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# **The Ecosystem Services of Residential Landscapes: A Delaware Study Site**

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# The Ecosystem Services of Residential Landscapes: A Delaware Study Site

## 1. Executive Summary

This report describes research on a sustainable landscape intervention in Delaware that altered a residential landscape in order to enhance ecosystem services. This intervention was termed, “contemporary” landscaping. Data were collected on installation and management costs and a survey of perceived impacts to off-site residents was conducted.

The landscape intervention occurred in the suburban “Applecross” development in northern New Castle County, Delaware. The affluent neighborhood has houses with large yards on lots of about 1.2 acres. The intervention sought to apply recent scientific advances to enhance ecosystem services, especially water quality protection.

The intervention consisted of reducing the lawn space from 98% of the yard to less than 50%. Native plants and various types of land cover were introduced, including a constructed forested area and separate meadow. With this landscape intervention came many ecosystem services including:

- Water quantity and quality improvements;
- Aesthetic changes; and
- Expanded habitats.

The intervention cost approximately \$32,000 to establish. Though high, this cost aligns with landscaping costs in similar affluent neighborhoods.

An intercept survey of non-neighboring Delaware residents was conducted to understand public preferences for this type of intervention, particularly the off-site received costs and benefits of the altered ecosystem services. An additional, small survey was conducted with neighbors.

The survey data show a majority of the ecosystem service changes were perceived to have a positive impact on people’s quality of life, though some had a negative or no effect. The most important impacts were found to be:

- Undesirable wildlife might be present (negative);
- Better flood control (positive); and
- Better water quality (positive).

The neighbors’ survey had an inadequately small sample, but generally matched the results of the other Delaware residents.

In sum, the research shows that contemporary landscapes may possibly increase social welfare, but high establishment costs will preclude many landowners from adoption. Further valuation research is needed to determine benefits and cost estimates.

The research suggests that even though contemporary landscapes are not prevalent, it may not be due to preference for traditional yards with extensive lawn space. Rather, there may be a mismatch between public benefits and landowner costs.

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## 2. Purpose of Study

Residential landowners substantively affect water quality and the provision of ecosystem services. Yet, residential landowners make land management decisions that are largely free from government regulations protecting water quality and other ecosystem service provision. This autonomy arises from historical norms and local laws that locate many on-parcel decisions firmly within the landowner decision space.

However, as scientists gain an increasing appreciation of the interconnectedness of ecosystems, autonomy comes at a cost. Economically, residential landowners are interdependent decision makers, who do not bear the full costs nor receive the full benefits of their actions. This means that activities that degrade ecosystem services will be oversupplied and those that enhance ecosystem services will be undersupplied. In short, there is a suboptimal, sustainable landscape allocation problem.

This report presents data from a study that seeks to understand better the interconnected web of residential ecosystems. There are three sets of results. First, this report describes the intervention, where a traditionally managed residential landscape was converted to a landscape with enhanced ecosystem services provision, termed a “contemporary landscape”. Data are reported on the intervention and the costs of this transformation.

Second, results are reported from a public preference survey. A random sample of

residents was surveyed about their preferences for this type of landscape transformation. As little research exists on public preferences for contemporary landscaping, this was largely exploratory research. Results reveal residents’ perceptions of the most important landscape attributes, thereby suggesting the residential ecosystem services that are most interdependent.

A third set of results concern preferences among the neighbors for the landscape transformation. Only a few neighbors responded to the survey, so these data are highly incomplete.

These three sets of results are presented in turn. Before presenting the research results, however, the next section will review the history of the site (termed parcel X) followed by an explanation of the intervention that was conducted on parcel X.

## 3. History of Site

The Applecross development in Wilmington, Delaware, was largely undeveloped as of 1992 (Figure 1), with only two older houses present.



Figure 1 Aerial View of Applecross Area  
(March 15, 1992)



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#### 4. Property Data

Within the neighborhood, the majority of the lots are relatively large in size, and the houses were built between 2005 and 2008. There are 24 lots in the neighborhood including houses on Great Barn Lane, Paired Oaks Lane, and North and South Ashview Lane (Figure 4).

Where sale data was available, the houses have been sold for an average price of about \$2 million. Table 1 provides lot sizes, the year the houses were last sold, and the year the houses were constructed.

The pin in Figure 4 shows the lot where the landscape intervention was conducted.

In Applecross, the average lot size is 1.22 acres, allowing for large houses to be built with an average square footage of 7,337.5. With the exception of the two properties that were built in 1802 and 1938, the average year the houses were built is 2006 and the average date sold was the beginning of 2008.

Of the 23 properties in the neighborhood, sales data were available for only 12 of the lots. The average price in the Applecross neighborhood is \$2,352,783.



Figure 4 Aerial View of Neighborhood

Table 1: Parcel Data for the 24 Lots in the Applecross Development

Property	Year Built	Date of Sale	Lot Size	Square Footage
1	1802	Jan 5, 2006	3.04	8625
2	1938	Dec 21, 2010	3.55	2400
3	2007	Jun 29, 2007	1.07	6675
4	2005	Apr 12, 2005	1.01	6450
5	2005	Jul 16, 2012	1.00	4525
6	2009	Jan 5, 2010	1.01	7575
7	2006	Jul 11, 2006	1.09	7175
8	2006	Apr 17, 2006	1.00	6050
9	2005	Sep 30, 2005	1.01	9750
10	2005	Sep 14, 2011	1.09	8575
11, parcel X	2006	Apr 28, 2006	1.07	6275
12	2006	Nov 17, 2006	1.00	7375
13	2008	Sep 2, 2008	1.00	9725
14	2007	Sep 28, 2007	1.03	8575
15	2007	Apr 3, 2009	1.06	7775
16	2007	Jun 26, 2010	1.00	8275
17	2005	Dec 19, 2005	1.00	7375
18	2006	Nov 8, 2007	1.02	8650
19	2006	May 30, 2006	1.01	7725
20	2006	Jan 31, 2007	1.09	8575
21	2007	Dec 7, 2007	1.07	6725
22	2008	Nov 14, 2012	1.00	5850
23	2008	Feb 29, 2008	1.00	8025
24	2006	Jan 30, 2006	1.00	7375

Table 2: Available Sales Data for 12 Lots in the Applecross Development

Sale Amount	Sale Amount
\$1,815,000.00	\$3,926,924.00
\$2,206,291.92	\$1,750,000.00
\$2,139,808.54	\$2,626,581.00
\$2,496,981.93	\$2,061,289.13
\$2,126,068.57	\$2,360,002.00
\$2,324,454.06	\$2,400,000.00



Table 3: Census Data Comparing Site's Block to Tract, Zip Code, County, State, and U.S.

	<b>Block (1010)</b>	<b>Tract (118)</b>	<b>Zip (19807)</b>	<b>County (New Castle)</b>	<b>State (DE)</b>	<b>U.S.</b>
<b>Population</b>	167	4,177	7,405	546,076	917,092	316,316,726
<b>Mean Income (HH)</b>		\$249,290	\$256,119	\$83,725	\$76,889	\$72,555
<b>Houses with 5 or more bedrooms (%)</b>		37.7	21.8	4.3	4.3	4.1
<b>Houses with 9 or more rooms (%)</b>		16.7	48.6	18.3	15.3	10.1
<b>Median Housing Value</b>		\$740,300	\$751,000	\$254,400	\$244,100	\$186,200
<b>Houses Valued at \$1,000,000 or more (%)</b>		34.9	28.7	1.0	1.6	2.3

Table 3 suggests that the large houses and lots in Applecross are common for the area in which it is located, but it is large when compared to other areas. The project site (parcel X) has 5 bedrooms and 12 rooms, which is similar to the Tract and zip code in which the site is located. Over 37% of the houses in the Tract have 5 or more bedrooms compared to 4.3% in the state.

More than 34% and 28% of the houses in the Census tract and zip code, respectively, are valued over \$1,000,000. However, as with the size of the house, when compared to the county and state this figure is unusually large, as only 1% and 1.6% of houses in the county and state, respectively, are valued at or above \$1,000,000. The median housing values for the tract and zip code are much larger than the county, state, and the nation, re-enforcing the fact that such a large lot size and house is unusual.

Higher mean incomes correlate with the large houses and higher than average housing values. Table 3 shows that the *The Ecosystem Services of Residential Landscapes* Applied Economics and Statistics, University of Delaware

average household income of people in Tract 118, where the site is located, is \$249,290, which is approximately \$172,000 more than the state average and \$177,000 more than the national average.

## 5. The Intervention

Located in the Brandywine Creek sub-watershed of the Delaware Bay Watershed, the study site herein called “Applecross” comprises 1.2 acres as shown in Figures 5 and 6.

As can be seen in Figure 5 and 6, over half of the pre-intervention 1.2-acre lot was covered in turf grass. Approximately 98% of its plantable space was lawn with a few trees, shrubs, and ground covers. Despite the few trees in two corners of the property and the shrubs and perennials in the foundation planting along the house, there was little tree cover or shrubs in the plantable space. There was little plant diversity and few native species, providing minimal habitat for animals.



Figure 5: Front Yard Before Project



Figure 6 Site from Above Before Project





Figure 7 View of Neighbor A from Above



Figure 8 View of Neighbor B from Above



Figure 9 View of Neighbor C from Above



Figure 10 View of Neighbor D from Above

This landscape was designed to have water flow from the high point at the road across the property to the stream that runs at the back of the lot. But, grading problems have resulted in poor water drainage. The primary vegetation, mowed lawn, is not able to take up the excess water and puddling occurs on site. This type of landscape practice, primarily mowed turf with few native plants, provides minimal ecosystem services.

Within the neighborhood, a majority of the lots have similar landscape patterns with low plant diversity and large expanses of lawn. Figures 7, 8, 9 and 10 show neighboring lots of the study site.

In 2012, parcel X became the site for a contemporary management landscape project (Figures 11, 12, 13, 14). Parcel X is a demonstration project designed and installed by researchers and students at the University of Delaware. It displays sustainable practices that reduce lawn area to 50% of the site while maintaining enough lawn for circulation, play and entertaining.

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One of the goals was to diversify plants by 100% (in actuality, plant diversity was increased by 500%). The landscape includes a 6,000 square foot meadow and 3,000 square foot reforestation area. Turf paths wind through the meadow and landscape beds, connecting relatively large areas of lawn. Planted landscape beds are helping control storm water runoff and increasing percolation.

During the landscape project many ecosystem services were introduced.<sup>1</sup> Approximately ten research months were spent interviewing residents to determine how to describe best these changes to the landscape in understandable ways:

1. Better flood control (water infiltration) – Plants were installed to slow water movement as it flowed from the high point of the site at the roadway to the low point at the back of the property. At the end of the driveway an area (approximately 200 square feet) surrounding a grove of newly planted sassafras trees was mowed every 6-8 weeks allowing taller grass to slow water movement off the driveway.
2. Better water quality on site (water infiltration) – Because water movement is slowed with strategic plantings, more

water is able to infiltrate, allowing natural cleansing of water by the soil system. Less runoff means less erosion and fewer particulates and pollutants entering the stream at the back of the site approximately 200 feet from the property line.

3. More plant diversity for wildlife – By adding 59 new species of plants, greater diversity was provided for wildlife. Specifically, fruiting plants (*Vaccinium corybosum*, *Ilex verticillata*, *Lindera benzoin*, *Viburnum nudum*) were planted for birds. *Asclepias* species were planted to attract Monarch butterflies.
4. More opportunities to move indoor activities outside – A circular area of lawn was maintained inside the meadow to provide a secluded seating area. Landscape beds surround other lawn areas to provide a sense of place, enclosure and to encourage both play and gathering in the landscape.
5. More opportunities to wander through and enjoy the garden – Pathways were created in the meadow and through landscape beds to promote strolling and enjoyment of the garden.
6. Less energy used due to shaded buildings – Trees were planted in landscape beds throughout the property. Eventually, those trees will provide shade on the house to reduce cooling needs in the summer months while allowing sun in during the winter

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<sup>1</sup>See for instance, B Behe, J Hardy, S Barton, J Brooker, T Fernandez, C Hall, J Hicks, R Hinson, P Knight, R Mcniel, T Page, B Rowe, C Safley, R Schutzki 2005.

**Landscape Plant Material, Size, and Design  
Sophistication Increase Perceived Home Value,**  
Journal of Environmental Horticulture 10/2005;  
23:127-133.

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Applied Economics and Statistics, University of Delaware

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months to reduce heating costs.

7. Fewer chemicals used – Lawn fertilization was reduced to one application per year in the fall. Hand weeding was used to control weeds initially in landscape beds until plants grow together to form ground covers and reduce the need for weeding, thus reducing the use of chemical weed control.
8. Less pollution from mowing smaller lawn – The lawn area was reduced by half, resulting in half the emissions of lawn mowing.
9. Less time spent mowing – The reduced lawn size resulted in half the time spent in lawn mowing.
10. Higher curb appeal – The added plantings (59 species planted) resulted in a complex landscape, increasing overall curb appeal for the home.
11. Potential property value increases – Property value increases due to having a complex landscape (research shows an average increase of 8% with sophisticated landscaping).
12. No hardwood mulch needed – Onsite leaf clippings and purchased leaf mulch were used for the landscape mulch. The mulch has been replenished three times on this site. Ultimately, the trees should provide enough leaves to reduce the need to purchase mulch. Leaf mulch can be generated on site and add valuable

nutrients back into the soil.

13. No sheering of plants required, just minimal pruning – Landscape plants were chosen for the size and shape appropriate to the space in which they were planted. There should be no sheering of plants required.



Figure 11 Front Yard, Adding More Plants



Figure 12 Back Yard Meadow During Installation





Figure 13 South Side of the House, Creating a Pathway Surrounded by New Plants



Figure 14 Forested Area Being Planted in the Back Yard

When the project was completed, the lawn was reduced by half, allowing for plant quantity and diversity to increase. More birds, insects and other wildlife are present and there is little or no puddling of water. A meadow and forested area were created in the back yard, while more plants were added to the landscape in the front and at the sides of the lot (Figures 15, 16, 17, 18 and 19).

However, with this new type of landscape and increased ecosystem services, there were shortcomings, such as:

1. Greater initial cost of establishment – Total installation cost of this project was approximately \$32,000. This is a relatively low number considering it is 1.36% of the average home price for this community. But, it does represent an additional expenditure that many homeowners are not prepared to undertake.
2. Takes time to become established – Any new landscape takes time to grow in and look established. A newly planted meadow may take as long as three years before it is stable and relatively weed-free. Shrubs are planted far enough apart that when they grow to mature size they will touch but not be too overgrown. Trees will eventually provide shade at this site, but are now too small to do much shading in relation to the size of the house.
3. More weeding initially until plants cover the ground – Exposing the soil and creating planting beds increases the potential for weeds in the landscape. Initially, hand weeding is required and represents additional maintenance until eventually shrubs and groundcovers grow together to cover the ground surface and reduce the weed potential. Close to \$5,000 was spent on maintenance during the first year after planting and most of that involved

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weeding and spreading mulch, both activities associated with controlling weeds.

pruning. Another expense comes from trees, which have long-term costs associated with their overall health.

4. Undesirable wildlife might be present – By increasing habitat, undesirable wildlife such as snakes, rodents, bees (although very important as pollinators), and deer may be present and visible.
5. Looks different from neighbors' lawns – By incorporating a meadow, forest and thickly planted landscape beds, this landscape looks different from the surrounding residential landscapes in the neighborhood. This may be deemed undesirable when there is pressure to conform to an established aesthetic.
6. Contemporary landscape will appear less managed – This type of landscape is less formal, with fewer pruned plants and results in a more naturalistic appearance. This may be perceived as unmanaged.
7. Education required for proper management – Fertilization in the fall only, recycling of grass clippings and fallen leaves, naturalistic pruning and identifying plants for hand weeding are all strategies that require education in order to properly maintain this type of landscape.
8. Long-term tree care required – Trees provide many benefits to the landscape but they also introduce potential maintenance costs. Trees may require
9. Leaves must be managed as they may blow out of beds until trees are fully grown – Trees shed leaves yearly that must be raked. Those leaves can be recycled and used as a resource on site. Ultimately leaves can be allowed to fall into large landscape beds and will be held in place by the shrub and perennial structure present in the bed. Until plants grow large enough though, leaves must be raked and shredded to prevent their accumulation in the lawn areas.
10. Less lawn for sports – By removing half the lawn area, there is less remaining lawn area for sports on this property. The landscape was designed to have contiguous lawn areas in the front and back yard to minimize this problem, but some people may perceive that there is not enough remaining lawn for recreation.





Figure 15 View of Lot from Front After the Project with More Plants



Figure 18 Meadow in the Back Yard



Figure 16 Forested Area in Back Yard



Figure 19 North Side of Yard with More Trees and Plants



Figure 17 Side Pathway with More Plants



## 6. Costs

Table 4 summarizes the installation and maintenance costs of the intervention. The project began in 2012, so the installation costs

reflect the prices of 2012, while the maintenance costs were the cost to maintain the sustainable landscape in 2013.

Table 4: Installation and Maintenance Costs of the Intervention

	Hours	Establishment Costs	Hours	Maintenance Costs
<b>Plant Materials</b>		\$13,727.13		\$1,161.63
<b>Labor</b>	295	\$3,669.80	230.1	\$2,862.44
<b>Subcontractor costs</b>	185.5	\$8,044.25		
<b>Equipment</b>		\$113.11		
<b>Supplies</b>		\$535.34		
<b>Multipliers</b>		**		x1.72*
<b>Total Costs</b>		\$31,931.86**		\$6,921.41*

\*Includes mark up of 1.72 calculated based on job costs = 58% total revenue; 32% overhead; and 10% profit on materials, labor, equipment and supplies

\*\*Includes mark up of 1.72 and 10% profit on subcontractor costs

Between February 1, 2012, and April 17, 2013, 89 hours of volunteer work were conducted, but these hours were entered as costs as if they were paid.

The total cost of the entire project from installation in 2012 cost \$31,932 and the maintenance in 2013 cost \$6,921.

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## 7. Public Preference Survey

The cumulative water quality and ecosystem service impacts of numerous residential decisions are likely significant. However, current policy has no solutions to offer and little research exists to inform the impacts of these decisions. Despite these challenges, a relatively simple policy could incentivize more sustainable practices. This project seeks to explore preferences to identify key preference drivers, which would be needed in designing any policy to enhance ecosystem service provision.

Real benefits and costs will accrue to neighbors from any marginal change in ecosystem services. The actual landscape change on the parcel X parcel is modest in that it was designed to be a demonstration project on a single parcel. However, the ecosystem service changes are real.

The hypotheses in this research involve examining public preferences to determine if these quality changes are perceived to be benefits, costs, or not to affect households in Delaware. Preference heterogeneity among residents is also explored.

Over approximately 10 months, the survey was designed by a systematic study of the potential set of ecosystem service impacts from the scientific literature. Then, interviews were conducted with residents about their understanding of these changes and to react to preliminary versions of the survey. Of particular importance was using nonscientific language that most residents would understand in a survey.

### *Protocol*

The survey was conducted from July 8<sup>th</sup> to July 15<sup>th</sup> 2013 at the New Castle Department of Motor Vehicles (DMV) and at the Greater Wilmington DMV, both in New Castle County (see Appendix 1 for the survey instrument). A team of 4-10 enumerators, wearing University of Delaware apparel, was present at the DMVs to conduct the survey. The team also used a sign and poster displaying information about the landscape transformation. The enumerators did not collect—and prevented efforts to reveal identifiable—information about the respondents. The University of Delaware Institutional Research Board approved the research protocol.

Respondents were selected randomly to participate. Each adult who entered the DMV was approached as a likely participant, unless all the enumerators were busy conducting a survey when a person entered. Careful screening questions were asked to ensure the sample was random and represented as closely as possible the target population, which was New Castle County residents of at least 18 years.

If the person was of at least 18, an additional screening question was asked to determine whether the potential respondent came to the DMV to renew his or her driver's license. Driver's licenses were the randomizing mechanism used to sample the target population. Most individuals have licenses, but they renew typically based on their birthdays, which are randomly selected.

If the person approached did not fall into these categories, they were ineligible to participate in the survey. However, if a person self-selected, i.e., approached an enumerator seeking to complete a survey, but was not there to renew their driver's license, a notation of "NDL, S" was written on the top of their survey.

The participants that were part of the target population—and in turn decided that they were willing to participate in the survey—were then presented with information

of the landscape project using a poster with a list of pros and cons and which contained pictures of the site before and after the intervention. An informed consent form was given to the participants, which provided background information on the project.

The enumerators provided individualized guided surveys. Introductory material was presented verbally, and then the enumerator would either read the survey or let the respondent fill it out, answering questions and describing the sections.

Table 5: Survey Response Rate

	Male	Female	Total
<b>Participants</b>	<b>73</b>	<b>48</b>	<b>121</b>
<b>Refusals</b>	<b>126</b>	<b>76</b>	<b>202</b>
<b>Number Surveyed</b>	<b>199</b>	<b>124</b>	<b>323</b>
<b>Response Rate</b>	<b>36.7%</b>	<b>38.7%</b>	<b>37.5%</b>
<b>Self-Selectors</b>	<b>8</b>	<b>12</b>	<b>20</b>
<b>Percent Of Participants Self-Selecting</b>	<b>11.0%</b>	<b>25.0%</b>	<b>16.5%</b>
<b>Usable Surveys</b>	<b>60</b>	<b>45</b>	<b>105</b>

Approximately 323 people were approached at the DMV to participate in the survey with a total of 202 rejections, making a 37.5% response rate. The number of respondents was 121 people. These include the 105 participants that completed the survey fully and the 16 participants who had incomplete surveys or whose surveys were unusable.

The response rate for male and female participants were 36.7% and 38.7%, respectively. Twenty of the 121 participants were self-selectors who approached the enumerators to participate, so 16.5% of the respondents were self-selectors. However, unlike the respondents approached, there were more female participants who chose to self-select compared to male.

Table 6: Characteristics of Respondents

	Number of Participants	Percentage
<b>Visited Applecross</b>	26	24.76%
<b>Live in Brandywine Creek Watershed</b>	9	8.57%
<b>Live in Delaware Bay Watershed</b>	104	99.05%
<b>High School Level Education or Lower</b>	11	10.5%
<b>High School Graduate or Higher</b>	94	89.5%

	Minimum	Maximum	Average	Median
<b>Year of Birth</b>	1995	1934	1971.7	1976
<b>Age</b>	18	79	41.3	37
<b>Distance from Site (mm)</b>	3	124	38.7	32

Question 1 of the survey sorted respondents into (1) those who do not live in the neighborhood and have never visited; and (2) those who do not live in the neighborhood but have visited it. Of all 105 people who completed a survey, none lived in the Applecross neighborhood.

When respondents were asked to fill out demographic information, one of the questions involved circling their highest level of education.

“High School Level or Lower” included

people who reported "Some High School" and those who said "High School and/or G.E.D." “High School Graduate or Higher” included people who reported "Some College and/or Associate's Degree," "College" and "Post Graduate Work."

One of the options, “Post Grad Work,” caused confusion among respondents who may have mistook it to mean any form of employment after graduating high school, rather than meaning any education higher than a college degree. Due to this possibility of confusion, herein we dichotomize the education category.

## 8. Survey Results

### *Participants' Opinions on Various Landscape Impacts*

The respondents were given a list of the various impacts associated with the contemporary landscape management. For each impact, the respondent stated whether it was good, bad, neither good nor bad, or if they did not care about it for their household.

Unfortunately, this question proved difficult for some respondents to understand. Specifically, it was considered too abstract to consider these changes in a neighborhood so far from their residence. Some enumerators helped these respondents by asking them to consider their responses in terms of changes in their neighborhood. During a post-survey

analysis, it was determined that some responses about the intervention were framed as relating to a change in the respondent's neighborhood while others were framed as being on the subject property. Some respondents may have understood the survey to be asking about alterations to their own property. Appendix 2 offers a conceptual breakdown of the different ways respondents may have answered, based on how they framed the impacts.

For each impact the percentage of participants that stated the impact was good for their household was calculated.

Figure 20a-d, shows the various impacts and the percentage of respondents who selected good, bad, neither good nor bad or they did not care.

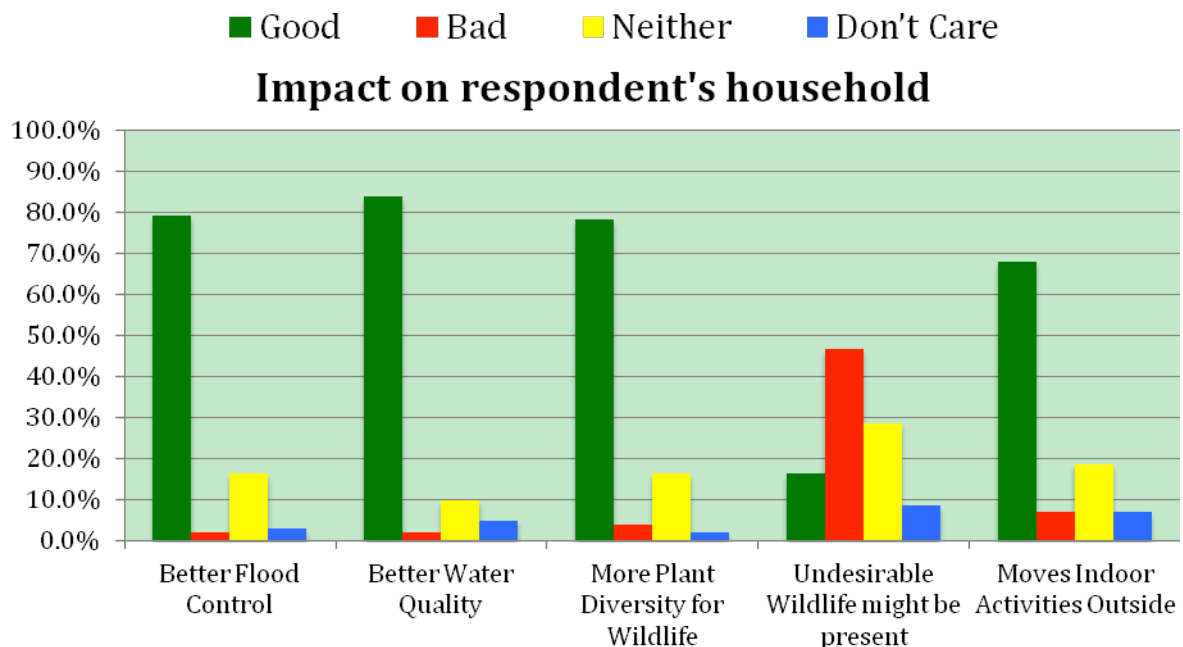


Figure 20a Respondents' Opinions of Various Impacts of the Contemporary Landscape Management on their Household

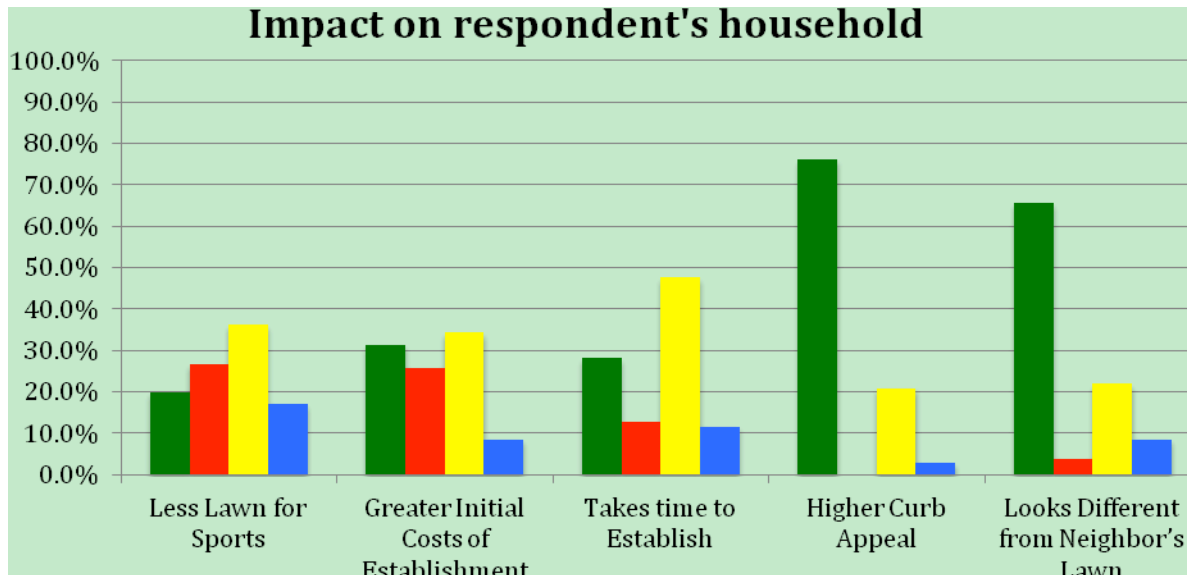


Figure 21b Respondents' Opinions of Various Impacts of the Contemporary Landscape Management on their Household

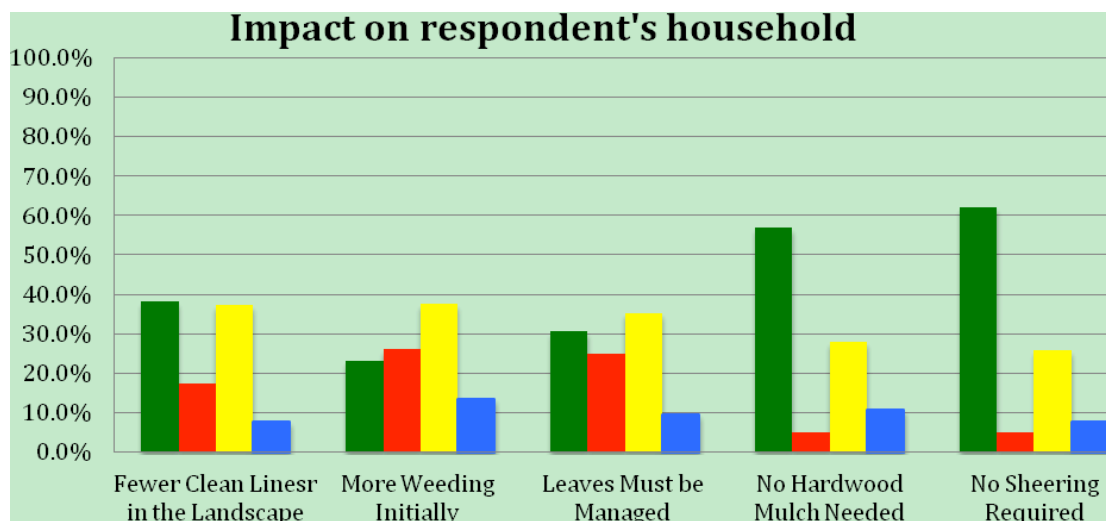


Figure 22c Respondents' Opinions of Various Impacts of the Contemporary Landscape Management on their Household

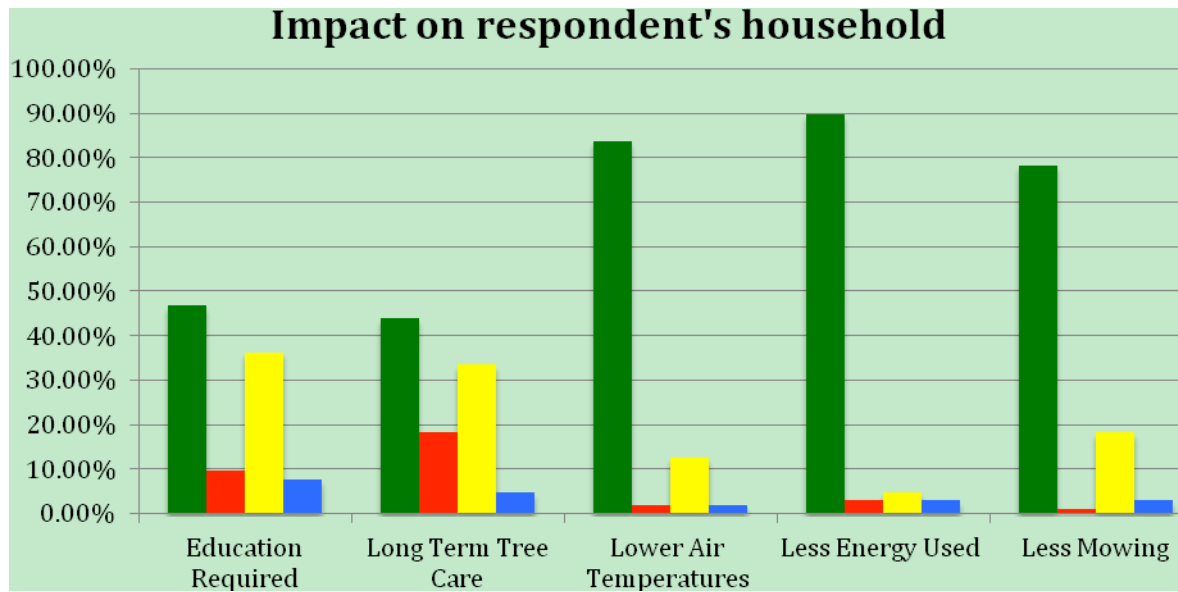


Figure 23d Respondents' Opinions of Various Impacts of the Contemporary Landscape Management on their Household

With the exception of a few impacts, respondents' opinions were extremely varied, making it difficult to determine whether the impact was viewed fully negatively or positively. Different levels of "Goodness" were created with different criteria and the various impacts that suited each criterion were grouped together. Table 7 shows the criteria for each level of "Goodness" and the various impacts that meet the criteria. There were five levels, Very Good, Good, Okay, Neither, and Bad. An impact was considered very good for their household if 70% of the respondents ranked it as good and less than 10% ranked it as bad.

An impact was "Good" if above 40% said the impact was good and less than 10% said it was bad. For "Okay" the difference between percentages for good and bad fell between 10% and 25%, with the percentage of people stating the impact was good being greater than bad. An impact was considered "Neither good nor bad" if the difference between the percentages of people who said the impact was good and the percentage that said the impact was bad was less than 10%. Lastly, an impact was "Bad" if more than 40% stated the impact was bad and less than 20% said it was good.

Table 7: Different Levels of “Goodness” and the Impacts that Meet the Criteria

<b>Very Good (&gt;70% good, &lt;10% bad)</b>	<b>Good (&gt;40% good, &lt;10% bad)</b>
Better Flood Control	Moves Indoor Activities Outside
Better Water Quality	Looks Different from Neighbor's Lawn
More Plant Diversity for Wildlife	No Hardwood Mulch Needed
Higher Curb Appeal	No Sheering Required
Lower Air Temperatures	Education Required
Less Energy Used	
Less Mowing	

<b>Okay (10%&lt;good-bad&lt;25%)</b>	<b>Neither ( good-bad  &lt; 10%)</b>	<b>Bad (&gt;40% bad, &lt;20% good)</b>
Takes Time to Establish	Less Lawn for Sports	Undesirable Wildlife
Fewer Clean Lines	Greater Initial Cost of Establishment	
Long Term Tree Care Required	More Weeding Initially	
	Leaves Must be Managed	

*How Respondents Ranked the Various Impacts (Beneficial or Undesirable)*

The respondents were asked to rank the top three most beneficial impacts of this landscape change to their quality of life, “1” being the most beneficial and “3” being the third most beneficial. The same was then done for the three most undesirable, with “3” being the third most undesirable. Those ranked third most beneficial or undesirable

were given 1 point, the second most beneficial or undesirable 2 points and the most beneficial or undesirable 3 points.

Figure 21 below shows the cumulative points of each impact for both beneficial and undesirable. Those impacts with the highest beneficial ratings had subsequently the lowest ratings for undesirability, and vice versa.



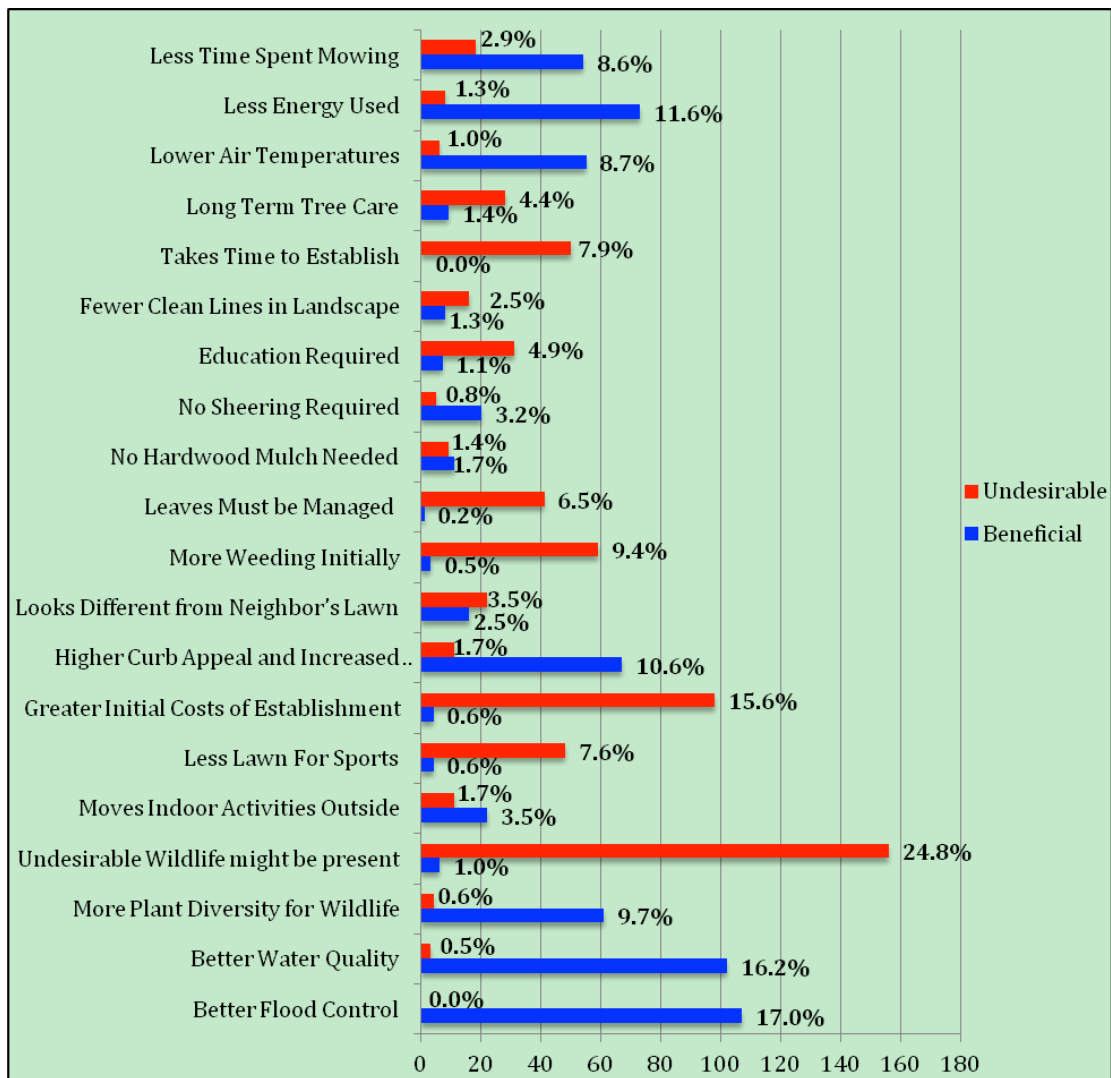


Figure 24 Histogram of How Respondents Rated the Effect of Each Impact on their Quality of Life

Figure 21 shows clearly that “Undesirable Wildlife might be Present” had the greatest impact on people’s quality of life in a negative way, whereas impacts dealing with water quality and quantity, “Better Water Quality” and “Better Flood Control,” were mainly viewed as positive impacts of the new landscape management.

A few of the impacts had mixed ratings for undesirable and beneficial (for example,

“No Hardwood Mulch Needed” and “Looks Different from Neighbor’s Lawn”), which makes it unclear to see from a graph whether they were viewed as positive or negative impacts. As a result, the importance of each impact was calculated.

### Importance of Each Impact

For each impact, the percentage of participants who ranked the impact as undesirable and beneficial was calculated. The percentages were then added for each variable to determine its overall importance as an impact on participants' quality of life.

Figure 22 shows the importance of each impact in descending order. The impacts near the bottom of the graph have a lower level of importance on respondents' quality of life compared to those near the top of the graph.

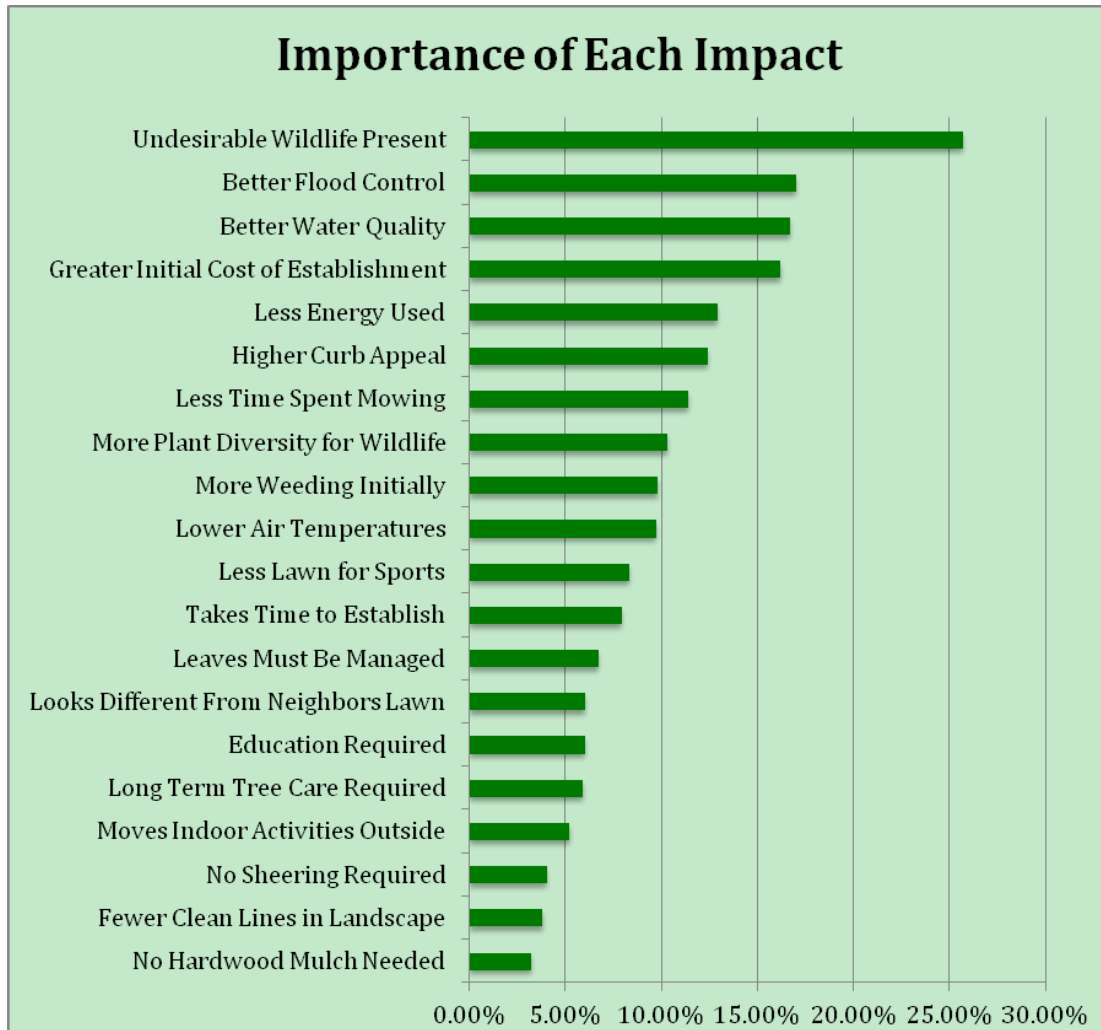


Figure 25 The Importance of Each Variable as an Impact on Participants' Quality of Life

To determine the impacts that were the most important and least important, the impacts were divided into four categories. The five impacts with the lowest importance were

deemed "Unimportant," the five impacts with the second lowest values for importance were considered "Minimal Importance," the five impacts with the

second highest values were considered “Important” and the five with the highest values were deemed “ Very Important.” These categories are presented in Table 8,

which shows which impacts fell under each of the categories and their corresponding percentage values that were used to determine level of importance.

Table 8: Categories Showing Values of Importance for Each Impact

<b>Unimportant</b>	<b>Percent</b>	<b>Important</b>	<b>Percent</b>
No Hardwood Mulch Needed	3.2%	Lower Air Temperatures	9.7%
Fewer Clean Lines in Landscape	3.8%	More Weeding Initially	9.8%
No Sheering Required	4.0%	More Plant Diversity for Wildlife	10.3%
Moves Indoor Activities Outside	5.2%	Less Time Spent Mowing	11.4%
Long Term Tree Care Required	5.9%	Higher Curb Appeal	12.4%
<b>Minimal Importance</b>	<b>Percent</b>	<b>Very Important</b>	<b>Percent</b>
Education Required	6.0%	Less Energy Used	12.9%
Looks Different From Neighbors’ Lawn	6.0%	Greater Initial Cost of Establishment	16.2%
Leaves Must Be Managed	6.7%	Better Water Quality	16.7%
Takes Time to Establish	7.9%	Better Flood Control	17.0%
Less Lawn for Sports	8.3%	Undesirable Wildlife Present	25.7%

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## 9. Neighborhood Survey Results

Following the survey of the New Castle residents, an additional survey was conducted in October 2013 to investigate neighbors' preferences. This survey had very few responses: Only 2 of the 23 households. But the results and approach are documented here, nonetheless.

The low response was due to challenges in reaching these neighboring household owners. Challenges arose when deciding on the best approach in which to carry out this survey. Four options came to the forefront of the discussion, each with its unique pros and cons:

- A. Door-to-door interviews. People unwilling to participate in the survey as disturbing people at home could anger them.
- B. Put a sign at property (or some other signal) to email the researchers for a survey. The people who participate in this way will be more friendly but it has a big potential for self-selection.
- C. Mail survey by mailing each house a survey instrument. This could result in the loss of anonymity, as new human subject approvals will be needed. It is also a time consuming approach, requiring up to 5 mailings per household over six weeks. However, all will be reached.
- D. Invite the neighbors on a tour of the

site, and then ask to fill out the survey at the end of the tour. This approach also has a self-selecting risk but would not need human subjects changes, as neighbors will be mailed a postcard with details on one or two tour dates. However, this will allow anonymity to be had, as it was at the DMV.

Approaches C and D were the most likely candidates. C was considered to be more work than D. With C, the neighbors will be answering just like the DMV respondents—with no extra scientific knowledge. However, the neighbors may or may not have seen and understood the whole intervention. So, with C, the neighbors have a very fresh but incomplete understanding of the intervention. With D, all the changes in the intervention could be explained so the neighbors will have a more complete and consistent basis of information upon which to make comparisons. However, the messenger (person giving the tour) could persuade the respondents, i.e., the respondents may try to get as many “right” answers as possible by repeating what the tour guide said.

In the end, option D was used to gain information on neighbors' opinions of the sustainable landscape management and ecosystem services it provides. Letters were sent out twice to neighbors to announce and remind them of the tour date. The invitation asked them to visit for an organized tour of the grounds, with the incentive of a free plant. At the end of the tour, the survey was administered to the neighbors.

The survey was given to neighbors who attended a tour of the transformed parcel in the Applecross neighborhood. Only two neighbors attended the tour and volunteered

to participate in the survey. The results of their survey are represented in Tables 9, 10, 11 and 12 below.

Table 9: How Neighbors Said the Impacts Affected Their Quality of Life

<b>Impacts</b>	<b>Good for Household</b>	<b>Bad for Household</b>	<b>Neither Good nor Bad for Household</b>	<b>Don't care about Impact</b>	<b>Missing</b>
<b>Better flood control</b>	2				
<b>Better water quality</b>	2				
<b>More Plant Diversity</b>	1			1	
<b>Undesirable Wildlife</b>		1	1		
<b>Indoor activities outside</b>			1	1	
<b>Less lawn for sports</b>			1	1	
<b>Greater initial cost</b>				1	1
<b>Takes time to establish</b>			1	1	
<b>Higher curb appeal</b>	1	1			
<b>Looks different</b>	1		1		
<b>Fewer clean lines</b>			1		1
<b>More weeding initially</b>			2		
<b>Leaves must be managed</b>			1		1
<b>No hardwood mulch needed</b>			2		
<b>No sheering required</b>			1	1	

<b>Education required</b>		1	1
<b>Long term tree care</b>		1	1
<b>Cleaner air</b>	1		1
<b>Less energy used</b>		1	1
<b>Less time mowing</b>		2	

Table 10: The Impacts that Neighbor Ranked as the Most Beneficial to Their Quality of Life

<b>Survey</b>	<b>Most Beneficial</b>	<b>2<sup>nd</sup> Most Beneficial</b>	<b>3<sup>rd</sup> Most Beneficial</b>
<b>1</b>	Higher Curb Appeal	Better Flood Control	Better Water Quality
<b>2</b>	Better Flood Control	Better Water Quality	Less Time Spent Mowing

Table 11: The Impacts that Neighbor Ranked as the Most Undesirable on Their Quality of Life

<b>Survey</b>	<b>Most Undesirable</b>	<b>2<sup>nd</sup> Most Undesirable</b>	<b>3<sup>rd</sup> Most Undesirable</b>
<b>1</b>	Undesirable Wildlife might be Present	Leaves Must Be Managed	Takes Time to Establish
<b>2</b>	Undesirable Wildlife might be Present	No Hardwood Mulch Needed	Education Required for Proper Management

#### *Participants' Opinions on Most Important Impact to Society Overall*

Respondents were asked an opened ended question to give their opinion on what impact of the sustainable management practice is the important to society overall. Table 12 and 13 below give the varied

answers given by each participant. Table 12 gives the answers of the neighbors and Table 13 shows the various answers given by respondents at the DMV.

Table 12: Neighbors' opinions on Most Important Benefit of the Landscape Change to Society

<b>Survey</b>	<b>Most Important Benefit of Landscape Change to Society Overall</b>
<b>1</b>	Fewer chemicals, better water usage and management, better flood control
<b>2</b>	Water Control

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## 10. Open-Ended Public Preference Survey Results

During the DMV surveys, a final question asked the respondents to provide open-ended explanations of the most beneficial aspect of the intervention. Table 13 presents all the open-ended responses.

Table 13: Participants' Opinions on The Most Important Benefit of the Landscape Change to Society Overall

	<b>Question 4- Most Important Benefit of the Landscape Change to Society Overall</b>
<b>1</b>	Saves money and is good for the environment
<b>2</b>	Better for environment
<b>3</b>	Better for birds and wildlife
<b>4</b>	Lowers overall energy consumption
<b>5</b>	Combination of wildlife and easier maintenance which could be a win-win for everything
<b>6</b>	No Opinion
<b>7</b>	More diversity
<b>8</b>	More energy efficient
<b>9</b>	As much natural greenery as possible to promote clean air
<b>10</b>	Most important would be to be in an area with wildlife, it would help better plants and more crops and make life lighter and easier and make the earth healthier. I love landscaping
<b>11</b>	Promoting nature
<b>12(S)</b>	It will improve the physical appearance of the landscape. The environment will be cleaner so that humans may live longer and enjoy the beauty of the landscape. Although I do not like animals (deer, raccoons etc.) it will help their habitat as well.
<b>13(S)</b>	Beautiful rich green landscaping adds to overall quality of life
<b>14(S)</b>	Animals will have shelter
<b>15</b>	It adds variety to the natural surroundings and enhances the property aesthetics and the property value (raises) of the neighborhood
<b>16</b>	Better flood control and less mowing
<b>17</b>	Better looking area, less work when done, looks better going through the area
<b>18</b>	Better for environment as a whole (wildlife, vegetation, energy-costs, etc.). Also, looks less cookie-cutter and more natural.
<b>19(S)</b>	May connect people and “nature” more and its beauty and diversity, especially since they have a sense of responsibility and relationship to the environment as “home”
<b>20</b>	Higher curb appeal that’s environmentally friendly

	<b>Question 4- Most Important Benefit of the Landscape Change to Society Overall</b>
<b>21(S)</b>	I am using this approach in my yard too (I could use some professional help-it would be great if UD had a list of nurseries in yard management services). I was inspired by “Noah’s Garden”- hoping to bring as many native species along if us human beings as we can. But I am really struggling with “pest” management-groundhogs in gardens, ants in pears, birds in blueberries. I think this type of gardening is better for resource conservation- I am definitely not watering and native plants are thriving. But there is a lot of weeding unfortunately. I have had to buy mulch to keep weeds under control. I could use some landscaping advice on what plant species are likely to thrive in different yard settings
<b>22(S)</b>	Re-establish native plants in the area
<b>23</b>	Better curb appeal, flood control
<b>24</b>	More natural
<b>25</b>	Improved environment
<b>26</b>	Better water quality and wildlife
<b>27</b>	Impact on appearance, better air quality
<b>28</b>	Natural shrub growth is most likely to create a sustainable environment and society
<b>29</b>	Provide a better living condition
<b>30</b>	Education on management is good
<b>31</b>	The plants because it looks better on property and good source of oxygen
<b>32</b>	Better landscape equals better air quality which leads to longer life
<b>33</b>	The most important is the water. Everybody likes clean water. Also the plants and trees.
<b>34(S)</b>	I believe these changes look better behind a home. I prefer a more manicured front yard.
<b>35</b>	Landscapes should not negatively impact the ecosystem nor humans
<b>36</b>	Looks much better
<b>37</b>	Cleaner air
<b>38</b>	More trees and wildlife is better for the environment
<b>39</b>	Better for environment
<b>40</b>	More nature the better, property value increase
<b>41</b>	This would benefit to control floods and rainy water and creates a positive impact on society to have an organized landscape in the neighborhood. This is a great project to enhance the understanding of people in residential areas, about residential landscape management
<b>42(S)</b>	Curb appeal, air quality
<b>43</b>	I agree with adding more plants but it is the upkeep that concerns me at this age
<b>44(S)</b>	Less fertilizer and pesticides needed
<b>45</b>	More plants, animals, cleaner air
<b>46</b>	No Opinion



	<b>Question 4- Most Important Benefit of the Landscape Change to Society Overall</b>
47	Better flood control and water quality
48(S)	Great views and enjoyment of properties
49	I think planting more trees is good but for people's own property they have their own choice.
50	More time spent outside enjoying nature
51	There are several things I like about it. The most important benefit I think is the reduction of waste. By this I mean waste of land and waste of energy. I think there is much better use of land than a lawn, and this change to a more natural landscape is a better use of the land. Also, I hadn't thought of it before this survey, but having a lawn puts the house in direct sunlight. During summer this will increase the energy required for cooling but will decrease the energy required for heating during winter. I don't know if this is a net gain or loss of energy but certainly something to take into consideration, for its potential for being an energy waste.
52	More pleasant area to live in, additional trees, greenhouse gas reductions depends on how many people have the landscape
53	"Unintelligible"
54	Better landscape brings in good surroundings, it maintains the air surrounding temperature
55	Better air condition, better circumstance for living and feeling of more green environment
56(S, NDL)	Less lawn fertilizer run off
57	More trees/ vegetation life
58	I think the change that is most beneficial to society at this point is flood control we've had several inches of rain this summer season and could use the extra help.
59	Good for the environment
60	Less lawn management
61	Lessens global warming
62(S)	Better water quality
63	Cleaner air quality and decrease in pollution
64	Environmental improvement
65	Better air quality
66	More important diversity in wildlife
67	Plant diversity for wildlife so animals have more places to live
68	It is beneficial to have plant growth to improve the overall environment on this landscape
69	Makes people more involved with their landscape
70	More areas for animals to be safe in
71	Better for environment and wildlife-especially bees
72	Better flood control, more woods for wild animals

	<b>Question 4- Most Important Benefit of the Landscape Change to Society Overall</b>
73	Better quality of water and flood control
74	Better for wildlife
75	Its soothing and interesting
76	Increased/decreased property value
77	Water quality
78	Society appears much more open to nature, which results in a healthier and more positive environment
79	Higher curb appeal and it's good for the environment
80	Gives people an idea of ecological diversity and how it can be aesthetically pleasing
81	More trees and plants contribute to improved air quality
82	I strongly think it is the air quality and flow of water
83(S)	I think we need to get back to small scale farms and gardens as well families should teach their kids more about the outdoors and how precious wildlife is
84	Cleaner air and better water quality
85	The most important benefit is that a good landscape will provide a better look to your house, will provide fresh air and will allow the rain water to flow better
86	Beauty, everyone won't have the same look-individuality
87	Water quality
88	Helps with drainage and aesthetically pleasing
89	Cleaner air, cleaner water, looks better
90	Customize your own garden
91	Use less time to waste time on establishment
92	Better for environment
93	The landscape becomes more diversified
94	Curb appeal, variety in landscape
95	No Opinion
96	The most important benefit of this landscape change to society overall is the favorable impact on health: better flood control, better water quality, cleaner air and less energy used to cool home
97	More nature and landscape will give home more appeal
98	This improves the overall environment which promotes health as well as sustainability for the long haul
99	More wildlife and more ground area for property
100	It could help the environment and add to the community for making it look better

	<b>Question 4- Most Important Benefit of the Landscape Change to Society Overall</b>
<b>101</b>	Better flood control is most important as a benefit to changing society overall. An added benefit with aesthetics is always entreating as well but because of amount of water damage and flood watches, it would rank “flood control” as an important factor to society.
<b>102</b>	Better flood control, results in cleaner air
<b>103</b>	Flood control and clean air and water
<b>104</b>	Pros: Diversity in wildlife increases, more beautiful landscaping brings more outdoor activities. Cons: Invasive plants and animals, more work to maintain
<b>105</b>	Brings beauty to our homes and neighborhood

The answers to question 4 were divided into four categories. These include the people who mentioned ecosystem services, good aesthetics, bad aesthetics and other. Each answer was separated into one of these categories and the percent of people in each category was calculated. The percentage

was calculated and not the number of people as some people’s answers fell under more than one category, and there were 4 surveys in which the answer to question 4 could not have been used. For this question the sample size was therefore 101. Table 14 gives the results.

Table 14: The Percentage of People who said Ecosystem Services, Good Aesthetics, Bad Aesthetics were the Most Important Benefit to Society

	<b>Percent Of People who Mentioned It</b>
<b>Ecosystem Services</b>	76.24%
<b>Good Aesthetics</b>	25.74%
<b>Bad Aesthetics</b>	0.99%
<b>Other</b>	16.83%

## 11. Conclusion and Project Limitations

Contemporary landscaping practices are not prevalent in Delaware, with many households having yards consisting of mainly lawn space and foundation plantings, consisting of exotic species. However, the results show that this may not be due to a preference for large lawn spaces. The survey

suggests that Delaware residents may value contemporary landscaping.

Figures 20a, b, c and d show how each resident stated how various ecosystem services affected their households. The results show that with the exception of a few impacts, such as “Undesirable Wildlife might be present,” “Less lawn for sports” and “More weeding initially,” the majority of the impacts were stated as having a net

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positive effect on off-site households rather than a negative effect.

Additionally, residents tended to view water quality and quantity improvements as important ecosystem services introduced in contemporary landscaping. In Figure 21, “Better water quality” and “Better flood control” were both mentioned by over 16% of respondents as one of the three most beneficial impacts of the landscape change to their quality life and less than 1% mentioned that it was an undesirable impact. This possibly shows that Delaware residents have a desire to implement better water management practices in their landscape.

In general, preferences for the beneficial ecosystem services likely balance or exceed the negative aspects of contemporary landscaping. Therefore, contemporary landscaping is likely to enhance welfare, but further valuation research is needed.

The costs for establishment and maintenance of a contemporary landscape are very high. “Higher Initial Cost of Establishment” was mentioned as one of the three most undesirable effects of contemporary landscaping by over 15% of the respondents. Also, from Figure 22, it has been viewed as the fourth most important impact in this landscape practice and could act as a barrier to the adoption of contemporary landscaping. Therefore, landowners will likely need incentives for broader adoption.

There were limitations in conducting the survey at the DMVs. Some respondents had difficulty understanding the way this type of

landscape management can affect their quality of life. This resulted in various different interpretations for how each impact can affect ones quality of life. The misunderstanding occurred in respect to where respondents interpreted that the landscape change occurred. Some respondents were under the impression that they were answering how the impacts affected them personally if it was in their own yard or neighborhood instead of at the Applecross site.

## 12. Acknowledgements

The researchers acknowledge help in enumerating the survey: Drew McAuliffe, Tianhang Gao, Samantha Nestory, Tyler Kornmehl, and Jessica Bomm. In addition, Jennifer Egan helped with the pretesting.

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## Appendix 1a

### Cover Letter- Informed Consent given to participants



Residential Landscape Opinion Survey  
2013

#### ABOUT THE PROJECT

We are surveying public opinions about residential landscapes as part of a University of Delaware research project. There are no right or wrong answers—we are just seeking to understand what people think about different kinds of landscaping practices. You need no special knowledge to participate. We are simply interested about your opinions about a landscape experiment that was designed by our researchers in New Castle County.

✓ **All responses are anonymous.**

You have been chosen at random by the University of Delaware students administering the survey. They will ask you a series of questions, and the survey should take 12-20 minutes to complete. The survey is anonymous, and the students will not record your name or address. No one will be able to link your answers to you personally. We want to know your opinions, but not who you are!

✓ **Participation is voluntary.**

Participating in this research has no risks for you. Participation will bring you no rewards other than learning about this research project on residential landscaping. However, you can help us very much by taking a few minutes to share your experiences and opinions.

- This survey is completely voluntary. If you do not wish to participate, you can “opt out.” Please tell our student “no thank you” and the interview will end.
- If you decide to participate, please indicate this to the student and “opt in.”

If you have any questions about this study, please ask the student questions. If you have further questions, we would be happy to talk with you. Please contact Dr. Duke, Dr. Barton, and Dr. Bruck at the addresses below.

Dr. Joshua Duke  
Department of Applied Economics & Statistics  
University of Delaware  
302-831-1309  
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Dr. Susan Barton and Dr. Jules Bruck  
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Note: This research protocol has been approved by the University of Delaware Institutional Review Board.

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## Appendix 1b

### Poster Shown to Participants with Pictures and Survey Instrument

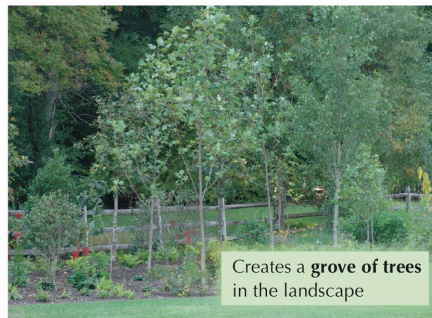
#### Traditional & Contemporary Management of Residential Landscapes

A suburban livable ecosystem is a landscape that takes advantage of natural processes while providing tangible benefits to its owner. By landscaping this way, it produces ecosystem services right in our backyard such as cleaning our water, increasing plant and animal diversity, cooling the environment, saving energy, sequestering carbon, and moving many indoor activities outside.

##### The owner's traditional home landscape:



Now, this landscape is becoming a **contemporary landscape...**

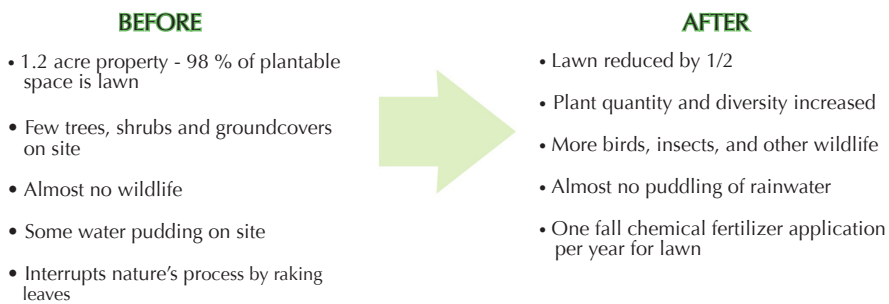


## Traditional & Contemporary Management of Residential Landscapes

There is scientific basis in the literature for contemporary components of landscape management. This project incorporates many scientific practices into one home landscape.

### Site characteristics:

The site is located in Applecross, a development on Route 100 north of Wilmington, DE.



### Some might find...

PROS	CONS
Better flood control (water infiltration)	Greater initial cost of establishment
Better water quality on site (water filtration)	Takes time to become established
More plant diversity for wildlife	More weeding initially until plants cover the ground
More opportunities to move indoor activities outside (such as dining, reading, socializing, etc.)	Undesirable wildlife might be present (ticks, deer, snakes, etc.)
More opportunities to wander through and enjoy the garden	Looks different from the neighbors' yards
Less energy used due to shaded buildings	Contemporary landscape will appear less managed
Less chemicals	Fewer clean lines and order in the landscape
Less pollution from mowing the smaller lawn	Education required for proper management
Less time spent mowing	Long term tree care required (disaster and disease removal)
Higher curb appeal	Leaves must be managed
Potential property value increases	Leaves may blow out of beds until plants are large enough to hold them in place
No hardwood mulch - uses onsite leaf clippings	Less lawn for sports
No sheering of plants required, just minimal pruning	

## Traditional & Contemporary Management of Residential Landscapes

### QUESTION 1

Please describe your relationship to this site:

- ☐ I live in the neighborhood, \_\_\_\_ houses away
- ☐ I don't live in the neighborhood, but I have visited the neighborhood  
(I live in \_\_\_\_\_ zip code)
- ☐ I don't live in the neighborhood, and I have never visited it  
(I live in \_\_\_\_\_ zip code)

### QUESTION 2

Some might find the following to be good or bad things. What do you think? How does this affect your quality of life? Check the box that most closely reflects the answer for your household.

IMPACTS OF CONTEMPORARY MANAGEMENT	It's good for my household.	It's not good or bad for my household.	It's bad for my household.	I don't care about this for my household.
Better flood control				
Better water quality				
More plant diversity for wildlife				
Undesirable wildlife might be present (ticks, deer, snakes, etc.)				
Moves indoor activities outside				
Less lawn for sports				
Greater initial cost of establishment				
Takes time to become established				
Higher curb appeal and increased property value				
Looks different from neighbor's lawn				
Fewer clean lines and order in the landscape				
More weeding initially until plants cover the ground				
Leaves must be managed and may blow out of beds				
No hardwood mulch needed because on-site leaves are used to mulch				
No sheering of plants required, just minimal pruning				
Education required for proper management				
Long term tree care required (disaster and disease removal)				
Lower air temperatures providing cleaner air				
Less energy used due to shaded buildings				
Less time spent mowing				



## Traditional & Contemporary Management of Residential Landscapes

### QUESTION 3

What are the 3 most important beneficial impacts on your quality of life? Rate them on a scale from 1 (most beneficial) to 3 (third most beneficial). What are the three most undesirable impacts on your quality of life? Rate them on a scale from 1 (most undesirable) to 3 (third most undesirable).

IMPACTS OF CONTEMPORARY MANAGEMENT	BENEFICIAL	UNDESIRABLE
Better flood control		
Better water quality		
More plant diversity for wildlife		
Undesirable wildlife might be present (ticks, deer, snakes, etc.)		
Moves indoor activities outside		
Less lawn for sports		
Greater initial cost of establishment		
Higher curb appeal and increased property value		
Looks different from neighbor's lawn		
More weeding initially until plants cover the ground		
Leaves must be managed and may blow out of beds		
No hardwood mulch needed because on-site leaves are used to mulch		
No sheering of plants required, just minimal pruning		
Education required for proper management		
Fewer clean lines and order in the landscape		
Takes time to become established		
Long term tree care required (disaster and disease removal)		
Lower air temperatures providing cleaner air		
Less energy used due to shaded buildings		
Less time spent mowing		

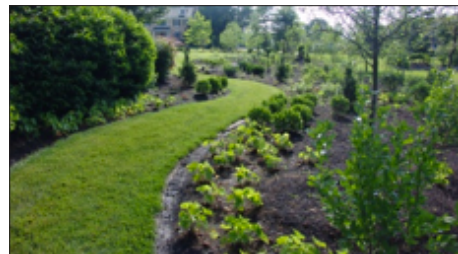
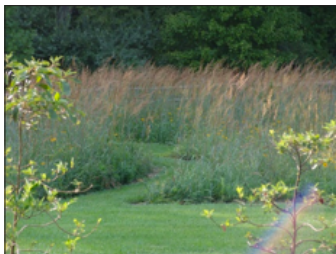
If you want to elaborate on the most beneficial impact, write here:

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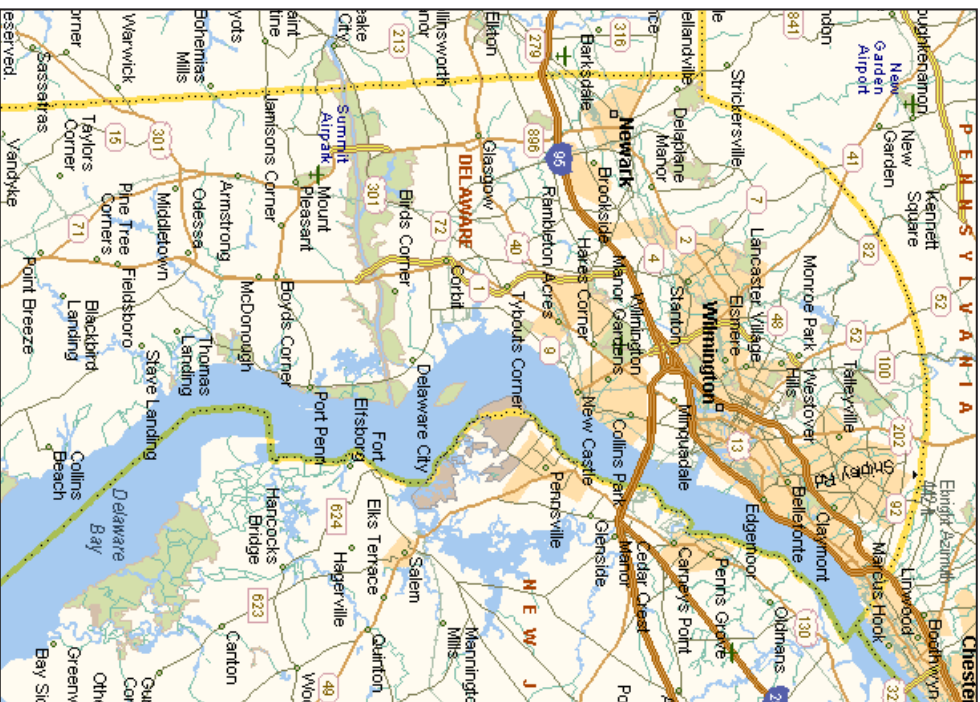
## Traditional & Contemporary Management of Residential Landscapes

### QUESTION 4

What is the most important benefit of this landscape change to society overall?



Please estimate where you live in New Castle County by placing an "X" on the map.



## ANONYMOUS INFORMATION ABOUT YOU ...

1. What year were you born? \_\_\_\_\_
2. Please circle one of the following that best describes your highest level of education achieved:
  - Some high school
  - High school degree and/or G.E.D.
  - Some college and/or Associate's degree
  - College degree
  - Post graduate work
3. How many people live in your household? \_\_\_\_\_



## Appendix 2: Conceptualization of Different Respondent Answers Based upon Different Question Framing

Respondents may have interpreted the preference questions as the intervention occurring at the Applecross site, in one of their neighbor's yards, or in their own yards. The respondents were directed to the Applecross interpretation and most seemed to have understood this intention. However, enumerators reported that some respondents might have interpreted the intervention occurring in the other two ways. This table classifies the different interpretations with hypothesized sign, and then assesses whether this problem could lead to sign reversal. The table considers if the respondents had a positive (+), negative (-), and indifferent (~) impression, how the results might have varied.

Impacts	Respondent's Yard	Respondent's Neighborhood	Applecross Site
Better flood control	+ because less to worry about when there is heavy rainfall and less to clean with reduced flooding ~ Won't care	+ because less to worry about when there is heavy rainfall, less to clean with reduced flooding ~ Won't care	+ because better for water systems as run-off is reduced so less flooding downstream for all counties ~ Won't care
Better water quality	+ because cleaner water for drinking from taps (save money on bottled water) ~ Won't care	+ cleaner water for drinking from taps (save money on bottled water) ~ Won't care	+ cleaner public water for drinking in all counties (save money on bottled water) ~ Won't care
Undesirable wildlife	- because spend more money preventing ticks etc. and increased risk of animal induced diseases + because there is more habitat for wildlife ~ Won't care	- because increased risk of animal induced diseases + because there is more habitat for wildlife ~ Won't care	- because the wildlife and diseases could spread + because there is more habitat for the wildlife ~ Won't care
Indoor activities outside	+ because healthier lifestyle ~ Won't care	+ because there is ability to develop relationships ~ Won't care	+ because it would make people healthier ~ Won't care

Less lawn for sports	- because not able to use yard and children have to spend more time indoors ~ Won't care	- because if children play in their neighbor's yard, there is less space to play ~ Won't care	- because less time spent outdoors so its unhealthy ~ Won't care
Greater initial cost	- because Need more upfront funds that may not be available ~ Won't care	- because won't have money to pay for neighborhood maintenance ~ Won't care	~ Won't care
Takes time to establish	- because more time doing yard work initially + because enjoying doing yard work to establish it ~ Won't care	- because makes the neighborhood look un-kept initially ~ Won't care	~ Won't care
Higher curb appeal	+ because increases value of ones assets ~ Won't care	+ because increases the value of assets ~ Won't care	- because it could devalue ones house ~ Won't care
Looks different	- because odd one out (doesn't fit in with the look of the area) + because it makes the property stand out ~ Won't care	- because it's not compatible with the rest of the yards (makes the neighborhood look uncoordinated) + because its adds diversity to the look of the neighborhood ~ Won't care	~ Won't care
Fewer clean lines	- because it looks messier + because it looks better ~ Won't care	- because it looks unmanaged and ruins the look of the neighborhood + because it adds diversity to the look of the neighborhood ~ Won't care	~ Won't care
More weeding initially	- because more time doing yard work initially + because enjoying doing yard work ~ Won't care	- because it decreases value of properties if not weeded and weeds could spread to yard ~ Won't care	+ because people spend more time outdoors with nature ~ Won't care

Leaves must be managed	- because more time doing yard work ~ Won't care	- because leaves could get into ones yard leading to more work ~ Won't care	+ because people spend more time outdoors with nature ~ Won't care
No hardwood mulch needed	+ because save money on purchasing inputs and less chemicals in yard ~ Won't care	+ because less chemicals in water from not using artificial inputs (better for environment) ~ Won't care	+ because less chemicals in water from not using artificial inputs (better for environment) ~ Won't care
No sheering required	+ because less work in yard (more free time) - because yard activities will be reduced ~ Won't care	- because the plants could look messy if not sheered ~ Won't care	- because less time spent outdoors so its unhealthy ~ Won't care
Education required	- because need time to be educated + because you get to increase knowledge ~ Won't care	+ because could spread new knowledge of landscape to help one better manage their yard ~ Won't care	+ because could improve environment if more people are knowledgeable on landscape management ~ Won't care
Long term tree care	- because more time doing yard work + because enjoy doing yard work ~ Won't care	- because looks messy if not managed ~ Won't care	+ because people spend more time outdoors with nature ~ Won't care
Cleaner air	+ because better air quality ~ Won't care	+ because better air quality ~ Won't care	+ because better air quality ~ Won't care
Less energy used	+ because save money on electricity bills ~ Won't care	+ because save money on electricity bills ~ Won't care	+ because its good for the environment to reduce energy usage ~ Won't care
Less time mowing	- because enjoy doing yard work + because less work in yard (more free time) ~ Won't care	+ because less noise pollution ~ Won't care	+ because less emissions (better for environment) ~ Won't care