown turf), "This seems wasteful to me-I feel depressed when I see long stretches of grass on the highway-it is just a waste of our money. The highways could be planted with native trees and plants and nature could be encouraged to thrive without much cultivation on our part instead of this long-term expensive fight." Others voiced concern for runoff and pollution problems associated with this strategy of management; a respondent in the control group said "No

plantings to collect rain, heavy water falling off road. Nothing to absorb this runoff or absorb fumes from traffic." And, many voiced distaste for the aesthetic values, or lack thereof this strategy presents. Comments about the lack of visual appeal ranged from "Says, We just don't care", to a rather blunt, "Looks like crap!" (Appendix C)

When asked to rank which attribute respondents considered most important in roadside vegetation management decisions: cost effectiveness, environmental stewardship or beauty, the majority of respondents (46.3%) placed environmental stewardship at the top of the list, and the least number of respondents (13.4%) put it at the bottom. This result was quite surprising given the current economic climate (Table 28).

Another surprising result amid an economic recession revealed that eighty-five percent of those surveyed agreed that DOT's should spend money on roadside enhancement (Table 27). This percentage shows a drastic increase since the 1999 Cooperative Extension survey, *Delaware Speaks Out*, in which only sixty-two percent expressed support for spending tax dollars to beautify Delaware's roadways (Barton, 2005).

Limitations in this study included the use of photographs as representation for sustainable landscape strategies. Despite a reminder at the beginning of the survey that participant's opinions of the roadsides, not the roads themselves were desired, negative comments about guardrails, houses, utility wires and the like were reflected in their ratings. One respondent commented, " I love the wildflowers but don't like looking at

all the new buildings on the other side of the street", rating the image neutral on the scale for desirability. Another commented, "There's nothing interesting about the houses. The best thing is the clump of black-eyed Susans." This respondent rated the image undesirable. Future studies could be improved by editing images to remove extraneous influences.

CONCLUSIONS

Two primary objectives were set forth at the start of this research:

> 1- To examine whether an awareness of benefits alters an individual's perception of sustainable roadside vegetation management strategies.
>
> 2- To investigate whether an engaging video is a more effective tool at altering perception than a static written list.

These questions, addressed through an Internet survey, revealed that upon receipt of information relevant to traditional and sustainable strategies of roadside vegetation management, and when compared to mown-turf, sustainable strategies including flowering perennial meadows, a mixed meadow of native flowering perennials and warm-season grasses, stands of native shrubs & trees and a mown-turf edge were found to be more desirable. Solid stands of warm season grasses with or without a mown margin, tall cool season turf with a mown margin and unmown turf, in other words tan grass and/or untidy grass, were found to be less desirable than fully mown turf. Subjective comments indicated that the undesirability was attributable to brown or dead-looking grass (a misunderstanding of the growth cycle of warm season grasses), a feeling that DelDOT was not maintaining the roadside sufficiently, or a lack of neatness or order. Mown turf was most frequently described as "boring" by survey respondents.

Regardless of the information provided, many respondents opined that mown turf was not an appropriate vegetation strategy for roadside use due to its inability to facilitate

water infiltration, foster biodiversity, provide wildlife habitat, reduce monotony, decrease maintenance expenditures and its boring aesthetic value. Comments about the neatly mown turf infield included: “Its (sic) nice seeing the green grass but it isn’t what I like seeing when I’m driving long distances.”; “Grass is boring and I personally prefer to see wild plantings and trees. Grass smacks of waste to me.”; and, “Unattractive to look at, same boring grass that’s in my yard and you can plainly see trash that may be tossed from someones (sic) car.”. These results support the conclusion that mown turf, as a default form of roadside vegetation, is not considered a sustainable landscape strategy and may have outlived its usefulness.

When compared to groups of strategies with similar attributes, mown turf was found significantly less desirable than strategies (images) of shrubs & trees, flowering meadows and mown turf edges. Praise for these sustainable strategies included, “It’s a blessing from God, and, it’s beautiful to look at and admire.”; “I prefer looking at the various wildflowers in bloom than that of just grass.”; “ …This type of land use prevents erosion, provides habitat for wildlife. Puts water back in local water tables instead of storm drains.”; and, simply “(It’s a) break from all the green.”. These results confirm the importance of color, and appearance of maintenance along roadsides in order to secure public acceptance of sustainable roadside vegetation management strategies.

In response to the second objective, an investigation of whether an engaging video is a more effective tool for altering perception than a static written list, the results suggest that an engaging interpretative video is somewhat more effective than a static written list. Additionally, informational interventions, in either form (list or video) may be an effective tool for changing public opinion about sustainable roadside vegetation management strategies. After viewing a 6 ½ minute video informing participants of the risks and expenses associated with traditional vegetation management strategies and the benefits associated with sustainable strategies, respondents were significantly more accepting of sustainable strategies including: a mixed meadow, a flowering perennial meadow and a stand of native shrubs and trees, and significantly less accepting of neatly mown turf. After reading a one-page list detailing similar information, respondents were significantly more accepting of sustainable strategies illustrated by a flowering perennial meadow and stands of native shrubs and trees, and significantly less accepting of un-mown turf. Qualitative data indicated that respondents who did not receive either educational intervention were more likely to view mown turf as "pretty" and were less aware of the maintenance costs and environmental concerns associated with turf than those who received an informational intervention. Respondents without an intervention were also less likely to identify flowering meadows as low maintenance. Respondents who viewed the video however were more likely to identify the environmental benefits of native shrubs and trees.

These results could attest to the efficacy of the video, and the images it contained to convey the message that sustainable landscapes need not appear wild or un-kept. Interestingly, requests for a copy of the video for use as a teaching tool came from pre-survey pilot viewings, a participant in the survey and during a post survey research presentation. It is also important to note however, respondents who received some form of information in general (list or video) rated four images depicting sustainable practices significantly more desirable and one image depicting an unsustainable strategy significantly less desirable.

The majority of respondents reported support for spending money on roadside enhancements and environmental concerns were rated as the most important factor in roadside management decisions as compared to aesthetics and cost. So, respondents want DOT's to spend money on the roadside to implement sustainable landscape practices that steward state land held for rights-of-way.

Implications

Recent budget cuts, climbing oil prices and an increased demand for sustainability have caused many DOT's to re-evaluate their management and operation procedures. Efficient management and responsible stewardship of Delaware's 10,000 acres of roadside right-of-way challenges the Delaware Department of Transportation to continue their shift from conventional practices to a more sustainable strategy. Altering these practices may require a paradigm shift for those involved with planning and

maintaining the roadsides as well as the stakeholders who utilize the roadways. Inherent values present in sustainable landscapes are often not visible to the naked eye, and communication of such values may be necessary to secure public acceptance of sustainable landscapes (Thayer, 1989).

Public acceptance of alternate strategies can be challenging, but is a critical component to the continued success of environmentally responsible, economically conservative and aesthetically pleasing rights-of-way management decisions. In the wake of public criticism, DOT's frequently revert to traditional regimes in order to placate public concerns. One reason sustainable landscapes have been slow to gain public support may be a deficiency of public knowledge about the issue. Lacking an awareness of the expense and perils that result from an unsustainable management strategy, many Delawareans unwittingly allow and expect DelDOT to continue on an expensive and unsustainable path of management. Fishbein shows attitudes are more susceptible to being changed if the original attitude is not central to the core belief system of the individual (Fishbein, 1967). This research indicates the public's attitudes about mown turf may not be central to their core beliefs since perceptions were readily changed after receiving a brief educational intervention. Since roadsides offer harsh and difficult conditions in which to grow, and regionally appropriate plants often take longer to establish than turf, education is essential to inform the public of the intrinsic values present in sustainable landscapes and to keep the public abreast of the process as plants evolve into their attractive and mature state (Harper-Lore 1998a).

The implications of this research relates to a greater understanding between public perception and sustainably managed landscapes. Research has shown the public notices the roadside landscape and their opinions as stakeholders influence the manner in which the roadsides are maintained (Roumillat, Personal Communication 2009; Rosan, Personal Communication 2009; Barton, 2005; Akbar et al, 2002). These results will provide DelDOT with accurate information about public perception of alternate strategies to help guide their planning, design and maintenance strategies, in addition to providing them with the tools necessary to defend their operating strategies when criticisms arise.

The results of this study need not be exclusive to roadsides and may be applied to a variety of landscapes including, but not limited to, business parks, corporate campuses, commercial development, and areas where large amounts of land have been disturbed for development. Contributions provided by the restoration of disturbed landscapes, in time, could work to ameliorate or arrest a host of undesirable economic, environmental and aesthetic situations. Informing employees and other stakeholders about sustainable approaches in the repair of these lands may contribute to an increase in public acceptance and support. An appreciation for environmentally responsible landscaping in public spaces may even translate into a new aesthetic that can be applied to home landscapes.

Future research into the long-term effects of an informational intervention on public perception of sustainable roadside vegetation management strategies, including a three-week post-test, could help determine if improved perceptions indicate a true paradigm shift among participants. Additional research could also investigate the influence of information on those responsible for the planning, design and maintenance of roadside rights-of-way in order to investigate whether knowledge of benefits provided by sustainably managed roadsides affects the planning design and maintenance process.

APPENDIX A-STATEWIDE MOWING REPORT

DelDOT

Statewide Mowing Report - Between Jan 1 2008 and Dec 31 2008

District	Area	Job Description			Qty Acc	Unit Acc	Labor Costs	Total Hrs	Material Costs	FEMA Tool Cost	Base Total Cost	Cost per Acre
CANAL	09	1100.1-Mowing - roadside, median, etc. - Machine Cut			2,434.00	Acres	$ 150,704.78	4,998.50	$ -	$ 69,453.16	$ 220,157.94	
	10	1100.1-Mowing - roadside, median, etc. - Machine Cut			2,785.70	Acres	$ 231,212.81	7,668.75	$ 0.56	$ 143,091.23	$ 374,304.60	
	10	1100.2-Mowing - roadside, median, etc. - Hand Cut			8.30	Acres	$ 3,210.98	106.50	$ -	$ 1,997.37	$ 5,208.35	
	10	1100.3-Mowing - Isolated Locations	1.00	Each	6.00	Acres(1)	$ 180.90	6.00	$ -	$ 20.52	$ 201.42	
	22	1100.1-Mowing - roadside, median, etc. - Machine Cut			1,451.50	Acres	$ 124,670.25	4,135.00	$ 5,005.10	$ 64,518.47	$ 194,193.81	
	22	1100.2-Mowing - roadside, median, etc. - Hand Cut			137.00	Acres	$ 21,127.61	700.75	$ 125.12	$ 8,294.72	$ 29,547.45	
	22	1100.3-Mowing - Isolated Locations	61.00	Each	576.00	Acres(1)	$ 17,366.40	576.00	$ 1,377.34	$ 7,716.60	$ 26,460.34	
	22	1100.4-Mowing - Boom Mower Grass Cutting	102,000.00	Feet	11.71	Acres(2)	$ 34,649.89	1,149.25	$ (1,215.26)	$ 14,891.57	$ 48,326.19	
		1100.1-Mowing - roadside, median, etc. - Machine Cut			700.06	Acres	$ 33,285.60	1,104.00	$ -	$ 17,784.95	$ 51,070.55	
District : CANAL					**8110.27**		**$ 616,409.21**	**$ 20,444.75**	**$ 5,292.86**	**$ 327,768.58**	**$ 949,470.65**	**$ 117.07**
CENTRAL	06	1100.1-Mowing - roadside, median, etc. - Machine Cut			4,270.44	Acres	$ 91,867.05	3,047.00	$ -	$ 30,959.00	$ 122,826.05	
	06	1100.4-Mowing - Boom Mower Grass Cutting	38,931.00	Feet	4.47	Acres	$ 1,597.95	53.00	$ -	$ 505.40	$ 2,103.35	
	07	1100.1-Mowing - roadside, median, etc. - Machine Cut			3,452.59	Acres	$ 123,479.32	4,095.50	$ -	$ 36,975.30	$ 160,454.62	
	08	1100.1-Mowing - roadside, median, etc. - Machine Cut			3,008.94	Acres	$ 136,594.58	4,530.50	$ -	$ 50,319.09	$ 186,913.67	
	08	1100.2-Mowing - roadside, median, etc. - Hand Cut			13.00	Acres	$ 4,688.33	155.50	$ -	$ 2,347.50	$ 7,035.83	
	08	1100.3-Mowing - Isolated Locations	36.00	Each	45.00	Acres(1)	$ 1,356.75	45.00	$ -	$ 483.23	$ 1,839.98	
	08	1100.4-Mowing - Boom Mower Grass Cutting	11,750.00	Feet	1.35	Acres(2)	$ 4,673.25	155.00	$ -	$ 914.94	$ 5,588.19	
	21	1100.1-Mowing - roadside, median, etc. - Machine Cut			2,189.75	Acres	$ 55,943.33	1,855.50	$ 0.15	$ 25,561.32	$ 81,504.79	
	21	1100.2-Mowing - roadside, median, etc. - Hand Cut			4.25	Acres	$ 2,396.93	79.50	$ -	$ 380.06	$ 2,776.99	
	30	1100.1-Mowing - roadside, median, etc. - Machine Cut			241.00	Acres	$ 14,494.61	480.75	$ -	$ 8,049.79	$ 22,544.40	
	30	1100.3-Mowing - Isolated Locations	253.00	Each	909.50	Acres(1)	$ 27,421.43	909.50	$ 0.45	$ 14,084.71	$ 41,506.58	
	8	1100.1-Mowing - roadside, median, etc. - Machine Cut			49.50	Acres	$ 2,035.13	67.50	$ -	$ 733.28	$ 2,768.40	
		1100.1-Mowing - roadside, median, etc. - Machine Cut			280.42	Acres	$ 11,577.60	384.00	$ -	$ 3,551.29	$ 15,128.89	
District : CENTRAL					**14,470.21**		**$ 478,126.24**	**15,858.25**	**$ 0.60**	**$ 174,864.88**	**$ 652,991.72**	**$ 45.13**
NORTH	11	1100.1-Mowing - roadside, median, etc. - Machine Cut			918.73	Acres	$ 67,038.52	2,223.50	$ -	$ 21,793.39	$ 88,831.91	
	11	1100.2-Mowing - roadside, median, etc. - Hand Cut			18.00	Acres	$ 1,809.00	60.00	$ -	$ 866.25	$ 2,675.25	
	11	1100.3-Mowing - Isolated Locations	517.50	Each	614.50	Acres(1)	$ 18,527.18	614.50	$ 27.96	$ 8,188.11	$ 26,743.25	
	11	1100.4-Mowing - Boom Mower Grass Cutting	5,822.00	Feet	0.67	Acres(2)	$ 2,487.38	82.50	$ -	$ 1,250.25	$ 3,737.63	
	12	1100.1-Mowing - roadside, median, etc. - Machine Cut			865.60	Acres	$ 89,666.10	2,974.00	$ -	$ 33,103.66	$ 122,769.76	
	12	1100.2-Mowing - roadside, median, etc. - Hand Cut			4.25	Acres	$ 3,648.15	121.00	$ -	$ 1,449.36	$ 5,097.51	
	12	1100.3-Mowing - Isolated Locations	3.00	Each	49.00	Acres(1)	$ 1,477.35	49.00	$ -	$ 281.76	$ 1,759.11	
	13	1100.2-Mowing - roadside, median, etc. - Hand Cut			3.50	Acres	$ 4,296.38	142.50	$ -	$ 150.00	$ 4,446.38	
	13	1100.3-Mowing - Isolated Locations	301.00	Each	86.50	Acres(1)	$ 2,607.98	86.50	$ -	$ 320.00	$ 2,927.98	
	14	1100.3-Mowing - Isolated Locations	1.00	Each	7.50	Acres(1)	$ 226.13	7.50	$ -	$ 75.00	$ 301.13	
	14	1100.4-Mowing - Boom Mower Grass Cutting	50,244.00	Feet	5.77	Acres(2)	$ 6,060.15	201.00	$ -	$ 3,349.50	$ 9,409.65	
		1100.1-Mowing - roadside, median, etc. - Machine Cut			121.81	Acres	$ 3,391.88	112.50	$ -	$ 985.00	$ 4,376.88	
		1100.3-Mowing - Isolated Locations	40.00	Each			$ 678.38	22.50	$ -	$ 225.00	$ 903.38	
District : NORTH					**2,695.83**		**$ 201,914.55**	**6,697.00**	**$ 27.96**	**$ 72,037.28**	**$ 273,979.79**	**$ 101.63**
SOUTH	01	1100.1-Mowing - roadside, median, etc. - Machine Cut			3,879.10	Acres	$ 133,006.73	4,411.50	$ -	$ 44,847.72	$ 177,854.45	
	01	1100.2-Mowing - roadside, median, etc. - Hand Cut			2,481.80	Acres	$ 19,891.46	659.75	$ -	$ 6,739.79	$ 26,631.25	
	02	1100.1-Mowing - roadside, median, etc. - Machine Cut			5,730.04	Acres	$ 119,000.54	3,946.95	$ -	$ 38,898.49	$ 157,899.03	
	02	1100.4-Mowing - Boom Mower Grass Cutting	64,400.00	Feet	7.39	Acres(2)	$ 9,904.28	328.50	$ -	$ 4,070.00	$ 13,974.28	
	03	1100.1-Mowing - roadside, median, etc. - Machine Cut			2,743.40	Acres	$ 160,043.74	5,308.25	$ -	$ 46,848.77	$ 206,892.50	
	03	1100.3-Mowing - Isolated Locations	2.00	Each	7.00	Acres(1)	$ 211.05	7.00	$ -	$ 70.88	$ 281.93	
	03	1100.4-Mowing - Boom Mower Grass Cutting	2,921.00	Feet	0.34	Acres(2)	$ 2,894.40	96.00	$ -	$ 440.88	$ 3,335.28	
	04	1100.1-Mowing - roadside, median, etc. - Machine Cut			6,033.49	Acres	$ 102,298.95	3,393.00	$ -	$ 35,206.21	$ 137,505.16	
	05	1100.1-Mowing - roadside, median, etc. - Machine Cut			4,552.53	Acres	$ 128,227.95	4,253.00	$ -	$ 40,854.03	$ 169,081.98	
	20	1100.3-Mowing - Isolated Locations	925.00	Each	1,920.75	Acres(1)	$ 57,910.61	1,920.75	$ -	$ 31,757.03	$ 89,667.64	
		1100.1-Mowing - roadside, median, etc. - Machine Cut			24.20	Acres	$ 829.13	27.50	$ -	$ 264.00	$ 1,093.13	
District : SOUTH					**27,380.04**		**$ 734,218.83**	**24,352.20**	**$ -**	**$ 249,997.77**	**$ 984,216.60**	**$ 35.95**
Report Totals :					**52,656.34**		**$ 2,030,668.83**	**67,352.20**	**$ 5,321.42**	**$ 824,668.51**	**$ 2,860,658.75**	**$ 54.33**

NOTES:

(1) Calculated at 1 acre per hour

(2) Calculated assuming 5' mower swath

Calendar 2008 Contract Mowing Costs

		$/Cycle	$/3-cycles	Cost Reduction
North	$ 42,394.00	$ 10,598.50		$ 42,394.00
Canal	43,800.00	$ 10,950.00		$ 43,800.00
Central	189,285.00	$ 47,321.25	$ 141,963.75	$ 47,321.25
South	326,275.00	$ 81,568.75	$ 244,706.25	$ 81,568.75
	$ 601,754.00		$ 386,670.00	$ 215,084.00

APPENDIX B-SURVEY

Thank you for taking time from your day to complete this survey**. Your voice is an important contribution** to help DelDOT manage and maintain their roadsides in the most cost effective and environmentally sensitive manner, while revealing Delaware's natural beauty. Please keep in mind this survey is targeting roadside vegetation only and not the roads themselves.

Your contribution is also helping a graduate student at the University of Delaware conduct the necessary research to produce a thesis and obtain a masters degree.

Please be assured that all personal and demographic information will be kept anonymous. Nothing will be released in reference to a person's name or e-mail address.

If you have any questions about this survey, please e-mail Anne Lucey at aklucey@udel.edu.

There are many different ideas about how roadsides should be maintained. People often have different opinions about economic, environmental and aesthetic importance. Please view each of the following images a driver might see while passing through Delaware and rate each for their desirability on a scale of 1-10, with 1 being the least desirable and 10 being the most desirable. Please feel free to add comments on a scene or explain your response

(Thumbnails of images)

.

DESIRABLE **UNDESIRABLE**

1 2 3 4 5 6 7 8 9 10

Comments:

DESIRABLE **UNDESIRABLE**

1 2 3 4 5 6 7 8 9 10

Comments:

ADDITIONAL QUESTIONS

Did the information you just received influence your judgment of the photos?

Not influenced Strongly influenced

1 2 3 4 5 6 7 8 9 10

Are you concerned about the current state of the environment?

___Not at all concerned

___Mildly concerned

___Concerned

___Strongly concerned

How much time is spent maintaining your lawn each week?

___None

___Less than 1 hour

___1-3 hours

___More than 3 hours

How much time do you spend maintaining a garden each week?

___None

___Less than 3 hours

___3-6 hours

___More than 6 hours

Do you recycle?

___Yes

(if yes) ___Because I feel it is the right thing to do

___Because it is mandatory

___No

While DelDOT's highest priority is to provide and maintain a safe and reliable road system, roadside enhancement is also an objective. Do you believe that departments of transportation should spend money on enhancing their roadsides?

___Strongly disagree

___Disagree

___Agree

___Strongly agree

There are numerous factors that influence the way departments of transportation manage roadsides including: cost effectiveness, environmental stewardship and aesthetics. Which of these factors is most important to you? Please order the following with 1 being the most important attribute and 3 being the least important.

___Cost effectiveness

___Environmental stewardship

___Beauty

Do you feel that DelDOT does a good job keeping roadsides vegetation in Delaware attractively maintained?

___Yes

___No

___Don't know

Approximately how much time do you spend in a car each week?

___Less than 2 hours

___More than 2 hours and less than 4 hours

___More than 4 hours and less than 6 hours

___6 hours or more

(For those who got the educational piece)

Do you think the information you have received in this survey has had an effect on the way you see the roadsides?

___Yes

___No

DEMOGRAPHIC INFORMATION

Please check the appropriate response.

1. Your Sex:

___Male

___Female

2. Date of Birth _____

3. Do you live in DE?

___Yes

___No

4. What is the highest level of schooling completed? Check **ONE** for the highest level completed or degree received. If currently enrolled in school, check the level of previous grade completed or highest degree received.

___Did not complete high school

___High school graduate or equivalent degree

___Some college but no degree

___College degree (associates or bachelors)

___Post college advanced degree

5. What is your approximate household income last year (before taxes)?

___Less than $25,000

___$25,000-$49,999

___$50,000-$74,999

___$75,000-$124,999

___$125,000 or more

APPENDIX C-INTERNET LINK TO RESPONDENTS COMMENTS

http://dl.dropbox.com/u/9839612/Treatment-Response%20Spdsht2.xls

APPENDIX D-INTERNET LINK TO VIDEO

http://dl.dropbox.com/u/9839612/final3.mp4

APPENDIX E-HUMAN SUBJECTS REVIEW BOARD APPROVAL

Certification of Human Subjects Training

The University of Delaware certifies that Anne Lucey
(Name of researcher)

attended an institutional training session on the use of human subjects in research on

November 19, 2009.
(Date)

The session included the following topics:

- The Belmont Report
- Federal regulations for using humans in research (45 CFR 46)
- The University's Federalwide Assurance
- Informed consent
- Institutional procedures
- Sources for additional information.

Elizabeth Duggins Peloso
Director of Compliance

Research Office
University of Delaware
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