THE ECONOMICS OF CONSERVATION SUBDIVISIONS
Price Premiums, Improvement Costs, and Absorption Rates

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The environmental benefits of less land consumption and a growing interest in addressing the negative economic and social impacts of sprawl have resulted in calls for more sensitive subdivision designs. One such design is conservation subdivisions. However, not much is known about these subdivisions, in particular about their economics. This article addresses the issue by examining price premiums, investment costs, and absorption rates for lots in conservation versus those in conventional subdivisions. The results show that lots in conservation subdivisions carry a premium, are less expensive to build, and sell more quickly than lots in conventional subdivisions. The results suggest that designs that take a holistic view of ecology, aesthetics, and sense of community can assuage concerns about higher density. However, the potential negative consequences of conservation subdivisions require further study.

Keywords: *conservation subdivisions; open space; developers; Smart Growth; New Urbanism*

The environmental benefits of less land consumption and a growing interest in addressing the negative economic and social impacts of sprawl have resulted in calls for more sensitive subdivision designs (Randolph 2004, 39; Rocky Mountain Institute 1998). One such type of design is "conservation

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subdivisions." These subdivisions are defined by their use of the natural landscape as the basis for overall design (Arendt 1999a). Their advantages over conventional "cookie-cutter" subdivisions include reduced land consumption, less damage to the environment, and the preservation of open space (Arendt 1999a; Arnold and Gibbons 1996; Berke et al. 2003; Odell, Theobald, and Knight 2003). Figure 1 shows a generic conventional subdivision and compares it to a generic conservation subdivision.

Beyond these broad generalizations, however, not much is known about conservation subdivisions. An exchange between Arendt (1997) and Daniels (1997) highlighted some of the unknowns related to conservation subdivisions, including their role in controlling sprawl and preserving agricultural land and their effects on the environment and land prices. This exchange presaged a growing interest in gaining a deeper understanding of the effects and policy implications of utilizing conservation subdivisions as a component of land use policies.

The issues related to conservation subdivisions are wide-ranging and require further study before a comprehensive picture of the policy implications of using these subdivisions can emerge. One of these issues is the economics of conservation subdivisions. In broadly discussing the economics of new subdivision designs, Pauker (1997) lists price premiums, investment costs, and absorption rates as three of the unknowns that hinder adoption by developers.

This article contributes to our understanding about conservation subdivisions by addressing these unknowns from three directions: First, it examines whether there is a price premium for lots in conservation versus conventional subdivisions. Although the natural and social features of conservation subdivisions are appreciated by residents (Kaplan, Austin, and Kaplan 2004), higher-density development is viewed negatively by most Americans (Danielsen, Lang, and Fulton 1999). How these two competing features of conservation subdivisions are resolved in the market is not clear.

Second, this article examines whether lots in conservation subdivisions are less expensive to build than lots in conventional subdivisions. Although smaller lot sizes reduce infrastructure costs, requirements to build around the natural features of a parcel might increase the overall cost of conservation subdivisions, offsetting any premiums such lots may carry.[1] The industry's experience with novel projects can explain developers' reluctance to undertake projects with uncertain costs. For instance, imaginative projects such as Reston, Columbia, and Kentlands almost failed because the rate of disposal of finished property was not sufficient to cover upfront costs (Fulton 1996).

Third, this article examines absorption rates for lots in conservation versus conventional subdivisions to ascertain if lots in the former sell at a faster

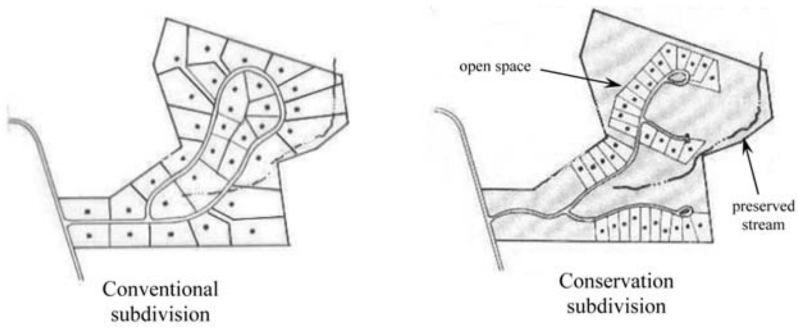

Figure 1: Generic Conventional and Conservation Subdivisions
SOURCE: Reprinted from Arendt et al. (1996).

rate. Differences in absorption rates will corroborate results from the analysis of prices. Although the research reported in this article does not ascertain the exact profits associated with conservation subdivisions, an examination of price premiums, improvement costs, and time on the market permits a ranking of the profitability of conservation subdivisions relative to other designs. Together, the results show that conservation subdivisions are more profitable to developers than conventional subdivisions.

The need for a convincing business case for developers is not trivial. Developers have long been known to be risk averse (Baerwald 1981; Kenney 1972; Leung 1987; Wiewel, Persky, and Sendzik 1999), and the relatively new conservation subdivision model can present additional risks. Indeed, in general, one of the key challenges facing policy makers is to convince developers of the profitability of alternatives to conventional subdivisions (Gyourko and Rybczynski 2000). Demonstrating the economic advantages of conservation subdivisions can contribute toward this larger objective, and the methodology employed in this article can be replicated to study other subdivision designs.

It is important to note that this article does not address the role of conservation subdivisions in Smart Growth or New Urbanism, the potential for negative socioeconomic consequences that result from their use, or whether the purported environmental benefits of conservation designs will be realized.[2] Moreover, this article is an accounting of benefits and costs only from the perspective of developers; it is not an accounting of benefits and costs to society that result from the use of conservation subdivisions. However, the results of this research are intended to inform these discussions and the larger discourse about adopting alternative subdivision designs.

DIFFERENCES FROM PREVIOUS STUDIES

Most previous research on the value of open space is concerned with open space that lies outside subdivisions (see, for example, Correll, Lillydahl, and Singell 1978; Hammer, Coughlin, and Horn 1974; Li and Brown 1980; Lindsey and Knaap 1999; Nelson 1985). Those studies are different from this study for two reasons. First, as noted by Thorsnes (2002) and Hammer, Coughlin, and Horn (1974), the price effects of open space are localized. Thus, extrapolating from open space outside subdivisions (even if it is close) will not lead to accurate estimates of this amenity within conservation subdivisions.

Second, conservation subdivisions contain a grouping of design and social features, such as exclusivity, privacy, and a perception of prestige, that are collectively valued by households (Kaplan, Austin, and Kaplan 2004) and should be reflected in the value of the lots. Moreover, properly designed conservation subdivisions could offer environmental and aesthetic benefits superior to those of other open space (Thompson 2004).

Peiser and Schwann (1993) addressed the issue of open space within subdivisions and found that developers' reluctance to leave internal open space was the result of the low value placed on such space by homeowners. However, the subdivision that the authors examined, Greenway Parks in Dallas, Texas, is very different from the design, ecological, and social constructs of today's conservation subdivision. For example, in Greenway Parks, lot sizes are large and open space consists of strips of land between the backyards of houses. Newer conservation subdivisions have large communal spaces that evoke a stronger sense of social and environmental benefits. In addition, whereas conservation subdivisions are designed with the natural features of the parcel in mind, there is no indication of this in Greenway Parks.

Finally, as far as I am aware, there is no research that simultaneously determines price premiums for innovative subdivision designs, improvement costs, and absorption rates. Thus, this study fills a critical knowledge gap by addressing the complexity of pricing and market issues related to conservation subdivisions and by providing a methodology that can be replicated to study the profitability of other subdivision designs.

CONSERVATION SUBDIVISIONS, SPRAWL, AND DEVELOPERS' CONCERNS

Conservation subdivisions can be traced to the past use of cluster subdivisions that were primarily concerned with protecting agricultural land (Nelson and Duncan 1995, 67). Over time, however, this design theme has evolved into today's conservation subdivisions. In addition to preserving agricultural land, open space is now expected to serve important ecological roles by providing natural habitat, reducing runoff volumes, limiting landscaping and lawn maintenance, and providing natural cooling (Berke et al. 2003; Burchell et al. 2002; Dramstad, Olson, and Forman 1996). These ecological benefits in turn translate into higher levels of residential satisfaction (Kaplan, Austin, and Kaplan 2004).

Using the expansive label of "conservation design," Arendt (1999a) formalized the design elements of conservation subdivisions. Moving beyond isolated treatments of agricultural land preservation and ecological sustainability, Arendt (1999a) argued that conservation subdivisions are a subset of traditional neighborhood designs (TNDs) that form part of the history of New England. Called villages and hamlets, TNDs are smaller versions of New England towns. According to Arendt (1999a), these villages and hamlets have the ultimate goal of conservation design.

Taking their cue from TNDs, conservation subdivisions lay the groundwork to "protect streams and water quality, provide habitat for plants and animals, preserve rural 'atmosphere,' provide recreational areas, protect home values, and reduce costs of municipal services" (Arendt 1999b, 7). Conservation subdivisions are thus distinct from the mere clustering of lots where environmental concerns, aesthetics, history, and culture are given relatively short shrift.

The role of conservation subdivisions in addressing issues related to sprawl has, however, attracted some controversy. The observation by Berke et al. (2003) that conservation subdivisions are sometimes built in greenfields highlights a criticism of these subdivisions: their potential to promote leapfrogging and socioeconomic disparities (Nelson and Duncan 1995, 67–68; Sutro 1990). Authors who propose a regional view of land-use planning argue that conservation subdivisions have to find their place in the context of social concerns and planning for habitats, corridors, transportation, and mixed-used development (Calthorpe and Fulton 2001).

The use of conservation subdivisions to preserve farmland has also emerged as a point of contention. Daniels (1997) took a critical view of such subdivisions in agricultural areas, claiming that they focus on site-specific rather than comprehensive land-use planning. He argued in favor of comprehensive planning that zones farming areas exclusively for agricultural use. Similar concerns about the efficacy of conservation subdivisions to save agricultural land were noted by Mennito (1995, cited in Daniels (1997)), who observed that their use in Howard County, Maryland, has not resulted in parcels that are amenable to farming. In addition, Nelson and Duncan (1995, 67) noted that residents in conservation subdivisions may place restrictions on the use of farming inputs and eventually oppose farming altogether. As a result, using conservation subdivisions to save farmland can backfire and turn the open space into an unsightly field.

In response to criticisms that conservation subdivisions can be detrimental to farming, Arendt (1997) argued that the debate should focus on the appropriate use of conservation subdivisions at suitable densities and configurations. For example, in rural areas with strong commercial farming, conservation subdivisions may not be appropriate. Instead, other techniques such as urban growth boundaries should be utilized. However, in areas with intermediate agricultural strength, conservation subdivisions are appropriate when they specify maximum lot sizes to ensure that critical amounts of farmland are preserved (Arendt 1997). Finally, Arendt (1997) argued that areas with suburban densities should employ conservation designs primarily for the provision of open space. The latter two situations are found across the nation, and it is in these two types of areas that lessons about conservation subdivisions can be applied.

Although discussions amongst planning academicians are informative, they do not address issues of concern to developers and have not had a major effect on developers' decisions. Intuitively, developers should welcome conservation subdivisions because they are believed to carry higher selling prices and to be less expensive to build. Higher selling prices should result from access to communal open space that makes full use of the natural landscape, superior aesthetic and environmental qualities, and a sense of higher socioeconomic standing (Kaplan, Austin, and Kaplan 2004). Lower construction costs should result from smaller lot sizes (Arendt 1999b; Arendt et al. 1996, 10–13; National Association of Homebuilders 1986). However, no hard evidence has been presented to support these hypotheses.

THE STUDY AREA: SOUTH KINGSTOWN, RHODE ISLAND

Rhode Island is one of a few states to have significantly updated state planning legislation from the first land-use planning efforts of the 1920s (American Planning Association 1999).[3] The Town of South Kingstown (Figure 2) has taken its cue from state legislation and revamped its subdivision regulations and zoning ordinances.[4] Under the rubric of "Smart Growth," the town has adopted open space preservation as a central feature of its land-use policies (Town of South Kingstown 2000). The town believes that open space preservation can lead to fiscal health and reduced sprawl and create a better

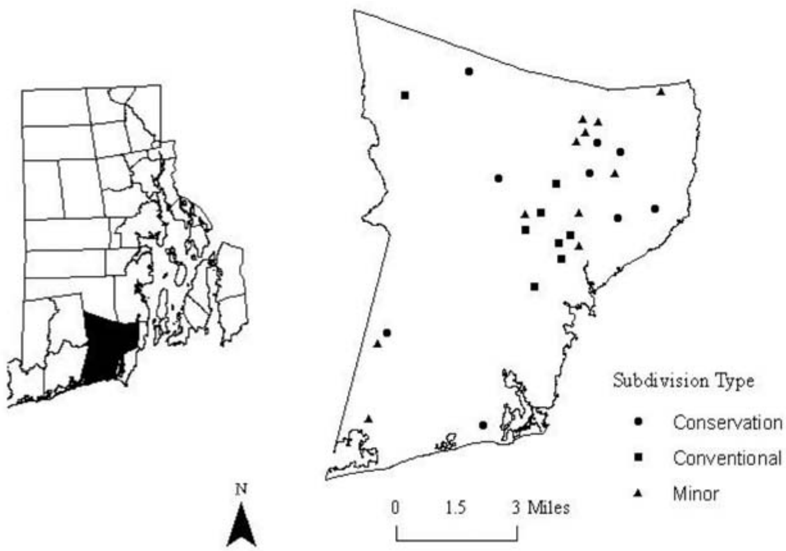

Figure 2: Locations of Different Subdivisions in South Kingstown, RI

delineation between the central core of the town and the periphery. One avenue for preserving open space is the use of conservation subdivisions.

It is important to note that the town's definition of conservation subdivisions follows the generally accepted model (Arendt 1999b). Referred to as *Flexible Design Residential Projects* (FDRPs) in the town's Subdivision Regulations, these subdivisions are required to set aside a minimum of 30% to 70% of a parcel as open space. Although 30% is smaller than the minimum 50% proposed by Arendt (1999b, 139), the lower percentage applies only to lot sizes that are typically found in built-up areas—10,000 to 20,000 square feet. When lot sizes approach those typically found in suburban and exurban areas—an acre or more—developers are required to set aside between 50% and 70% of the parcel.

Requirements for FDRPs in South Kingstown also take other cues from archetypical conservation subdivisions discussed by Arendt (1999b): conditions for ownership of the open space (usually homeowners' associations or a land trust), access to the open space (direct access for as many lots as possible), interconnections between the open spaces of different subdivisions, preservation of sensitive lands, and limited permitted uses of the open space. The town's criteria for projects to be approved and designated as conservation subdivisions are therefore consistent with the archetypical model.

In addition, South Kingstown is typical of areas in which conservation subdivisions might be considered a useful policy tool to address the loss of open space. First, the town's recent development could be considered exurban in that it extends from the edge of built-up suburbs into environmentally fragile land (Nelson and Duncan 1995, 71–72). Second, utilizing geographic information systems (GIS), I found that in Washington County, where South Kingstown is located, the percentage of land that is classified as forested had fallen from 54% to 51% between 1988 and 1995. Third, analyses of census and land-use data showed that between 1990 and 2000 the 13% increase in population was accompanied by a 20% increase in land consumed for residential development. Thus, like other sprawling areas, the town is consuming environmentally sensitive land in the periphery at rates that exceed the growth of its population. In summary, South Kingstown is a town where conservation subdivisions might be considered a useful policy tool for preserving open space; this is the reason it was chosen for study.

DATA AND APPROACH TO ANALYSIS

This article takes a three-pronged approach to discussing the financial implications for developers of conservation subdivisions. First, the *value added* to developed lots in conservation subdivisions was determined relative to lots in other subdivision types. This analysis was performed using ordinary least squares (OLS) regressions where the dependent variable was the price per acre of developed lots. The results obtained from the OLS regressions were corroborated by an analysis of covariance (ANCOVA) of the price per acre of developed lots.

In the absence of interaction effects, OLS regressions are equivalent to ANCOVA (Cohen and Cohen 1983, 4; DeMaris 2004, 126). However, the advantage of ANCOVA is that it determines the actual mean selling price of lots in different subdivisions and whether the differences in those means are statistically significant, while controlling for other covariates. On the other hand, OLS regressions present the results in a form that is familiar to policy makers and expresses the premium for conservation subdivisions in terms of a percentage over conventional subdivisions, a figure that is more robust than actual values. To monitor multicollinearity, the variance inflation factor (VIF) was observed for each variable in each regression.[5]

Second, costs for producing lots in different subdivision types were compared through analyses of variance (ANOVA). Finally, again using ANOVA, absorption rates were determined by analyzing the time it took for lots in different subdivision types to sell after being recorded.

This study utilized data from 184 randomly selected vacant developed lots in South Kingstown built and sold between 1993 and 2002.[6] The lots represent the finished product that was sold by developers.[7] Data were obtained from six sources: four departments or programs within the town government; the Rhode Island Geographic Information System (RIGIS), a database maintained at the University of Rhode Island; and the U.S. Census Bureau.

First, records from the Tax Assessor's Office provided information on sale prices for finished lots, the dates lots were recorded, and the dates they were sold. The sample was screened to ensure that all transactions were "arms length." Screening was performed by checking that the transaction price per acre of each lot deviated by no more than one-third from the median price per acre of all lots in the subdivision to which it belonged. No anomalous prices were observed.

Second, files maintained by the town's planning department were reviewed to determine each subdivision type (conservation, conventional, or other), utilities provided, and the number of lots in each subdivision. Third, basic data such as lot sizes were obtained from a parcel-based GIS maintained by the planning department. Fourth, for comparing improvement costs between different subdivision types, data were obtained from performance bond estimates prepared by the public works department. These data assess the costs of public improvements required in each subdivision, such as landscaping, drainage, roads, and public water and sewer services.[8] To provide a common point in time to compare costs, the estimates were inflation-adjusted to year 2000 dollars using cost indices obtained from *R. S. Means* (2001) for Providence, RI, the closest location for which data were available.

Fifth, RIGIS provided location information on roads, scenic districts, the coastline, water bodies, the seasonal high-water table, and steep slopes. GIS software was utilized to ascertain the distance between developed lots and roads, scenic districts, and the coastline, respectively. The software was also utilized to determine the percentage of lot area that contained water bodies, a seasonal high-water table, and steep slopes. When combined, these three variables provide a proxy for on-lot costs to be incurred by buyers of lots. Finally, data from the U.S. Census Bureau provided information on the socioeconomic status of the census block group in which the subdivision was located.

THE OLS REGRESSIONS AND ANCOVA MODEL

Equation 1 shows the model utilized to perform the OLS regressions and ANCOVAs for the price of developed lots. "P_L" is the price per unit area of developed lots, $X_{i,1}^{\alpha_1}$ is the area of the lot, α_1 is the regression coefficient associated with lot size, and *i* and *j* are measures of the *j*th attribute for the *i*th lot, respectively. Variations of this model have been used in the past, for example, by Adams and Milgram (1968), Colwell and Sirmans (1980), Chicoine (1981), and Guntermann (1997).

$$P_L = \alpha_0 X_{i,1}^{\alpha_1} \exp\left(\sum_{j=2}^{n} \alpha_j X_{i,j}\right) \quad (1)$$

Transforming gives:

$$\ln P_L = \ln \alpha_0 + \alpha_1 \ln X_{i,1} + \sum_{j=2}^{n} \alpha_j X_{i,j} \quad (2)$$

This specification has three advantages: It sets prices equal to zero when parcel size equals zero, detects plottage and plattage, and allows for an interpretation of inflation in land prices. Plottage signifies additional value that can be obtained from combining more than one parcel, whereas plattage is additional value that can be obtained from dividing a parcel (Colwell 1999; Colwell and Sirmans 1980). If $\alpha_1 > 0$ there is plottage, but if $-1 < \alpha_1 < 0$ there is plattage.

The review of subdivision files revealed that in addition to conservation and conventional subdivisions, there are also minor subdivisions of five or fewer lots. (These are not discussed in detail because they are included in the analyses only for control purposes and they constitute only a small portion of the subdivisions built in South Kingstown.) For the three types of subdivisions, two dummy variables were utilized in the OLS regressions. The first variable, CONS, is assigned a value of 1 if the lot is in a conservation subdivision and 0 otherwise. This is the key test variable. The second variable, MIN, is assigned 1 if the lot is in a minor subdivision and 0 otherwise. Minor subdivisions benefit from a less onerous approvals process and fewer road standards. Although a less onerous approvals process will affect prices for the undeveloped parcel, it will not have any effect on prices for developed lots. Fewer road standards, however, often results in shared driveways that are expected to reduce the value of lots in minor subdivisions. In addition, minor subdivisions are often built on irregularly shaped parcels that are sometimes near busy streets, again reducing the value of their lots.

CONTROL VARIABLES

The same control variables used in the OLS regressions were employed in the ANCOVAs as covariates. Table 1 contains all variables in the OLS and ANCOVAs and their expected signs. Table 2 provides summary statistics.

Natural log of lot size. Several scholars have noted a concave relationship between price and land area that leads to the declining marginal value of land, the phenomenon of plattage referred to above (Brownstone and Devany 1991; Chicoine 1981; Colwell and Sirmans 1993; Nelson and Knaap 1987). Thus, the sign on this variable is expected to be negative.

Year of transaction. Regression models of land prices routinely include a variable to account for inflation. For this research, the year in which the first sale took place is assigned the number 1, and each subsequent year is assigned 2, 3, and so on. The study period, 1994 to 2001, is one of steadily increasing property values associated with the longest U.S. economic expansion on record. There were no years in this period during which land prices decreased. Thus, a single variable to represent time is sufficient, and dummy variables for each year that capture annual changes in price are not necessary.[9]

Public water and sewer infrastructure. On developed lots, public water and sewer infrastructure are unambiguously expected to be capitalized into prices because of their inherent advantages and conveniences (Adams et al. 1968; Knaap 1985; Nelson and Knaap 1987).

Accessibility. Research has found that homeowners pay a premium for locations close to jobs or downtowns, though these studies appear to mix undeveloped parcels with developed lots in the same sample (Adams et al. 1968; Brigham 1965). The distinction is important because developers might pay more for undeveloped parcels near major roads, where fewer infrastructure extensions are required. However, households may pay less for locations near busy streets (Adams et al. 1968; Asabere 1990; Hughes and Sirmans 1992).

The study area contains a web of roads that allows easy access to the major highway, I-95, and major employment centers at the University of Rhode Island and downtown. Two important roads in this web are US-1 and Route 138, and the shortest distance from a developed lot to either of these roads was used as a proxy for accessibility. Because of the important role that these roads play in providing access, being closer to them is expected to carry a premium.

Distance to scenic districts. This variable measures the distance of each lot to state-designated scenic districts. Premiums are expected for lots close to these districts (Correll, Lillydahl, and Singell 1978; Hammer, Coughlin, and Horn 1974; Li and Brown 1980; Lindsey and Knaap 1999; Nelson 1985).

TABLE 1: Determinants of Developed Lot Prices

Independent Variables	*Variable Name*	*Expected Signs*
Main variables		
Subdivision in which lot is located: 1 if conservation subdivision, 0 if conventional or minor subdivision	*CONS*	Positive
Subdivision in which lot is located: 1 if minor subdivision, 0 if conservation or conventional subdivision	*MIN*	Negative
Control variables		
Natural log of lot size, acres	*NLLS*	Negative
Year developed lots were sold	*YEAR*	Positive
Public water: 1 if yes, 0 if private well	*WATER*	Positive
Public sewer: 1 if yes, 0 if private septic system	*SEWER*	Positive
Accessibility: mean distance to Rt. 138 and U.S. 1, feet	*ACC*	Negative
Mean distance to scenic districts, feet	*SD*	Negative
Mean distance to coastline, feet	*COAST*	Negative
Relative socioeconomic status of subdivision as determined by median housing price in 1990 census block group, $1,000s	*MHP*	Positive
Number of lots in each subdivision	*LOTS*	Positive
Percentage of lot with difficult building conditions	*UNBUILD*	Negative
Time for lots to sell after subdivision (or phase of) was recorded, months	*TIME*	Negative

It is important to control for this variable because conservation subdivisions located close to scenic districts may reflect the value placed on these districts rather than the intrinsic value of the subdivision.

Distance to coastline. The effect of this variable on prices could be difficult to determine because of special permits required to build close to coastal areas. As Brownstone and Devany (1991) noted in their study of undeveloped land sales in Southern California, the insignificant coefficient obtained for this variable, when regressed against prices, was most likely a result of difficulties in obtaining permits from the California Coastal Commission. In South Kingstown, there is a marked lack of undeveloped land sales close to the coast. This is not coincidental, because development in these areas requires additional approvals from the Rhode Island Coastal Resources Management Council (CRMC), increasing the costs of approvals. Thus, there are few developed lots available close to the coast, and the nearest one in the sample is more than 6,000 feet away (Table 2). Nonetheless, a premium is expected the closer a lot is to the coast.

TABLE 2: Descriptive Statistics of Independent Variables

Independent Variables	*Mean Value*	*Standard Deviation*	*Minimum Value*	*Maximum Value*
Conservation subdivisions (1 if yes, 0 if no)	0.47	0.50	0	1
Minor subdivisions (1 if yes, 0 if no)	0.08	0.27	0	1
Average lot size, acres	0.62	0.32	0.22	1.64
Year in which developed lots were sold	5.18	2.02	1	8
Public water (1 if yes, 0 if no)	0.78	0.42	0	1
Public sewer (1 if yes, 0 if no)	0.40	0.49	0	1
Accessibility: Mean distance to Rt. 138 and U.S. 1, feet	2,995	1,869	113	6,348
Mean distance to scenic districts, feet	3,591	2,721	0	9,921
Mean distance to coastline, feet	19,476	5,623	6,143	28,415
Relative socioeconomic status of subdivision as determined by median housing price in 1990 census block group, $1,000s	158	7	144	171
Number of lots in each subdivision	52.2	34.9	3	89
Percentage of lot with difficult building conditions	6.4	20.1	0	100
Time for lots to sell after subdivision (or phase of) was recorded, months	12.0	12.12	0.03	58.4

Relative socioeconomic status of the neighborhood. There is evidence that locations of higher socioeconomic status carry a premium (Brigham 1965). This article uses self-assessed housing values from the 1990 census at the block group level to represent relative socioeconomic status. This variable is not endogenously determined because the values were determined in 1990, before the period covered by this study.

Number of lots. This variable is an indication of the ability of developers to control neighborhood characteristics. Previous research has found that the control of subdivision characteristics can increase property values, for example, through the use of restrictive covenants (Hughes and Turnbull 1996; Speyrer 1989). Thorsnes (2000) corroborated these findings in his research, but he used the size of the entire subdivision as a proxy for the effect. This analysis utilizes the number of lots as a proxy for subdivision size, and, in turn, as a proxy for the degree to which developers can control neighborhood characteristics. It is a more appropriate measure than the size of the entire subdivision because it isolates the effects of open space in conservation subdivisions while at the same time reflecting the size of conventional and minor subdivisions.

Difficult building conditions. This variable is a composite measure of the percentage area of a lot that contains water bodies, a high water table, and steep slopes. These characteristics limit the layout of houses unless the buyer invests in substantive landscaping. Thus, the presence of difficult building conditions will reduce the value of developed lots. However, it is evident that there are errors in the GIS measurements of water bodies because the data in RIGIS were found to be significantly different from those reported on developers' approved plats. This discrepancy suggests that other measures related to the buildability of lots may also be erroneous, thus affecting the validity of the results. Indeed, RIGIS reports that one lot was 100% unbuildable (Table 2), clearly a situation that is not possible.

Time for lots to sell after the subdivision was recorded. This variable accounts for the effects of the market on prices. It is expected that as lots take longer to sell, prices will be negatively affected.

RESULTS OF THE OLS REGRESSIONS AND ANCOVAs

Four regression models (Table 3) show that developed lots in conservation subdivisions carry additional value ranging from 12% to 16% per acre over lots in conventional subdivisions. Not surprisingly, lots in minor subdivisions are heavily discounted because, as discussed earlier, they have some undesirable features. As shown in Table 3, multicollinearity was not a problem in any of the regression models.

In the ANCOVAs, the subdivision type is the main variable of interest (the fixed factor), and the other variables are controls. In each of the four models, subdivision type significantly affects land prices (Table 4), as revealed by F-statistics that are significant at greater than the 0.001% level.

In addition, Bonferroni post hoc analyses found that mean selling prices of developed lots in the three subdivision types are significantly different from each other at the 5% level. Table 5 shows that lots in conservation subdivisions sold for $122,000 to $125,000 per acre whereas lots in conventional subdivisions sold for $107,000 to $109,000 per acre. These numbers translate into premiums for lots in conservation subdivisions ranging from $13,000 to $18,000 per acre over lots in conventional subdivisions (Table 6).

These results confirm the attractiveness of conservation subdivisions to developers from the demand side. However, more definitive statements about the relative profitability of conservation subdivisions cannot be made until investigations are performed on the costs of producing lots in different

TABLE 3: Results from OLS Regression Models on Price per Acre of Developed Lots

	Model 1 Adj. $r^2 = 0.94$		*Model 2* Adj. $r^2 = 0.94$		*Model 3* Adj. $r^2 = 0.94$		*Model 4* Adj. $r^2 = 0.94$	
Independent Variables	β	*VIF*	β	*VIF*	β	*VIF*	β	*VIF*
Main Variables								
CONS	0.16	6.1	0.13	6.2	0.12	6.5	0.13	7.1
MIN	–0.27	2.9	–0.27	2.5	–0.28	2.6	–0.26	3.2
Control Variables								
NLLS	–0.78	2.9	–0.73	3.2	–0.74	3.3	–0.74	3.4
YEAR	0.08	1.3	0.08	1.4	0.08	1.4	0.08	1.6
WATER	0.26*	3.0	0.20	3.0	0.20	3.0	0.20	3.0
SEWER	0.08*	4.8	0.11	5.5	0.11	5.5	0.12	5.7
ACC	1.90E–05*	4.0	4.12E–06**	2.1	1.08E–06**	2.3	4.04E–08**	2.3
SD	–5.93E–05	7.7	–4.62E–05	5.5	–4.58E–05	5.5	–4.60E–05	5.5
COAST	6.10E–06**	6.7						
MHP			2.86E–03**	1.9	3.33E–03*	2.0	3.97E–03*	2.4
LOTS			1.66E–03	2.7	1.69E–03	2.7	1.62E–03	2.8
UNBUILD					–7.42E–04**	1.2	–7.70E–04**	1.2
TIME							7.90E–04**	2.0
CONSTANT	10.50		10.15		10.09		9.99	

NOTE: $N = 184$. *Significant at the 10% level.
**Not significant. All other coefficients are significant at greater than the 5% level.

TABLE 4: Results of ANCOVAs for Price per Acre of Developed Lots Where Subdivision Type is the Fixed Factor

	Model 1	*Model 2*	*Model 3*	*Model 4*
F-statistic	39.19	40.53	38.67	35.12
p-statistic	< 0.001	< 0.001	< 0.001	< 0.001

subdivision types and the rate at which these lots are sold. Before moving onto these analyses, other results from the OLS regressions and ANCOVAs are discussed.

RESULTS FOR CONTROL VARIABLES IN THE OLS REGRESSIONS AND ANCOVAs

Importantly, the existence of plattage, around –0.75 across the four models, shows that there is diminishing marginal value from additional lot size. The results suggest that developers would rather not build large lots, but instead, they may prefer the opposite, that is, to take area from the lots and convert it into open space. These results differ from those of Peiser and Schwann (1993), who found that strips of open space directly behind backyards added little value to property.

Other variables are significant, as expected. Many lots are located in close proximity to state-designated scenic districts, and buyers pay a premium for this amenity. Across Models 1 through 4, the premium ranges from 4.5 to 5 percent per acre of lot for every 1,000 feet closer to a scenic district. Lots in areas of higher socioeconomic standing carry a premium of around 3.5% per acre of lot, though these results are significant only at the 10% level (Models 3 and 4).[10]

As expected, lots with public water and sewer sell for more. For the former, the premium ranges from 15% to 26% per acre of lot, while for the latter the premium ranges from 8% to 12%. Inflation averages about 8% per year. Each additional lot in a subdivision increases the per acre price of lots by less than 0.25% in all the models. This demonstrates households' preferences for living in larger projects where developers are able to internalize amenities but the absolute effect is small.

Accessibility, distance to the coastline, percentage of the lot that is unbuildable, and the time it takes for lots to sell after recording are not significant in any of the models in which they were considered. In the case of

TABLE 5: Results of ANCOVAs for Price per Acre of Developed Lots in Different Subdivision Types

	Model 1	*Model 2*	*Model 3*	*Model 4*
Average price per acre of lots in conservation subdivisions ($1,000s)	125.3	123.5	122.3	123.3
Average price per acre of lots in conventional subdivisions ($1,000s)	107.1	108.5	109.2	108.4
Average price per acre of lots in minor subdivisions ($1,000s)	81.7	82.5	82.6	83.6

TABLE 6: Results of ANCOVAs for Differences in Price per Acre of Developed Lots in Conservation versus Other Subdivision Types

Subdivision Type	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Conventional ($1,000s)	18.2	15.0	13.6	14.9
Minor ($1,000s)	43.5	41.0	40.1	39.6

accessibility, the results may reflect the web of roads in the study area that allow for quick access to I-95 and major sources of employment in the downtown and at the University of Rhode Island, regardless of where development takes place. For distance to the coastline (Model 1), the results most likely reflect the fact that there was too little construction near the coast during the study period to provide sufficient variation in the data. The percent of the lot that is unbuildable may be insignificant owing to errors in RIGIS measurements of this variable (Models 3 and 4), as discussed earlier. Finally, the time it takes for lots to sell after being recorded is not significant (Model 4).

The results indicate that, in general, the fundamentals of the land market in South Kingstown are fairly typical. Putting aside the coefficients on subdivision type, the other results are for the most part consistent with results obtained elsewhere. For example, there is general agreement that in a variety of land markets, values increase when infrastructure such as public water and sewer are provided, the property is located in areas of higher socioeconomic standing, scenic areas are in close proximity, and neighborhood amenities are internalized (as measured by the size of the subdivision—in this article, the number of lots). In addition, as has been observed elsewhere, there is diminishing marginal value to additional land, and in recent years there has been a steady increase in residential land prices across many land markets in the United States.

COMPARISON OF COSTS FOR PRODUCING DIFFERENT LOT TYPES

Using data from performance-bond estimates, an ANOVA was performed on improvement costs per lot within conservation, conventional, and minor subdivisions.[11] The results shown in Table 7 are statistically significant at the 1% level, showing that lots in conservation subdivisions cost on average about $7,400 less to produce than lots in conventional subdivisions. The results for minor subdivisions are lower, as expected; these typically do not require internal infrastructure and are often located alongside existing roads. A direct comparison between lots in conservation and conventional subdivisions using a *t*-test also results in statistically significant differences at the 1% level. Together with the results obtained from the OLS regressions and ANCOVAs, these results show that there are higher profits to be made from conservation subdivisions.

COMPARISON OF TIME FOR DIFFERENT LOT TYPES TO SELL

The earlier results are sufficient to show that developers should prefer conservation subdivisions. However, corroborating evidence could be obtained by analyzing the time it takes for lots in these subdivisions to sell when compared to lots in other subdivisions. The time interval starts when lots are first recorded (taking account of any phasing in the subdivision), thus making delays purely a function of the market, not the subdivision review process.

The results of the ANOVA are presented in Table 7. Lots in minor subdivisions sold the fastest (on average, 1.1 months) because they are usually sold in sets at a time, followed by lots in conservation subdivisions (9.1 months), and then lots in conventional subdivisions (17.0 months).[12] The differences are statistically significant at the 1% level. That lots in conservation subdivisions sold in about half the time as lots in conventional subdivisions must be advantageous to the cash flow of developers.

When lots in conservation subdivisions were compared only against lots in conventional subdivisions using a *t*-test, the statistical difference was maintained at the 1% level. This was also the case when they were compared to lots in conventional and minor subdivisions combined; the average time for lots to sell in conventional and minor subdivisions was 14.5 months, still considerably more than the 9.1 months for lots in conservation subdivisions. The strong demand for lots in conservation subdivisions corroborates the price premium observed in the OLS regressions and ANCOVAs.

TABLE 7: ANOVA of Mean Improvement Costs per Lot and Mean Selling Time for Lots for Different Subdivision Types

Subdivision Type	*Sample Size*	*Mean Improvement Costs per Lot ($1,000s)*	*Mean Selling Time (months)*
Conservation	87	18.7	9.1
Conventional	82	26.1	17.0
Minor	15	5.5	1.1

CONCLUSIONS

Innovative subdivision designs continue to be viewed by developers as financially risky (Gyourko and Rybczynski 2000). This article, however, shows that one type—conservation subdivisions—can provide higher profits to developers. Lots in conservation subdivisions carry a price premium, are less expensive to build, and sell more quickly than lots in conventional subdivisions. The methodology used in this article could be easily applied to other subdivision designs to ascertain whether, from the perspective of developers, they are preferable to conventional subdivisions.

The results from this study are instructive when compared to other studies that examine the value of open space. For example, whereas Peiser and Schwann (1993) show that residents prefer private backyard space to communal open space, this study indicates that buyers of lots in conservation subdivisions would pay less for additional lot size and more for amenities associated with conservation subdivisions.

The possible reasons for these differences have implications for subdivision layout and the use of open space. Designs that take a holistic view of ecology, aesthetics, and sense of community may assuage concerns about density. In comparing this case to other attempts to create open space in subdivisions, such as that examined by Peiser and Schwann (1993), three important differences emerge:

- Concentrating open space in one or a few locations matters: In contrast to open space that is laid out such that each household gets to "claim" a small portion, conservation subdivisions provide concentrated open space accessible to a maximum number of households and discourage claims of individual ownership.
- Communal ownership is important: When the ownership of open space is ambiguous, it may not be as well appreciated as when ownership, rights, and responsibilities are clear. For example, Peiser and Schwann (1993) found that

strips of open space behind backyards simply encouraged residents on either side of the strip to consider portions as private, leaving a small communal greenbelt of little use. With their backyards effectively enlarged, there was little reason to value the remaining greenbelt. Moreover, when boundaries are not properly demarcated, it is not clear which neighbor is responsible for preservation. This is clarified in the communal setting of conservation subdivisions. In addition, the concentrated layout of open space in conservation subdivisions may lead to economies of scale in its management.

That communal open space in conservation subdivisions may be better preserved appears to be at odds with contemporary views of property rights, which argue that the private ownership of property leads to better management. However, conditions in conservation subdivisions are consistent with some of the criteria spelled out by Ostrom (1990, 91–102) as necessary for successfully managing communal property. These include: 1) physical boundaries and rights and responsibilities of households that are clearly defined; 2) households affected by operational rules can participate in changing those rules; 3) households and officials have low-cost mechanisms to resolve conflicts; and 4) households have the right to organize their own managerial institutions.

- High density can be acceptable: Americans can be comfortable with higher density subdivisions provided that other environmental, aesthetic, and communal concerns are addressed, as observed by Kaplan, Austin, and Kaplan (2004). Although the negative sign of the coefficient of lot size is usually attributed to the diminishing utility of additional land, the relatively large value of the coefficient obtained in this research suggests that the utility of additional land falls faster when open space is available than when it is not. The size of the coefficient reflects the intuition that there is little value to additional yard space given the existence of concentrated open space in conservation subdivisions (and nearby scenic districts). This result suggests that lot sizes in conservation subdivisions may be somewhat endogenously determined, and that the choice of lot size is not entirely a function of zoning or the availability of infrastructure.

For municipalities that seek to address issues related to sprawl by using conservation subdivisions, the results of this study are encouraging. However, the role of conservation subdivisions in promoting Smart Growth and New Urbanism is uncertain. In particular, the socioeconomic implications of conservation subdivisions need to be addressed. Further, the potential environmental benefits may not be realized if the open space is misused, and conservation subdivisions may be a hindrance rather than a boost to agriculture. These issues require further research.

NOTES

1. Designing around natural landscapes is a new concept not only to developers, but also to engineers, planners, and attorneys, who have long been accustomed to conventional designs (Gyourko and Rybczynski 2000). Thus, engineering, approvals, and attorney fees may be more onerous. However, these costs are not considered in this article because data are not available. These costs are not expected to affect the results presented in this article.

2. A common concern among the anonymous reviewers of this article is the potential negative socioeconomic consequences of conservation subdivisions. In general, the concerns center on whether conservation subdivisions are just a mechanism for ensuring class separation by building another form of "gated communities."

3. This was achieved through the passage of the Rhode Island Zoning Enabling Act of 1991, Chapter 45, Sections 24–27 through 24–72 and the Rhode Island Land Development and Subdivision Review Enabling Act of 1992, Chapter 45, Sections 23–25 through 23–74.

4. See the Town of South Kingstown Subdivision Regulations (February 14, 1995, with amendments through 2002).

5. A VIF above 10 indicates that the variable is collinear with others in the model (Gujarati 1995).

6. Some of the lots in this sample were developed before more rigorous standards for conservation subdivisions, following (Arendt 1999b), were adopted by the Town.

7. In a few instances (about 15% during the study period) the builders were the developers. These observations are not included in the sample because a price for the vacant developed lot could not be observed; the product that was sold consisted of a house and a lot.

8. The purpose for requiring performance bonds from developers is that in the event developers default on their projects, the town can utilize the bond to complete the subdivision. Performance bond estimates do not include engineering, approvals, and attorney fees. In addition, performance bond estimates do not include on-lot costs that are borne by buyers, such as costs for building the house and on-site landscaping.

As far as I am aware, this is the first time that performance bond estimates have been used in scholarly research to analyze the costs of subdivision development.

9. Preliminary regressions that used dummy variables for each year during the study period revealed that inflation rates did not vary dramatically from one year to another, further justifying the use of a single variable.

10. Alternative regressions where the median household income was used instead of the median housing value produced similar results.

11. Another approach to comparing improvement costs is on the basis of costs per area of lot. However, lots in conservation subdivisions are smaller than lots in conventional subdivisions and thus in the former case improvement costs will be concentrated on smaller areas. Indeed, on this basis the mean cost per acre of lots in conservation subdivisions ($45,600) is virtually the same as in conventional subdivisions ($45,500).

12. An anonymous reviewer suggested that minor subdivisions may be at a different "price point" than other subdivisions, explaining why they sell faster despite being the least valued.

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