Non-Market Benefits and Costs of Preserving Estuarine Watershed Open Space: A Case Study of Riverhead, Long Island, New York

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Abstract

We provide a preliminary benefit-cost analysis for preserving open space in the Peconic Estuary watershed. We estimate benefits for a subset (three) of the values provided by preserving 904.08 acres of open space, 220.67 acres purchased outright and 683.41 acres preserved through restrictions on development. Because these are two largely separable policies, we carry out separate analyses of the two issues. We estimate the cost of acquiring 220.67 acres of vacant land to provide a perspective on the relationship between benefits and costs. Although development restrictions do not require out of pocket expenditure of public funds, it does impose a private cost on the impacted landowners. Unfortunately, we do not have adequate data to estimate these costs. Hence we provide a perspective on the possible benefits of development restrictions, but not the costs.

The benefits of open space preservation considered in this report are restricted to just three categories (1) onsite recreational use for bird watching and wildlife viewing, (2) offsite water quality impacts on recreational swimming, and (3) localized amenity values to adjacent property owners. Data limitations preclude us from estimating the full suite of benefits, including aesthetic benefits to individuals other than adjacent property owners, nonuse values, and offsite benefits other than swimming. Thus, it should be recognized that these results likely understate benefits.

We estimate benefits to recreational bird watchers and wildlife viewers from the purchase of 220.67 acres of open space. However, we do not calculate benefits for this category associated with the 683.41 acres of land preserved by development restrictions, since public access would not necessarily be allowed on all lands in this category. We first estimate a statistical relationship between acres of publicly accessible open space and the number of recreational trips. This allows us to estimate the number of recreational trips which is expected to be maintained by purchasing land in order to protect open space. To quantify the value per recreation day, we use the results of the two most recent recreational surveys carried out by the U.S. Fish and Wildlife Service (2004). We then calculate the total discounted value of the trips maintained, assuming the purchased land is protected in perpetuity. The value of protected onsite recreational wildlife uses attributable to the purchases of 220.67 acres of vacant land ranges from \$16.1 million to \$46.2 million, depending on the discount rate selected.

We estimate benefits from water quality improvements for recreational swimming by combining results from a recent study of how development affects water quality in the Peconic (TETRA TECH, 2000) and a study of how water quality affects recreational swimming in the Peconic (Opaluch et al, 1999). Estimated benefits to swimmers from purchasing 220.67 acres of open space range from \$0.4 million to \$1.2 million, depending upon the discount rate used. Estimated benefits to swimming from preserving 683.41 acres of open space through development restrictions range from \$1.1 million to \$3.6 million.

Finally, we estimate the localized amenity values provided to adjacent property owners. Because specific open space parcels to be preserved have not been identified, we use a set of reasoned assumptions to calculate the number of private properties adjacent to the open space parcels to be preserved. We then use the results of Opaluch, et al (1999) to estimate the change in the value of the private properties resulting from having adjacent open space. We find that the localized amenity value associated with purchase of 220.67 acres of open space is approximately \$4 million. Estimating the amenity value associated with for the 683.41 acres preserved by land use restrictions is more challenging than for outright purchase, since there could be offsetting effects. We provide a range of estimates from zero to \$12.3 million depending upon the assumed benefits per acre of the preserved open space.

The total of all three categories of quantifiable non-market benefits associated with the purchase of 220.67 acres of vacant land ranges from \$20.5 million to \$51.4 million, depending upon the discount rate used. The mid-point of this range of benefit is approximately \$36 million. The cost of acquiring open space ranges from \$22.1 million to \$38.6 million, with a mid-point of \$30.3 million. Given the many uncertainties involved, we conclude that the quantified benefits and the costs of acquiring vacant land are of similar magnitude. However, it should also be noted that many categories of benefits are excluded. Including these categories of benefits would strengthen the case for open space preservation over development.

The total quantifiable benefit from preserving 683.47 acres of open space through development restrictions is estimated to range from \$1.1 million to \$16.1 million, with a mid-point of \$8.6 million. Again, this likely understates open space benefits from development restrictions, since several categories of open space benefits are not included in these estimates. As indicated above, we are not able to provide an estimate of the costs of development restrictions.

In summary, total estimated non-market benefits from preservation of the entire 904.01 acres of open space preservation range from \$21.6 million to \$67.5 million. Again, it is emphasized that several categories of benefits are excluded from our analysis due to data limitations, so that the true benefits would be expected to exceed this estimate.

I. Introduction

I.A. Background and Importance

The marine waters and undeveloped coastal lands of the Peconic Estuary System (PES) support a wide range of recreational and other uses enjoyed by residents, second homeowners, and visitors (Grigalunas and Diamantides, 1995; Opaluch, et al, 1999; Mazzotta, 1999; Diamantides, 2001). However, population growth, development, and pollution put at risk the open space, habitat, and water quality required to sustain these uses.

In the face of severe development pressures, the preservation of vacant land is being used as an important policy instrument by the Peconic Estuary Program (PEP) in order to meet the goal of protecting habitat and water quality within the PES. According to the PEP's Critical Lands Protection Plan, a little more than 22% of the 113,892 acres of land in the Peconic Watershed's five eastern towns is still available for development (as of 2001). The PEP's decisions concerning which parcels of land to protect were viewed "through the lens" of habitat and water quality protection (PEP, 2004). Reflecting these two broad concerns, environmental criteria and priority categories defined below were developed to screen available vacant lands and sub-dividable lands to identify protection priorities.

Environmental Criteria

1. **Shoreline –** located within 1000 feet of the shoreline of a bay, tidal creek or the Peconic River
2. **NWI –** contains freshwater or tidal wetlands as identified by the U.S Fish and Wildlife Service 1994 National Wetlands Inventory (NWI)
3. **CNRA –** within a Critical Natural Resource Area, areas of particular ecological significance designated by the Peconic Estuary Program (further described in the Habitat and Living Resources Chapter of the CCMP)
4. **N-Stressed –** within a nitrogen-stressed subwatershed as designated by the Peconic Estuary Program (further described in the Nutrients Chapter of the CCMP)

Priority Categories

1. **Aggregates** - Multiple parcels of any size, that meet at least one (1) environmental criterion and form an aggregate of > 10 acres
2. **10 Up** - Parcels of > 10 acres that meet at least one (1) environmental criterion
3. **3 Hits 1,000 feet** - Parcels of any size with at least three (3) environmental criteria hits including 1,000 feet from the shoreline
4. **Adjacent to Protected** - Parcels of any size that meet at least one (1) environmental criterion and are adjacent to protected lands of > 2 acres

Almost 70% of the 25,271 acres of remaining land available for development were designated as high priority parcels for protection, meeting both the PEP-designated environmental criteria and priority categories. In the Town of Riverhead, over 86% of the 2,574 acres of remaining land available for development are designated by the PEP as high priority parcels for protection. Preservation of lands would be achieved either through outright purchase or through the use of restrictions on development, which would limit clearing and require the use of clustering.

I.B. Economic Issues in Land Preservation

Land preservation programs typically receive widespread general support in public surveys and referenda (King and Anderson, 2004), and this is true of the PES as well (e.g. Opaluch et al., 1999; Mazzotta, 1999). However, significant preservation actions are expensive, and the benefits and costs of land preservation proposals are often not well understood and difficult to assess.

On the benefit side, land preservation helps to maintain amenities, wildlife habitat, recreational areas, and surface and ground water quality, for example. These resources, in turn, provide a flow of direct (on site) and indirect (offsite) services to the public. If recreation services for a site were traded on the market, then the value of the services would be reflected in the price of (willingness to pay for) the land. However, the value of lands to the public is not a captured in land prices. Hence, special studies using non-market valuation methods (e.g., Freeman, 2003; Opaluch et al., 1999) are needed to estimate the value of non-market uses ("shadow prices")

This is easier said than done. Assessing the benefits from land preservation is complicated because (1) the cause-and-effect links between the uses (demand for) and the quantity and quality of resources ("supply") are often not well understood, and (2) the environmental and natural resource services provided to the public are not exchanged on markets so that no prices exist to easily value these services. Further, (3) benefits will vary by the type and location of land, the size of parcels, and uses of contiguous land (e.g., Opaluch et al., 1999). As a result of all of these issues, little is known about the demand for, and the value of, the services from preserved land, and non-market valuation methods must be used to uncover estimates of such value.

Many challenges also arise in assessing the costs of specific programs. The cost of land preservation programs is the value of what is given up (opportunity cost) when scarce watershed lands are diverted from private uses in order to support the public goals of preservation mentioned above. While land is exchanged in markets, the value of specific parcels being considered for preservation depends upon many factors. Included among these are the location, the type of vacant land, soil characteristics, size of the parcel, zoning, and the presence of infrastructure. Hence, even the seemingly clear task of assessing the cost of land preservation may not be straight forward. This is especially true in the present study in light of the fact that information on specific parcels to be acquired or otherwise protected is unavailable.

I.C. Purpose and Scope

This report examines the non-market benefits and costs of preserving priority lands under the Critical Lands Protection Strategy (CLPS) (2004) of the PEP. Riverhead, one of five towns in the PES, was selected by the PEP as a case study, and consequently is the focus of this research. Stated simply, the issue addressed in this study is: How do the anticipated benefits of preserving vacant land in Riverhead stack up against the costs?

Given the natural resource and environmental policy goals established by the PEP, we estimate the user benefits of land preservation in Riverhead to:

- non-consumptive outdoor recreational users of the preserved open space who view, photograph, and feed birds and other wildlife on site,
- recreational users – swimmers -- of Flanders Bay, the sub-watershed most directly related to pollution runoff from Riverhead,
- property owners adjoining the land to be preserved, who enjoy natural amenities of open space.

Land that is preserved can provide a flow of annual benefits over a very long period – essentially "forever". Recognizing this, each of the incremental benefits is assessed in perpetuity. Dollar estimates are all converted to mid-2004 dollars using the consumer price index (http://data.bls.gov/cgi-bin/surveymost).

The sum of the public values we estimate provides insight into the "social value" of preservation. If all benefits can be reliably estimated, this social value represents what a planner might ideally consider as reflective of the overall – market and non-market -- land value when making development-preservation decisions. As we show below, the social value of land can be high, despite the fact that we are able to quantify only three non-market benefits of land preservation.

Several aspects of land preservation are not considered herein either because the work involved is outside of the scope of the project or because adequate information was unavailable. First, we are only able to assess three use values: birding and wildlife viewing on preserved lands, benefits to swimmers from maintaining water quality realized through land preservation, and amenity values to adjoining property owners. We do not assess benefits open space may provide to individuals other than adjacent property owners, nor do we estimate benefits to indirect or offsite users (e.g. recreational shell fishing, fin fishing or boating which are improved with cleaner water) other than to swimmers.

The net fiscal effects of land preservation are not examined. Preserving land from residential development may mean a lower demand for public services, such as education and public safety, and may keep taxes lower than they would be with development (e.g., Johnston, 1998). However, the effect would depend upon the type of development which would have occurred in the absence of land preservation. The effect also depends on actions of those who are precluded from developing the preserved parcels. For example, excluding one parcel from development might simply displace development to other, unprotected land in the town, or to an adjoining town.

Also, it should be clear that limiting the land available for development reduces the supply of available developable land and makes the remaining developable land more valuable. This can have adverse effects on affordability of housing for young people attempting to purchase their first house and those with low incomes. A variety of other short- and long-term effects may occur as well (King and Anderson, 2004). Unraveling and quantifying the short- and long-run market and fiscal effects of land preservation raise complicated issues much beyond the scope of this report[1].

Less development also may mean lower traffic and, perhaps, less congestion (e.g., Johnston, 1998). However, the traffic generated by development (and avoided by open space) depends upon the scale, density, and location of development in complex ways that may not be easily predicted. For example, preserving land in a town could cause people to locate further away from the town, possibly increasing commuting distances, and possibly *increasing* traffic. Further, traffic in the PES has a large seasonal element. And potential traffic congestion at or near a particular area might be avoided through various traffic management measures. We note, again, that specific areas for preservation within Riverhead have not been designated, making site-specific studies impossible. For all of these reasons, traffic congestion issues are not considered in this report.

No original data were obtained to assess the benefits and costs of land preservation for this study. Instead, we adopt and adapt data from a variety of sources. A major data source is the results of prior economic research carried out for the PES Program by the authors and their associates at Economic Analysis Inc. (Opaluch, et al., 1999.; Mazzotta, 1996; Diamantides, 2001; Grigalunas, et al, 2004; Johnston, et al, 2001, 2002)[2]. Other important sources include land use data and maps prepared by the PEP as part of the Critical Lands Protection Plan, data on potential land acquisition and costs from the Nature Conservancy (PEP, 2004; Pogue, 2004). Additionally, estimates of outdoor wildlife recreation values per trip for New York from US Fish and Wildlife Service (2004) are used to assess the value of preserving vacant land for birding and wildlife viewing. These data sources, and how they are used in this study, are described in more detail in later sections.

We emphasize data constraints limit the analysis that was possible for this report. The land use data available for this research are aggregate land statistics and maps, as we describe in the data analysis section later in this report. Information on specific parcels to be preserved was unavailable. The lack of site-specific data forced us to employ averaged values for benefits and for costs. Also, we are able to estimate only aggregate benefits and costs, that is, the benefits and costs for preserving all or none of the acres designated by the PEP as high priority. Hence, we do not attempt to come up with an "optimal" preservation strategy, which might, for example, include identifying the scale and location of properties with the highest net value of preservation.

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[1] King and Anderson (2004) show that land preservation in the short run increases taxes by removing taxable land from the tax roles. This increases taxes on homeowners in the short run. However, in the longer run (after 3 or 4 years), they found that land preservation works to reduce taxes by increasing property values and perhaps reducing services. They also show that the gains from preservation are unevenly distributed with preservation raising all property values but nearby property owners experiencing more of the gain..

[2] The recreation data relied upon was from surveys administered by EAI in 1995. However, we have no reason to believe that the general patters found have significantly changed in the intervening period.

Further, we note that the data gathered in the original Economic Analysis Inc. research on the PES was not designed specifically to estimate the benefits of open space in Riverhead. Some of the results of the earlier research prove to be very useful, as we show below, but data problems still were encountered.

Finally, a note on the style we adopt. This report is being written for resource managers and the informed public. In order to be assessable to wide audience, we adopt a non-technical style. Throughout, we attempt to make clear the goals, concepts, data, judgments and assumptions adopted.

I.D. Organization

First, we provide background of the case study town, Riverhead. We describe essential geographic and socio-demographic features of the town and put Riverhead in the context of other PES towns. Then, key aspects of the PEP land preservation program are described.

Next, the basic economic concepts relevant to the assessment of benefits and costs are given. After that, the methods used are described after which data and results are presented.

II. Overview of the Study Area and Potential Protected Land

II.A. Introduction

The Peconic Estuary System is situated at the east end of Long Island in Suffolk County, New York (see Figure 1). Five towns (and part of a sixth, Brookhaven) comprise the PES. With a year- around population of 125,370, the PES towns make up about 9% of the county's population of 1,419,363 (Table 1).

Noted for its attractive coastal-estuarine environments, the PES is a major vacation and recreation destination. Residents, second homeowners and visitors actively participate in beach use, swimming, boating, fishing, birding and wildlife viewing, and other activities (Grigalunas and Diamantides, 1996.; Opaluch et al., 1999; Diamantides, 2001). However, the PES has been growing almost twice as fast as the rest of Suffolk County (Table 1), putting severe pressures on the natural environment. Initiation of the PEP as part of the Environmental Protection Agency's National Estuary Program was, in part, a response to the many development pressures occurring within the watershed, and the risks they pose to the quality of the Peconic Bays system and surrounding uplands and coastal fringe.

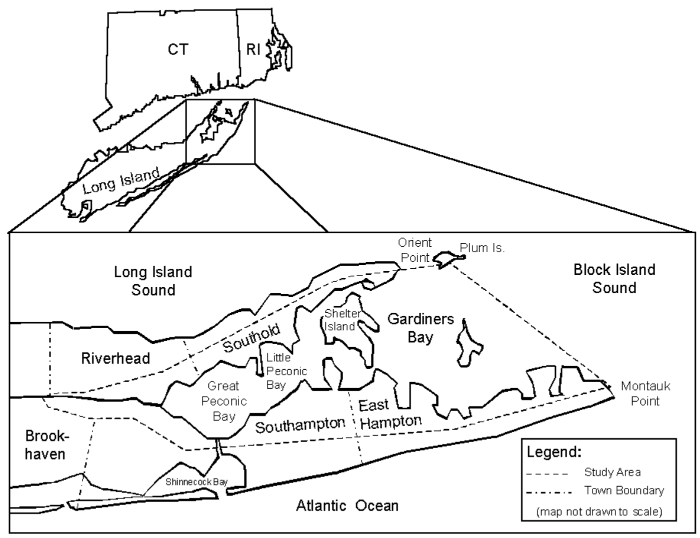

Figure I. Depiction of the Peconic Estuary System

Riverhead, the subject of this case study, has a year-around population of 27,680, the second most populated PES town. It also has been rapidly growing over the past 20 years (Table 1). Compared with the other PES towns, Riverhead is relatively small and densely settled, and has the lowest number and share of seasonal housing units. Riverhead also has the lowest income and housing values among the five PES towns (Table 2).

Table 1. Population of PES Towns and Suffolk County, 1960 - 2000

	******* Year *******								
	1960	**1970**		**1980**		**1990**		**2000**	
			% Growth		***% Growth***		***% Growth***		***% Growth***
Riverhead	14,519	18,909	*30.2*	20,243	*7.1*	23,011	*13.7*	27,680	*20.3*
Southampton	27,095	36,154	*33.4*	43,146	*19.3*	45,909	*6.4*	55,216	*20.3*
Southold	13,295	16,804	*26.4*	19,172	*14.1*	19,836	*3.5*	20,599	*3.8*
East Hampton	8,827	10,980	*24.4*	14,029	*27.8*	16,132	*15.0*	19,647	*21.8*
Shelter Island	1,312	1,644	*25.3*	2,071	*26.0*	2,263	*9.3*	2,228	*-1.5*
Total PES	**65,048**	**84,491**	***29.9***	**98,661**	***16.8***	**107,151**	***8.6***	**125,370**	***17.0***
Rest of Suffolk County	601,736	1,042,539	*73.3*	1,185,570	*13.7*	1,215,384	*2.5*	1,293,999	*6.5*
Total County	**666,784**	**1,127,030**	***69.0***	**1,284,231**	***13.9***	**1,322,535**	***3.0***	**1,419,369**	***7.3***

Source: Long Island Power Authority, 2002, www.lipower.org

Table 2. Selected Characteritics of Peconic Estuary Program Towns, 2000

Town Characteristics / **Towns**		**Riverhead**	**Southampton**	**Southold**	**East Hampton**	**Shelter Island**
Total Population		27,680	54,712	20,599	19,719	2,228
	Urban	21,766	42,646	14,109	10,461	0
	Rural	5,914	12,066	6,490	9.258	2,228
	65 years and over	5,107	9,083	4,756	3,271	638
	Median Age	40.6	40.4	44.7	41.6	49.2
Total Area*		201,3	295.6	404.5	385.9	27.1
	Land Area	67.4	138.9	53.7	74.3	12.1
	Water Area	133.9	156.7	350.8	311.6	15
Density**						
	Population	410.8	394	383.5	265.4	183.6
	Housing Units	185.2	258	256.3	264.3	195.3
Total Housing Units		12,479	35,836	13,769	19,640	2,370
	Occupied Housing Units (Households)	10,749	21,504	8,461	8,101	996
	For seasonal, recreational, or occasional use	1,165	12,604	4,689	10,693	1,307
	Median Value for Owner-Occupied Housing Units***	171,500	253,600	225,700	303,100	295,500
Income						
	Median Household Income***	47,742	55,701	51,577	53,955	54,792
	Per Capita Income***	25,478	32,373	28,550	32,350	31,370

* Measured in Square Miles
** Measured per Square Mile of Land Area
***Values are in 2000 dollars
Source: US Census Bureau, 2004, (http://www.census.gov/)

II.B. Potentially Protected Land in Riverhead

Some 2,230 acres of land in the Peconic Watershed in the Town of Riverhead are considered high priorities for protection by the Peconic Estuary Program (PEP, 2004). These acres lie in parcels that are either vacant or are developed but can be subdivided. Given the average cost per acre of $80,000, the cost of acquiring 2,230 acres of land in Riverhead (some $178 million) would be prohibitively expensive.

In light of the high cost, only 220.67 high priority acres out of the 2,230 acres could be purchased with Community Preservation Fund revenues projected through 2020. An additional 683.41 acres, however, could be "preserved" in their open state by using land use restrictions, which would limit clearing and require clustering development to 50% of the parcel's acreage. As is given in Table 36 in the Critical Lands Protection Plan, the following acreage in the Peconic Watershed within the Town of Riverhead could be protected:

- 523.44 acres could be protected with clearing restrictions alone
- 369.41 acres could be protected by requiring cluster development alone, with a 50% cluster of existing acreage
- 683.41 acres could be protected by combining cluster development and clearing restrictions

In sum, it is these 904.08 acres (220.67 acres of vacant land preserved and 683.41 acres of open space preserved through development restrictions) in Riverhead that are the focus of the current study. Agricultural lands are not considered in this report because protection of these lands is being considered under a separate program. Wetlands also are not included because under law, these lands cannot be developed.

We note that having two categories of preserved land poses challenges for assessing some benefits and costs. Benefits and costs for the 220.67 acres are relatively straight forward. However, the 683.41 acres maintained as open space may not provide the same benefits per acre as lands acquired outright. For example, restrictions on clustering and clearing will not necessarily always provide full benefits of open space to nearby property owners, and estimating the amount of such benefits raises very difficult issues. Also, if clustering reduces the value of land which is developable, then this would be a cost to land owner.

Furthermore, land which is preserved by restrictions on clearing and clustering will provide some wildlife viewing opportunities to development residents, but may provide only limited viewing experiences for residents who live outside the particular development. As a result, assessing localized amenity benefits becomes daunting. We return to these issues later.

III. Overview of General Concepts and Methods

III.A. Recreational Benefits to Direct and Indirect Users

Our goal is to estimate the incremental non-market benefits from and costs of maintaining open space in Riverhead. This open space includes three mutually exclusive designations: wetlands, coastal fringe (within 1,000 feet of the shoreline), and forested uplands. However, as noted earlier the exact lands to be preserved have not been designated by the PEP. Agricultural lands have been excluded from the analysis because they are included in a separate program outside the scope of the research in this report. Wetlands also are not considered because by law, they cannot be developed.

Maintained in its undeveloped state, open space lands may serve as productive nursery and habitat for a vast array of wildlife and fisheries. By incurring the costs of traveling to recreation sites and other related incremental costs, users can observe, photograph, feed and hunt (although hunting occurs in Riverhead, it is minimal and is ignored in this report). Open space lands also may provide scenic vistas and contribute to other natural amenities, such as a buffer for noise and a place of solitude.

In turn, open space provides natural functions and services that support direct and indirect benefits to many user groups. *Direct* benefits arise when open space enhances physical or onsite (*in situ*) uses of environmental and natural resources. For example, outdoor recreational users gain when access to open space is maintained, by that providing an area to carry out activities such as wildlife viewing, photographing and feeding. Nearby property owners also may benefit when open space is set aside in perpetuity[3].

Here we note again that of the 904.08 acres to be maintained in open space, only the 220.67 acres to be purchased would be accessible to the public. The remaining 683.41 acres maintained as open space through clearing and clustering restrictions would be private land. In the Town of Riverhead, acreage protected through clearing restrictions would remain in the private ownership of whoever owns the developed parcel. Protected land resulting from the implementation of clustering requirements would most likely be owned by the affected development's homeowners association (Bavaro, personal comm., 2004). This does not imply such lands protected through clearing restrictions and clustering requirements provide no open space benefits – indeed that is their purpose -- just that they are inaccessible to the general public for *in situ* use, apart from use by the landowners concerned.

Indirect (offsite) uses also may be enhanced when property remains vacant. For example, swimmers may benefit because open space reduces nitrogen inputs and perhaps other pollutant flows into bay waters. Also, many wildlife species (fish, birds, deer,

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[3] Some double counting may occur, for example, if both use benefits to wildlife viewers and to nearby property owners are included. Someone may pay more for home because it gives them ready access to habitat for viewing wildlife. When the benefit from greater access is captured in the value of the home, the value of wildlife viewing on abutting property by the residents of the home should not also be included since this would count the same benefit twice. However, our data do not allow us to deal with this issue.

small mammals) travel considerable distances so that recreational fishers, birders and other non-consumptive wildlife viewers – perhaps miles away -- may have a better recreational experience because PES habitat and nursery areas are maintained in an undeveloped state. Yet, such indirect users likely are totally unaware of the wetlands that support those services.

Our study focuses primarily on direct use benefits, in this case benefits accruing to wildlife viewers and owners of property adjoining preserved lands. However, indirect benefits to swimmers are included because we have the benefit of prior research in the PES on this issue by Economic Analysis Inc..

III.B. Benefits: Consumer Surplus

For each user group, we estimate the annual flow of non-market benefits in constant, mid-2004 dollars. Non-market benefits are measured in the standard way, as the unpaid-for gain from the use of a good or service -- the value of the many services nature supports when open space provides habitat, quality water, and amenities.

Consumer surplus (CS) is the difference between the most a user is *willing to pay* to engage in recreational activities or to maintain amenities, less the cost they pay to do so.[4] For example, suppose you would be willing to pay up to $20 to visit a beach in order to swim, but the cost of doing so (for gasoline, parking, and the value of your time) is $12. Then, the unpaid for gain – CS – is $8 for that trip. In sum, throughout this report, when we use the word “benefit” we mean “consumer surplus”.

People who engage in outdoor recreation reveal that they value the activity by their actions and the costs that they voluntarily incur to participate in the activity. Visitation to and the value of sites for recreation depends upon the costs of participation, the quantity and quality of the natural resources involved, and the availability of substitutes, among other factors. In the case of direct recreation uses, land preservation affects distance traveled to recreation sites for some, and also may affect the quality of the experience by affecting congestion at available sites.

Effective land preservation programs provide a stream of benefits over time. In order to assess and compare benefits and costs, we follow standard practice and convert estimated future annual flows into a single number – a *present value*.

The present value of an annual flow of benefits or costs can be regarded as the lump sum amount of money, which, if received or paid today, would be equivalent to the annual flow concerned. Hence, if the yearly benefit (consumer surplus accruing to users) from wildlife viewing is $X each year for T years, and r is the discount rate used, the present value of the annual benefits is given by:

$$\text{Present Value of Wildlife Viewing} = \$X/(1+r)^1 + \$X/(1+r)^2 + \ldots + \$X/(1+r)^T$$

[4] WTP is compensating variation in the case of use values and compensating surplus with regard to our discussion of non-use (or total) value.

$$= \$X\,[1/(1+r)^1 + 1//(1+r)^2 + \ldots +1/(1+r)^T] \qquad (1)$$

Land purchased and left vacant provides benefits in perpetuity. In the case of a constant annual benefit of $X received in perpetuity, the present value formula is simply the annual amount divided by the discount rate:

$$\text{Present Value of Wildlife Viewing} = \$X/r \qquad (2)$$

In order to apply the formula, one more piece of information is needed -- the discount rate, "r". The choice of an appropriate discount rate raises many issues (see, for example, Weitzman, 2002). For this study, alternative discount rates of 3% and 7% are employed. The former is the administratively determined discount rate commonly used to assess natural resource damages under the Oil Pollution Act of 1990 and the Comprehensive Response Compensation and Liability Act of 1990 and it also approximates the current real rate of interest on long-term federal bonds. The use of 7% provides an upper bound rate closer to the real rate of return on private investment displaced by a public project, and use of this rate also allows for comparability with earlier studies of the PES by the authors and colleagues (Mazzotta 1999; Diamantides, 2001; Grigalunas, et al., 2005).

III.C. Benefits to Nearby Property Owners When Open Space is Preserved

Natural amenities can affect sales prices of nearby properties. For example, a residential lot with an ocean view will tend to sell for a higher price than a lot that is identical in all other ways, but which does not have an ocean view. Although natural amenities are not sold directly on the market, it may be possible to infer the value of the amenity value conferred on a nearby property owner by comparing the sales price of properties with the amenity to the sales price of properties without the amenity. The price differential will reflect the value of the localized amenity. If the price premium is less than the value held by potential buyers, then one would expect buyers to bid more aggressively on those properties relative to others without the amenity, and the price differential will tend to increase. If the price premium is greater than value held by potential buyers, then buyers will tend to bid less aggressively for those properties, and the price differential will tend to decline.

Open space provides various natural amenity services to adjacent homeowners, such as attractive views, privacy, quiet, and a readily available area for recreation. Thus, the natural amenities services to nearby property owners may be revealed in sales prices in housing markets. Property abutting open space will tend to sell for a higher price than an identical house that is not near open space, all else equal. These arguments are intuitively strong, and a rich literature using the hedonic property model documents the significance of the open space "premium" (e.g., Braden and Koldstad, 1991; Freeman, 2003).

Of course, rarely are two properties identical in all respects except for one attribute. Instead, as anyone who has bought a home knows, the price that a property commands on real estate markets reflects a great many factors. These include: lot size, size of the home and its location, the characteristics of the surrounding neighborhood, and a wide range of other environmental factors. Nevertheless, if all of these important factors can be taken into account, it is possible to isolate the value of individual factors, much as a real estate broker or tax assessor does when appraising a property.

In short, preservation of open space creates higher property values, all else equal. It follows that development confers a loss on nearby property owners, all else being the same. Below, we draw upon the results of an earlier property value study for the PES in order to estimate the localized amenity value of preserving open space in Riverhead (Opaluch et al., 1999; Johnston, et al., 2001, 2002). We show that preservation of open space provides important benefits in the Riverhead open space case study. We also discuss complications that arise when attempting to assess local amenity benefits from land restrictions limiting clearing and requiring clustering.

III.D. Total Value of Preservation Benefits Estimated in This Study

When the above, user benefits are estimated, their sum represents the use value or the social (asset) use value of the land in its preserved state. In the present study, it will be an underestimate of total value in that we include only a subset of all possible values. For example, we exclude amenity values other than those accruing to abutting property, and we only include one offsite use, swimming. Also, non-use (or passive use) value is not included because relying upon the monetary results of this research is problematic.

IV. Methods, Data and Results

IV.A. Recreational Benefits: Bird and Wildlife Viewing

For birding and wildlife viewing (hereinafter referred to simply as "wildlife viewing" unless otherwise noted), recreational benefits are estimated in two steps. First, we estimate the number of wildlife viewing trips which are "maintained" each year in Riverhead when land is preserved in its vacant state (that is, open space is not lost to development). This is done by estimating a statistical relationship between the *number* of outings and the acreage of open space. This relationship is used to estimate the annual number of recreational outings that would be maintained by avoiding the loss of 220.67 acres of open space. Then, these outings maintained are valued using the results of a recently published economic study carried out by the US Fish and Wildlife Service (USFWS, 2004). Unfortunately, the USFWS unit of analysis for estimating the value per trip for wildlife viewing is at the state level only; no estimates are available at the sub-state level. Hence, we use the value per wildlife trip for the State of New York.

The USFWS shows a value of $52 per outing for 2001 and $26 per outing for 1985 (both in 2001 dollars). However, the USFWS the two estimates are not statistically different because the small sample size creates a wide variance in the estimates. We use the average of these two estimates. This results in a value of $41.6 per outing when updated to mid-2004 dollars.

The USFWS provides estimates of the number of trips only at the state level for New York; an estimate specific to the PES are not available. Fortunately, the results of an earlier study by Economic Analysis, Inc. of land- and water-based recreational uses was carried out specifically for the PES (Opaluch et al., 1999; Diamantides, 2001) and some of the results obtained are useful for the present study.

For the PES recreational use study, EAI constructed a survey following standard survey development methods, including focus groups, one-on-one interviews, and a pilot test (for details, see Opaluch et al., 1999 and Diamantides, 2001). The final survey was administered throughout the PES during the week of August 22-29, 1995 using convenience intercept sampling at a variety of pre-selected public sites. These sites included shopping malls, post offices, and busy street corners, as well as recreational sites (Diamantides, 2001).

Briefly, a total of 1,354 recreational use surveys were completed by residents, second homeowners, and visitors. Respondents were asked about their participation in outdoor recreation activities in the PES. They were queried about whether they engaged in land and water-related recreation activities within the past year, and if so, the location(s) visited, and the number of times they visited each location.

Of direct relevance for this report, respondents were asked specifically about their participation in birding and wildlife viewing ("wildlife viewing") within PES towns. A total of 45 residents and second home owners from Riverhead were interviewed and of these, 35 engaged in wildlife viewing. In total, the 35 participants reported that they took 683 outings[5]. It is important to note that 60% of the participants were visitors and not PES residents or second homeowners. Later, we adjust our results to exclude the benefits of land preservation to visitors to the PES who do not "count" in our assessment of benefits in this study,

IV.A.1.Linking Outings and Open Space

Given our goal of estimating how preserving land in its vacant state provides recreational benefits, we want to know the link between use and the availability of open space. The data available is limited to the 5 PES towns (n = 5), but to pursue this issue, a simple analysis was done to see if wildlife viewing in PES towns is associated with the total open area available for such activities.

We regress the annual number of wildlife outings taken by residents and second homeowners in each town as reported in the EAI recreational survey on open space (excluding agriculture lands) and on income (often associated with education), also from the survey. Thus, we have the regression:

$$\text{Riverhead Wildlife Viewing Outings} = \beta_0 + \beta_1 \text{Open Space} + \beta_2 \text{Income} + e$$

Information on wildlife viewing outings, by town, is from the EAI recreational survey (Opaluch et al., 1999; Diamantides, 2001), as described above. Data on acres of open space for each town is taken from land use analysis done as part of the PEP program for the CLIP. In the PEP land analysis, open space is measured as three mutually exclusive categories: total acreage of wetlands, vacant coastal land within 1,000 feet of the shoreline, and forested upland area. Agricultural land is omitted because it is less accessible to viewers than other vacant land, as noted. The income of participants also is taken from responses to the EAI survey. The data used are given in Table 3.

Table 3. Birding and Wildlife Viewing Outings, Open Space, and Average Participant Income for PES Towns

Town	Bird Watching Outings	Wildlife Viewing Outings	Total Wildlife Viewing Outings	Open Space (exc. Agric. Land)	Average Income
Riverhead	498	185	683	3,565	57,849
Southold	837	871	1,708	2,338	72,007
Southampton	746	908	1,654	1,053	78,058
East Hampton	1,438	1,470	2,908	5,334	74,934
Shelter Island	1,143	1,267	2,410	5,268	75,678
All Towns	4,662	4,701	9,363	17,558	71,705

[5] We note the risk that respondents may overstate the number of outings, if recall or memory bias occurs (Westat, 1989). In contrast, vivid events, doctor appointments, and the like may be easier to recall than recreational outings.

It is interesting to note that the participation rates for bird watching and wildlife viewing used herein are very similar to the participation rates reported by the US Fish and Wildlife in their annual recreational survey (U.S. Fish and Wildlife Service, 2002). Our survey respondents report an average participation rate of approximately 21.3 days per person. The US Fish and Wildlife survey reports an average participation rate of 20.8 days per person for New York. Hence, the estimated participation rates from our survey are very close to those for the US Fish and Wildlife Service, adding credibility to our results.

Nevertheless, there is some concern that participation days could be overstated. It is well known that recall or memory bias is a potential issue when respondents are asked to recall recreational trips over a past period (Westat, 1989). Unlike visits to the doctor, for example, which are rare and involve appointments, people simply may not recall the exact number of trips taken to engage in specific activities during an extended period, like the past year. Empirical evidence suggests that people tend to overstate trips, sometimes quite dramatically (e.g., Westat, 1989).

A possible problem surfaced in assessing the number of trips taken by respondents. Some reports on the number of outings so high that their credibility is open to question. Wildlife viewers in Riverhead reported up to 180 trips in the past year, and two PES towns (Southhampton and East Hampton) had respondents reporting as many as 240 visits in the past year. The variation is such that for each town, one standard deviation includes negative trips.

Given the possible overstatement because of recall or memory bias, we adopted a rule whereby we “trimmed” the responses for individuals who reported the top 5% of outings. This results in an estimate of outings per participant of 14, substantially below the untrimmed EAI data and the USFWS data. Excluding these individuals lowers estimated use and provides a more conservative (lower) estimate of recreational benefits. Doing so also somewhat improved the statistical results, presented below. We note, however, that the statistical results are very similar to those obtained when all observations are included. Hence, while using the trimmed data slightly reduces benefits, the trimming does not significantly change the statistical results, which appear to be robust.

The estimated equation (Table 4) has an adjusted R^2 of 0.86, the coefficients have the right sign and are all significantly different from zero at the 10% level. Hence, a positive relation exists at the town level between total outings for wildlife viewing and open space. The results can be used to infer incremental effects: how a change in open space affects wildlife viewing outings. According to the regression results, loss of an acre of open space land would reduce the number of wildlife outings for the sample by 0.287. Looked at in a way more appropriate for this study, preserving an acre in its natural state would *maintain* 0.287 visits per year for the sample.

Note that this estimate appears reasonable, compared with the average participation per acre of open space from our sample. Using the results of Table 3, we find that the average annual number of outings per acre of open space is about 0.57 per year for the trimmed sample (0.81 annual outings per acre for the full sample). Our findings above are that the change in the annual number of outings with increased open space is 0.29 outings per acre. If participation increases at a decreasing rate with availability of open space, then one would expect the marginal effect on participation of an additional acre (0.29) to be less than the average number of outings per acre (0.57). So the results of our analysis are consistent with this rationality test.

Below we convert these results to estimate the total wildlife visits maintained through preservation of 220.67 acres of vacant land. As discussed above, we do not include recreational benefits for the approximately 641 acres preserved through clearing and clustering restrictions on private developed land, based on the assumption that there is no public access to that land.

Table 4. Regression Results – Dependent Variable Total Wildlife Viewing Outings by Residents and Second Homeowners

	Coefficients	Standard Error	t Statistic	P-value
Intercept	-3931.32	1220.64	-3.221	0.084
Open Space	0.287	0.0708	4.059	0.056
Income	0.057	0.0164	3.4711	0.074

N=5 Adj R^2=0.86 F: 14.41

Given that an additional acre of open space maintains 0.287 wildlife viewing outings per year, preserving 220.67 acres of land would maintain 63 (=220.67*0.287) outings annually for the sample.

Our final step for estimating the number of outings is to expand the sample to the entire population of Riverhead in order to get total wildlife viewing outings preservation maintains for the town. Following standard practice, we count only residents or second homeowners 16 years of age or older. The total population 16 years of age or older in Riverhead is estimated as 23,686 in the year 2000. This includes a year-round population 16 or older of 21,921 (US Census) and an estimated 1,765 estimated “equivalent” second homeowners[6]. We assume that the 45 individuals sampled are generally representative of the Riverhead population at large. This expands the number of yearly resident and second homeowner wildlife visits to 151 per acre preserved (=[(0.287)*(23,686/45)], or approximately 0.41 outings per acre per day.

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6 The population of second home residents in the PES is unavailable, but there are 1,165 seasonal homes in Riverhead (Table 2). We estimate second home resident by assuming that such homes have the same number of occupants over 16 per home as year-round residences, 2.02. However, second homes by definition are seasonal (many without heat). Part time occupants are in residence less and hence likely will take fewer outings than full time residents. To account for this in our calculations, we assume that second homes are occupied 75% of the time during the wildlife viewing season which we take to be 8 months, April–November. Hence, implicitly second homeowners take fewer trips per person per year in Riverhead than fulltime residents since they are in residence less often.

Now we are in a position to estimate the benefits that land preservation has for those who engage in wildlife viewing. Using the value per wildlife viewing outing of $41.60 (in mid-2004 dollars) from the USFWS, as described above, the annual benefit of 220.67 acres of open space is $1.38 million per year from preserving 220.67 acres.

In perpetuity, the present value of the 220.67 acres is $46.2 million for the 3% discount rate and $16.1 million for the 7% discount rate. The implied value *per acre* for wildlife viewing ranges thus from $31,663 to $83,706, depending upon the discount rate (Table 5). The recreational values per acre seem somewhat high. However, the annual outings per person in the EAI study were quite close to those found in the USFWS survey and therefore seem credible. Furthermore, our estimate of the increase in recreational activity from an additional acre is less than the average recreational use per acre of open space in the Peconic, which also adds to the credibility of our results.

Table 5. Present Value of Non-Market Benefits of the Wildlife Viewing Trips Maintained by Preserving 220.67 Acres of Vacant Land in Riverhead in Perpetuity at 3% and 7% Discount Rates (in mid-year 2004 dollars)

	3%	7%
220.67 Acres	$46.2 million	$16.1 million
Per Acre	$209,362	$72,960

Several factors may cause benefits to be overstated. For one thing, our use of the per-trip estimate of $41.6 from the USFWS may be too high for wildlife viewing in Riverhead. The USFWS estimate is for a dedicated trip to view wildlife at least 1 mile from home. In the EAI survey, we did not strictly define such outings, and hence it is possible that some respondents might have included viewing in or near their backyard as a viewing event. Respondents also may have counted a single trip as both a bird viewing and a wildlife viewing trip, raising the possibility of double counting outings in both categories (which we added to get total wildlife viewing days). Also, recall or memory bias may have occurred, and such bias has been found to lead to overstatements of activity levels (Westat, 1989), as noted. Further, despite our efforts to adjust for possible recall by bias by eliminating the highest 5%, it is possible that all respondents have exaggerated recall of trips made, or that the absolute error is greater for those who made the most trips. Finally, it is possible that the individuals who responded to the survey were more interested in wildlife viewing than the average person, and hence were not representative of the population in general. In short, the estimates of benefits for wildlife viewing may be still overstated for all of these reasons.

On the other hand, benefits could be understated, for several reasons. For example, we exclude offsite wildlife viewing benefits which might result from protected habitat in Riverhead. We also exclude benefits to non-residents who recreate at sites in Riverhead.

IV.B. Recreation Benefits: Swimming.

Improving water-dependent recreation and other uses is one of the stated goals of the PEP. This section focuses on non-market benefits to *swimmers* from controlling nitrogen pollution through maintaining open land in its natural state. We focus on swimming because it is the most important (in terms of participation) water-based recreational activity and is directly affected by water quality. However, we exclude other potential benefits, such as improvements in shellfishing, boating or fin fishing which also could occur. Further, we focus on the issue of water clarity, which earlier research has found to be a key water quality attribute for swimmers (Diamantides, 2001; Poor *et al*., 2000; Freeman, 2003).

We illustrate the basic problem using a hypothetical (Hicksian income-compensated) demand function for an individual for recreational swimming trips to the PES. The number of trips in a time period depends upon the cost of engaging in the activity (price), the price of visiting substitute sites, site quality, and initial utility. Price is assumed to reflect the cost of participation and encompasses all incremental costs, including the opportunity cost of the user's time.

$$r_B = D(P,\mathbf{Ps},Q_{B,} U^0) \qquad (1)$$

Where

r_B = quantity of recreation days
$D(\cdot)$ = Demand function for recreation trips to the site
P = Price of visiting site i,
$\mathbf{Ps}$ = Vector of the prices of visiting substitute sites $j = 1,\ldots J, j \neq i$
Q_B = Site quality before the change
Q_A = Site quality after the change
U^0 = Individual's initial level of utility

Given an initial choke price, P*, consumer surplus (CS) is measured as the area under the individual's demand curve and above the price of participation (Area A+B+C in Figure 2). Suppose now that site quality decreases following a loss of open space land to development. The change in quality from Q_B to Q_A at site i shifts the demand for trips to the site from $D(Q_B)$ to $D(Q_A)$, causing a decrease in trips, r, from r_B to r_A. The new choke price is P**, and the quality change decreases CS to from area A+B+C to area B in Figure 2. The decrease in CS reflects losses accruing to the user associated with a reduction in days (Area C) plus the loss associated with a reduction in quality of days that continue to occur despite the loss in quality.

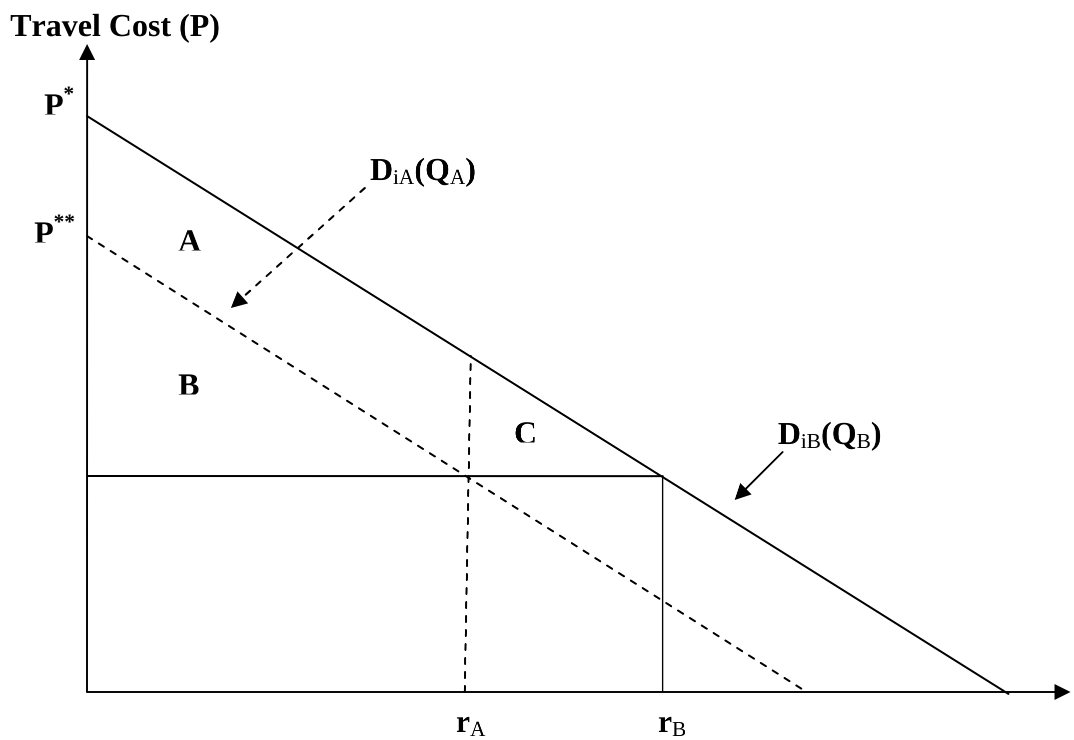

Figure 2. Consumer Welfare Loss Effect Due to Quality Reduction at Site

Key empirical issues for estimating the recreational demand model concern (1) perceptions of water quality by recreational users, (2) how recreational behavior is affected by such quality perceptions, (3) the link between these *subjective* perceptions of quality and *objective* measures of quality; and (4) the estimated recreational behavioral changes due to the cause-and-effect link between source controls and objective water quality measures.

In order to estimate benefits to swimmers arising from maintaining water quality in Flanders Bay through land preservation, a link first must be established between the change in land use and water quality. To do this, we draw upon two studies.

One is an earlier economic study by Economic Analysis, Inc. of swimming benefits for the PES by Diamantides (2001) (also, see Opaluch, et al., 1999; Johnston, et al., 2002). A unique feature of the EAI recreation study is that it linked subjective and objective measures of water quality. Specifically, the swimmers who responded to the survey were asked their subjective assessment of water quality ("poor", "fair", "good", and "excellent"). Then, the swimmers' subjective assessments were compared with area-specific measures of water quality based field sampling measures for each PES Bay carried out by the Suffolk County Department of Health around the same time as the EAI survey August 1995). A key result is that the Department of Health "objective" measures of water quality based on sampling at the time of the survey were found to be statistically associated with the "subjective" perceptions of recreational swimmers in the PES.

This is an important finding. The connection between swimmers' subjective perceptions of water quality and objective measures of water quality based on field sampling was exploited in Grigalunas, et al. (2005). They used the results of a three-dimensional, hydrodynamic model developed by TETRA TECH (2000) for the PEP in which water quality parameters were simulated for selected source control policies. The estimates of water quality then were used in the recreation demand model, as explained below.

A full explanation of the details of the hydrodynamic model is beyond the scope of this work (for details see TETRA TECH, 2000). It is sufficient to note that the model provides a dynamic simulation of nitrogen inputs, subsequent transport through the Peconic Bay system, storage in and remobilization from the sediments, and degradation over time. Hence, when the model determines the effects of actions taken to control nitrogen inputs at a point, it simulates how nitrogen stocks change over space and time, until a new equilibrium is reached.

The TETRA TECH model simulates the effect of several stylized water pollution source control policies on water quality parameters for fine-grid "cells" throughout the PES bay system, including Flanders Bay, the major "sink" for pollution from Riverhead. Of special interest for this report, TETRA TECH simulated how build out (development) options within the PES would affect water quality throughout the PES.

The estimates of water quality changes from the TETRA TECH model were used as input to a recreational demand model developed by EAI (Opaluch et al, 1999; Diamantides, 2001). In turn, the economic model provides estimates of the associated changes in recreational swimming trips and their value. Hence, as water quality changes spatially and temporally, and recreational demand shifts over space and time in response to these quality changes. Our results consider how improved water quality provides benefits both by increasing the number of recreational swimming trips taken to a bay, and by improving the quality of the swimming experience.

This linking of a hydrodynamic model and an economic model yielded an estimate how swimming and the resulting benefits change, using the estimated relationship between the objective measures of water quality, as simulated by the TETRA TECH analysis, and the subjective perceptions of swimmers. Specifically, one of the source control policies considered by TETRA TECH involved the consequences for bay water quality for full build out--that is, development of all undeveloped land throughout the PES. We adapt these results in order to estimate the benefits from land preservation in Riverhead.

For this study, we assume that the preservation of 904.08 acres in Riverhead (220.67 acres of vacant land plus 683.41 acres of developed but sub-dividable land) is equivalent to 50% percent of the land which would be affected by the "full build out" scenario simulated by TETRA TECH for areas surrounding Flanders Bay. Our earlier study estimated that full build out would involve a present value loss of \$2.35 million in mid-2004 dollars over a 25-year period at 7% (Grigalunas et al, 2005, Table 7). The corresponding loss in perpetuity would be \$2.87 million in mid-2004 dollars.

Preservation of 904.08 acres in Riverhead would reduce this loss by maintaining water quality. Of course, we do not know the specific acres to be protected, and it is possible that some lands may offer more water quality protection, and hence benefits, than others. Without this information, we assume all lands preserved in their undeveloped state are equally productive in maintaining quality. Assuming that the preservation of the 904.08 acres is 50% of the build out scenario in the TETRA TECH analysis, the indirect use value benefit to swimmers would be $1.43 million (0.5*$2.87) in mid 2004 dollars at 7%. This is equivalent to a value of $1,580 for each acre preserved in perpetuity. At 3%, the benefit to swimmers from maintaining water quality would be $4.79 million, or $5,216 per acre preserved in perpetuity.

Of the 904.08 acres, 24% of the land (220.67 acres) would be preserved by outright purchase. Hence, consistent with our assumption that all acres preserved provide the same water quality benefit, we can assign this 24% of the offsite swimming benefits to land purchase. This amounts to $349 thousand at 7% and $1.17 million at 3%. The balance (76%) can be assigned to the 683.41 acres of land protected by restrictions relating to clearing and clustering. This comes to $1.08 million at 7% and $3.62 million at 3%.

IV.C. Localized Amenities to Adjacent Property Owners

As discussed above, preservation of open space parcels provides localized amenities to adjacent property owners. Note that open space could also provide broader aesthetic benefits, including benefits other nearby property owners and broader amenity values to all residents and visitors who enjoy the rural character of the Peconic region. However, data limitations preclude us from considering these broader aesthetic benefits.

Here we outline an illustrative example of calculating the local amenity value from preserving open space through outright purchase of 220.67 acres of open space. Given that we do not now have actual open space parcels to evaluate, this illustrative example uses a number of simplifying assumptions regarding the open space parcel and the adjacent private properties. Of course, if there is parcel-specific information, this information should be used in place of the assumptions described below.

To calculate the contribution of open space to the value of adjacent properties, one needs to determine the number of adjacent properties and the change in value of properties due to localized amenities provided by adjacent open space. We make a number of simplifying assumptions in place of parcel-specific values for these. First, the number of private parcels adjacent to open space is estimated based on (1) the perimeter of the open space parcel, (2) the fraction of land that is comprised of private residential properties (including vacant lots), and (3) the average size of residential properties.

The perimeter of the parcel of open space is calculated from the acreage of the open space parcel, assuming the parcel is square. The total linear distance of developed property is calculated by multiplying the linear distance of the perimeter of the open space parcel by the percentage of privately owned, residential lots. The number of parcels is then calculated assuming each parcel is 1 acre and square. The linear distance of developed property surrounding the open space parcel is divided by the average linear distance of a side of a one-acre developed parcel (approximately 210 feet). This ratio is multiplied by the fraction of land that is comprised of residential properties to provide an estimate of the number of private parcels that enjoy the amenity value of the adjoining parcel. For purposes of this example, we assume four 55 acre parcels of open space are preserved, totaling 220 acres. Two parcels are presumed to be located within 1,000 feet of the shoreline, and the other two are assumed to be further than 1,000 feet of the shoreline.

The price premium for localized open space amenities is assumed to be 12% of the average sales price of developed parcels, based on the results of a hedonic property model in Opaluch et al (1999). The average value per residential parcel is based on average selling prices of houses for 2004. This information was obtained by contacting three PES real estate companies. Estimates of representative prices ranging from $350 thousand to $375 thousand. For purposes of this illustrative example, private property within 1,000 feet of the shoreline is presumed to be of higher value ($500 thousand) than properties located further than 1,000 feet from shoreline ($200 thousand). All other parameters are assumed to be identical for all open space parcels.

Using the assumptions described above, there are 24 private properties adjacent to each open space parcel. As shown in Table 6, the value of localized amenities for the each of the two 55 acre open space parcels within 1,000 feet of the shoreline is estimated to be approximately $1.44 million, or approximately $26 thousand per acre. The value of localized amenities provided by each of the open space parcels located more than 1,000 feet of the shoreline is estimated to be approximately $576 thousand, or approximately $10 thousand per acre. We use the mid-point of the two estimates of per acre amenity values-- $18 thousand per acre in mid-2004 dollars -- to reflect the value of to adjoining property owners because of preservation of open space in Riverhead. The total value of the 220.67 acres is approximately $4 million.

Of course, it should be emphasized that these results are specific to the many assumptions regarding the number and value of adjacent residential properties. The accuracy of the results could be improved significantly by using parcel-specific information.

Table 6. Localized Amenity Values

Parcel Less Than 1,000 Feet from Shoreline

Size (Acres)	55
Number of Adjacent Parcels	24
Average Value of Properties	$500,000
Local Amenity Value ($000)	$ 1,440.0
Value per Acre ($000)	$26.2

Parcel Greater than 1,000 Feet from Shoreline

Size (Acres)	55
Number of Adjacent Parcels	24
Average Value of Properties	$200,000
Local Amenity Value ($000)	$576.0
Value per Acre ($000)	$10.5

Average Value per Acre ($000)	$18.3
Total Acres Preserved	220.67
Total Amenity Value ($000)	$4,044.3

Calculating the localized amenity value associated with development restrictions is somewhat more complicated. First consider cluster development. Property owners adjacent to the open space portion of the cluster might enjoy the open space, but property owners adjacent to the developed portion of the parcel might be worse off than they would by living next to a traditional development due to the increased housing density. Imposing clearing restrictions could provide some benefit to owners of adjacent property, but would probably provide less benefit than would permanently preserved open space.

Unfortunately we have no data to quantify the effects of either type of development restriction on adjacent property owners. Therefore, we make a set of assumptions to provide a perspective on the range of benefits that might result. On the low end, we assume no benefit to adjacent property owners from either type of development restriction. On the high end, we assume that the benefits per acre of preserved open space from development restrictions are equal to the benefits per acre of open space obtained through outright purchase of vacant land.

Under these assumptions, the per-acre benefits to adjacent property owners from development restrictions range from zero to $18.3 thousand. Therefore, the benefits of open space from 683.41 acres of open space obtained through imposition of development restrictions range from $0 to $12.5 million (=18.3 thousand *683.41).

IV.D. Summary of Non-Market Benefit Results

We estimate benefits for a subset of values provided by preserving 904.08 acres of open space, 220.67 purchased outright and 683.41 preserved through restrictions on development. The categories of benefits included in the analysis are (1) onsite recreational use for wildlife viewing, (2) swimming benefits associated with protected water quality in Flanders Bay, and (3) benefits open space provides to adjacent property owners. Note that many benefits are not included in this analysis, including offsite benefits to recreational fishers, offsite wildlife viewers, and amenity values to those other than owners of adjacent property. We also have not included non-use values and perhaps other values.

The quantifiable benefits from purchase of 220.67 acres of vacant land range from about $20.5 million at a 7% discount rate to $51.4 million for a 3% rate. The midpoint of these two estimates is approximately $36 million, or roughly $160 thousand per acre. Most of these benefits (over 80%) are attributable to recreational access. The benefits from placing development restriction on 683.41 acres of private land range from $1.1 million to $15.9 million, with a mid-point estimate of about $8.5 million. For the high end estimate, most of the benefits result from localized amenities to adjacent property owners. For the low end estimate, all of the benefit comes from water quality improvements.

Table 8. Summary of the Present Value of Non-Market Use Value Benefits from Land Preservation in Riverhead (in millions of mid-2004 dollars)

	Purchased Vacant Land (220.67 acres)		Development Restrictions (683.41 acres)		Total Benefit of Land Preservation (903.08 acres)	
Category of Benefits	High End Estimate	Low End Estimate	High End Estimate	Low End Estimate	High End Estimate	Low End Estimate
Wildlife Viewing [a]	$46.2	$16.1	----	----	$ 46.2	$ 16.1
Water Quality – Swimming [b]	$ 1.2	$ 0.4	$ 3.6	$ 1.1	$ 4.8	$ 1.5
Localized Amenities[c]	$ 4.0	$ 4.0	$12.3	$ 0.0	$ 16.3	$ 20.3
Total	$ 51.4	$ 20.5	$ 15.9	$ 1.1	$ 67.3	$ 21.6

[a] Includes birding and wildlife viewing for 220.67 acres of vacant land. The high end estimate is based on a 3% discount rate, and the low end estimate is based on a 7% discount rate. Residents on property with open space protected through cluster and clearing restrictions assumed to get 0 benefit from wildlife viewing on protected land.

[b] For 904.08 acres (220.67 vacant land and 683.41 of developed but sub-dividable land kept open by clearing and clustering requirements).

[c] High end estimate is treats open space amenity values for 683.41 acres of open space associated with cluster development and cutting restrictions identical to that for purchase of vacant land. The low end estimate is based on zero amenity value for open space associated with cluster development and cutting restrictions.

IV.D. Costs

The cost of open space is the value of the services given up when land is withdrawn from alternative residential, commercial, or other use – that is, the cost we are interested in is the opportunity cost of the land. As noted earlier, the opportunity cost of land will depend upon such factors as (1) the location of the land, including especially proximity to the shoreline; (2) applicable zoning requirements; (3) infrastructure requirements and in place (roads and utilities); (4) whether it is forested; and (5) other factors (see e.g., Edwards and Anderson, 1984; Opaluch, et. al, 1999). The opportunity cost of private land will be reflected in its price when there are well functioning land markets, therefore we use the price of acquiring land as a measure of its opportunity cost. We adopt estimates of land costs prepared by the Nature Conservancy for the PEP (see Table 9).

These results show that substantial differences in the cost per acre for vacant land within Riverhead. Non-wetland land near the shore, for example, is 75% more expensive, on average, than forested uplands. Differences also exist between the cost of land near the shore in Riverhead and land in this category in other PES towns (Table 9). In contrast, lots containing wetlands are far less expensive to acquire than other types of lands, primarily because of development restrictions placed on wetlands. Agricultural lands are not considered because they are being considered for preservation under another program. Also, wetlands are not considered in our benefit-cost analysis because by law they cannot be developed.

Table 9. Average Cost per Acre of Acquiring Land in Riverhead and the Peconic Watershed (in mid-2004 dollars).

Land Types	Average Cost - Riverhead	Average Cost - Overall Peconic Watershed
Lots Containing Wetlands	$13,000	$13,000
Lots Within 1000' of Shoreline With No Wetlands	$175,000	$136,627
Forested Uplands with No Wetlands and Outside 1000' from Shoreline	$100,000	$100,000
Agricultural Lands	$50,000	$50,000

Source: Peconic Estuary Program (2004), Attachment #1 (June 9)

As in the preceding section, we provide two estimates of costs for the 220.67 acres to be purchased. The other 638.41 acres of developed but sub-dividable land is excluded from our assessment of costs because the open space maintained on these lands through the use of restrictions on clearing and clustering involve no out-of-pocket cost to the public. Note, however, that placing restrictions on development may imply a private cost to landowners.

The high-cost estimate assumes that all the 220.67 acres of land purchased are within 1,000 feet from the shoreline. Under this assumption, the cost per acre would be $175,000 per acre for a total cost of acquiring 220.67 acres of $38.62 million. The second estimate assumes all of the land purchase for preservation as open space is forested land located beyond 1,000 feet from the shoreline. Using this information, the cost of purchasing 220.67 acres of vacant land is $100,000 per acre or $22.07 million in total. Below, the midpoint of these calculations, $30.35 million, is used in our overall assessment of the benefits and costs of preserving land in Riverhead.

Calculating the costs associated with cluster development and cutting restrictions is more difficult to assess. Development restrictions do not require an explicit public expenditure, as is true with outright purchase. However, such restrictions do impose private costs on the developer and purchasers of the property. For example, cluster development creates open space that is enjoyed by the purchasers of the properties, but it also increases the density of housing on parcels that are developed. Hence, there are offsetting effects of land use restrictions on private property owners, and the net effects should be reflected on the sales prices of the properties with land use restrictions. Unfortunately, we do not have data on such sales, so we are unable to estimate the costs associated with development restrictions.

V. Summary, Conclusions and Qualifications

The Peconic Estuary System (PES) is known for the high quality of its environment, is an important destination for summer visitors, and provides a range of resource-based services to residents, second homeowners, and visitors. However, development pressures threaten the sustainable use of, and benefits from, the PES environmental and natural resource base.

To maintain the quality of the water, habitat, and other resources, the PEP proposes to purchase and maintain in its vacant state 220.67 acres of land and to preserve 683.41 acres of sub-dividable land through restrictions on clearing and requiring clustering. However, the benefits and costs, using the town of Riverhead as a case study. Unfortunately the task is complicated by the fact that specific properties have not yet been targeted for preservation. If additional data on the specific properties to be preserved were known, more precise estimates of benefits and costs could be made.

We estimate the incremental economic non-market benefits of land preservation for (1) wildlife viewing, (2) swimming in Flanders Bay, and (3) the amenity benefits open space provides to nearby property owners. Benefits are measured in perpetuity inasmuch as the protected lands will be preserved in their natural state indefinitely. For the purposes of this report, only benefits and costs to residents and second homeowners of the PES are considered. Benefits to visitors are excluded. All monetary values are in constant mid-2004 dollars.

Non-market benefits to wildlife viewers are estimated as the value of the outings maintained when 220.67 acres of vacant land are purchased and maintained by the public. Only purchased land is included for this category of benefits, because land preserved to through clustering and clearing restrictions is private land, and hence not generally available to the public for wildlife viewing to the public.

The annual value of wildlife viewing trips maintained was estimated using a simple regression analysis to establish the relationship between the change in open space (excluding agricultural land) and changes in the number wildlife viewing outings. This allowed us to estimate the number of outings maintained each year for a marginal acre and, by extension, the 220.67 acres to be purchased. Each visit maintained was valued using the results of the wildlife viewing per trip ($40.60) in New York State from the US Fish and Wildlife Service. Annual values for wildlife viewing were assumed to continue in perpetuity and discounted at 3% and 7%. The estimates of the total present value and the value per acre for the 220.67 acres ranges from $16.1 to $46.2 million, depending upon the discount rate used (Table 8).

Benefits to swimmers are estimated as the value of the water quality maintained in Flanders Bay when 905.08 acres are protected from development, by that reducing pollution of the Bay. To arrive at this estimate, we use the results of prior research by EAI, in which we linked the TETRA TECH three-dimensional hydrodynamics model for the PES with an economic model of recreational swimming benefits in all PES Bays.

The present value of this category of benefits to Riverhead is $1.1 to $3.6 million (Table 8).

The amenity benefits to nearby homeowners from reserving vacant land was estimated by making reasoned assumptions concerning the number of nearby property owners who would be affected and the average value of the affected properties. Preservation is estimated to increase nearby property values by 13%, based on a prior study of property value determinants (hedonic property model) by the authors and colleagues (Opaluch, et al., 1999; Johnston, et al., 2001). These benefits amount to approximately $4 million for 220.67 acres of vacant land purchased preserved in perpetuity.

Overall, we find that our sensitivity analyses for the non-market benefits of open space preservation bracket the costs of acquiring the vacant land. The estimated benefits of preserving 220.67 acres of open space in perpetuity range from $20.5 million to $51.4 million. The mid point of these results is approximately $36 million or $163 thousand per acre. In contrast, the total cost of acquiring 220.67 acres of open space is estimated to range from approximately $22 million to approximately $38 million, with a mid-point estimate of about $30 million or $135.9 thousand per acre.

Therefore, the mid-point of the range on estimated benefits exceeds the mid-point of the range on estimated costs by about 20%. Given the many uncertainties involved, we conclude that the estimated costs and benefits are of similar magnitude. Again, we remind the reader that our benefit estimates exclude several categories that could be important, including offsite benefits to boaters and recreational fishers from water quality, amenity values to those other than adjacent property owners, recreational values to non-residents, and non-use values. Including these categories of benefits would undoubtedly strengthen the case for preservation over development.

We also estimate the benefits, but not the costs, associated with development restrictions that preserve 683.41 acres of land through cluster zoning and clearing restrictions. These development restrictions involve no out-of-pocket public expenditure, but limitations placed on development may involve private costs which should be reflected in changes in the selling prices of these properties. Unfortunately, we have no data upon which to base estimates of those costs. Thus, social costs and benefits are involved in these forms of development restrictions, but we currently have no information upon which to base estimates the costs of land development restrictions.

Non-market benefits associated with development restrictions fall into two categories: amenity values for adjacent property owners and water quality benefits to swimmers. We do not estimate recreational benefits associated with wildlife viewing and bird watching, since the open space preserved through development restrictions will not necessarily have public access (though occupants of hosuing on preserved lands will realize some benefits). Amenity values for this category of open space are estimated to range from $0 to $12.5 million. Swimming benefits from land restrictions are estimated to range from $1.1 million to $3.6 million. Total non-market benefits for open space preserved through land use restrictions are estimated to range from $1.1 million to $16.1 million. Again, it should be emphasized that there are several categories of benefits are excluded in these estimates, so that true values would be expected to be higher than these estimates.

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