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How Well Can Markets for Development Rights Work? Evaluating a Farmland Preservation Program

Virginia McConnell, Elizabeth Kopits, and Margaret Walls

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Abstract

Transferable development rights (TDRs) can be used as a local planning tool to preserve land for particular uses. TDRs separate ownership of the right to develop land from ownership of the land itself, creating a market in which the development rights can be bought and sold. Landowners who sell TDRs permanently preserve their land in an undeveloped state; those TDRs are then used to increase the density of development elsewhere. In this paper, we evaluate a TDR program for preserving farmland in Calvert County, Maryland. We evaluate the performance of the TDR market over the 23-year life of the program by looking at the number of transactions and TDRs sold and the level and dispersion of prices over time. We also look closely at the influence of the county government as a participant in the market. We locate the properties that have been preserved in the county as well as the subdivisions that have used TDRs to increase the density of development. We find that the program is achieving Calvert's farmland preservation goals and the TDR market appears to have operated efficiently, at least since 1993 when the county increased its role in the TDR market. At that time, the county began purchasing a small number of development rights each year at a fixed and known price and also began publishing a newsletter providing information about the program. These actions stabilized prices and appear to have bolstered participants' faith in the longevity of the program. Most of the agricultural properties preserved in the program are in areas less profitable for development. The demand for TDRs to increase density is greatest in subdivisions in the northern part of the county, closer to the major urban cities, and interestingly, in relatively rural areas with low-density zoning. There appears to be little demand for TDRs and the associated higher density in town centers or areas zoned with residential zoning.

Key Words: land use, farmland preservation, development rights

JEL Classification Numbers: Q15, Q24, R140

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1. Introduction

As urban areas in many countries around the world struggle with a myriad of land-use and environmental problems, a market-based policy that has been around for many years offers new promise. Transferable development rights (TDRs) were first introduced for managing land-use in the 1960s but since the 1990s, their use has grown. TDR programs sever the right to develop land from the land itself, creating a market with buyers and sellers in which the development rights can be traded. TDRs are currently being used as a way to achieve a number of land management goals, including the preservation of farmland, the safeguard of unique natural areas or historic landmarks, and the protection of environmentally sensitive areas.[1]

Because they provide a market-based solution to land use problems, TDRs have the potential to result in efficient land allocations. Prices provide signals to landowners about the relative values of preservation and development, but landowners are allowed to make decisions for themselves about whether or when to preserve or develop their land. These are created

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markets, however – often with the heavy hand of government – and in practice, many have not worked as expected. There is a large literature describing TDR programs (Field and Conrad, 1975, Baresse 1983, Pruetz, 2002) and laying out the theory of TDR design and use (Thornes and Simon, 1999, Mills, 1980; 1989), but there are virtually no empirical studies of the detailed workings of a TDR market in practice.[2] This paper partially fills this void by examining one TDR program in detail, the program for preserving farm and forestlands in Calvert County, Maryland.

The Calvert program has been in place since 1978 and is one of the most active programs in the U.S. It provides a rich source of data with which to assess the performance of real-world TDR markets. Using 23 years of data on TDR transactions in Calvert County, we are able to summarize TDR sales and prices over time, and determine the number and location of acres preserved through the program since its inception. We also have data that allows us to track the number of farm acres that have the potential to enter the TDR market but have not yet done so. We are particularly interested in the performance of the TDR market and how efficiently it has worked over the life of the program. In this regard, we examine the level and dispersion of prices over time, problems of thin markets, the role of transaction costs, and the influence of the County government on market prices and market outcomes.

We begin the paper by discussing how TDRs can, at least in theory, be used to improve allocation in land markets. We then lay out several complicating factors that can make TDRs in practice less efficient and less successful than theory might suggest. Section III describes the important features of the Calvert County program, and Section IV presents a number of findings from that program since its inception in the late 1970s. In this section, we pay particular

attention to how the complicating factors that we introduced in section II play out in the Calvert program. The final section of the paper provides concluding remarks.

2. TDR Markets: Theory and Practice

The economics and planning literatures provide several possible justifications for government intervention in land markets. For example, some observers argue that certain negative environmental effects associated with development are not taken into account by private markets. In addition, the public good attributes of open space, ecological habitats, and farmland cause these land uses to be underprovided by private landowners (Thornses and Simon, 1999; Heimlich and Anderson, 2001; Hellerstein et al, 2002).

The objective of the Calvert County TDR program is farmland preservation. The county government has stated that goals of the preservation program are to "maintain the rural landscape and sustain agriculture" in the county (BOCC 2000). Several studies have analyzed the benefits of farmland preservation, but this is an issue we sidestep in this paper.[3] Instead, we take farmland preservation as the given public policy objective and focus our attention on the relative merits of a TDR program to achieve this goal.

In theoretical studies, TDR markets are usually viewed as working in the following way: the government decides on a maximum amount of overall residential development, distributes enough permits, or development rights, to landowners to generate that amount of overall development, then allows landowners to trade those permits with each other (Mills, 1980, 1989; Thorsnes and Simon, 1999). If landowners have different opportunity costs of not developing their land, some will end up selling development rights while others will purchase rights and build at a higher density than is permitted with their initial allocation. By giving individual

landowners the flexibility of going over or under their initial allocation while maintaining a cap on the overall number of rights, land parcels with different relative values in development are allocated to their most efficient uses.[4] This conceptual description of TDRs is, in principle, like a tradable emissions permit system in which there is an overall cap on emissions but individual polluters are allowed to trade permits with each other (Tietenberg, 1985).[5]

Also, TDR policies can mitigate inefficiencies that arise from traditional zoning policies. Mills (1989) argues that, although zoning rules and zoning differences across regions may improve efficiency and enhance land values in some cases, often those gains are lost as a result of rent-seeking behavior by landowners. Zoning increases rents for owners of those parcels that allow more dense development, creating incentives for landowners to spend resources to obtain zoning associated with the highest valued land uses. TDR markets can mitigate this behavior by allowing the gains from development to be spread more equally across all landowners.

In practice, however, TDR programs can be quite different from these theoretical ideals. First, the irreversible nature of the decision to develop or to sell TDRs is a key difference between emissions permits and other created markets and TDR markets. Landowners have important intertemporal decisions about what to do with their land – including if and when to sell TDRs and how many to sell in any given period – recognizing as they make those decisions that, once either a TDR is sold or the land is developed, that action has permanent consequences. Second, TDR markets are often dominated by a few buyers or sellers and may come with high transaction costs. These problems can reduce the efficiency of this market-based system. Third, the role of the government is usually much larger and more wide-ranging than allowed for in the conceptual studies. This role often includes putting a number of constraints on how the TDR

market operates, such as limiting exactly which parcels of land are allowed to sell TDRs and which ones can use TDRs to increase development. The government may also become a participant in the TDR market thus affecting equilibrium TDR prices and quantities. We address each of these three issues in this section of the paper.

The amount of land preserved is variable in any time period, and may come at a high cost. Markets for development rights differ from markets for emissions permits, water rights, fishing quota, and other created markets in that (1) the decision to develop or preserve land – and thus to sell or not sell a development right – is a one-time, essentially irreversible decision, and (2) that decision can be made at any date over a long period of time.[6] Landowners decide for themselves whether or not to sell development rights in a given year and, if so, how many to sell. Thus, the supply of rights is endogenous and often fluctuates significantly from year to year. If the timing of development matters, there can be efficiency implications from these fluctuations. And at a minimum, they can pose problems for local officials in designing TDR programs and in assessing those programs' results.

Also, the costs of preservation may be inefficiently high in a voluntary, market-based program. This is because some of those landowners who opt to maintain their land in an undeveloped state by selling TDRs may not have developed their properties anyway – at least in the foreseeable future. For any number of reasons – including personal or family considerations, or the possibility that their land has relatively low current value in development – they may prefer to continue farming, forestry, or other related activities rather than sell to a developer. It is impossible for government officials structuring the program to identify such properties, however, thus TDRs are made available to all properties that meet a fairly broadly defined set of criteria.

This leads to a type of adverse selection problem that has been identified in other voluntary environmental programs, most recently in the SO2 trading program (Ellerman et al, 2000). In the case of TDRs, this problem raises the cost of preservation above what it needs to be.

This adverse selection problem can also lead to *more* development than would occur under a straight zoning policy. The TDRs landowners sell are used to build more houses elsewhere, so if properties that would not have been developed anyway are now selling TDRs, more development is occurring in other areas than would have occurred in the absence of the TDR program (Levinson, 1997).

Potential "Thin Markets". Efficiency in the TDR market requires that TDRs be traded at a single competitive price, and that this price be the result of interactions by a large number of buyers and sellers. This outcome may not be achieved in actual TDR markets for several reasons. We discuss first market power concerns and then transactions costs.

If one side of the market has some monopoly power, too few permits will be traded (Hahn, 1984). For example, if there are relatively few developers and they have access to information about a large number of potential sellers of TDRs (farmers), then those developers may have some monopsony buying power. Field and Conrad (1975) argue that this can occur in many TDR programs, because developers are likely to be small in number and well organized relative to private property owners. If this is the case, both prices and quantities transacted are likely to be too low. On the other hand, some areas may have many buyers of TDRs but few sellers, leading to monopoly power on the supply side and its concomitant high prices and low number of TDRs sold.

Since most TDR programs allow trading only in an individual county or municipality rather than across larger regions, there is the potential for such monopsony or monopoly power to cause "thin markets." Compounding this problem in many programs is the further restriction on who can buy or sell – for example, only landowners in particular areas of the county may be able to sell.

Thin markets can both result from high transactions costs and contribute to the problem of high costs. Stavins (1995) has argued that there are two potential types of transactions costs in permit markets: (1) search and information costs, and (2) bargaining and decision costs. The first type of cost is reflected in TDR markets in brokerage or finders' fees, and the second in negotiation costs and lawyers' fees. When there is no centralized broker to facilitate sales, the buyer and seller have to find each other and negotiate a price. In such cases, both search costs and bargaining costs may be high, because there is little information about other transactions or the "going" price of a TDR. In programs in which real estate agents broker transactions, the fees these agents charge are part of the overall cost of the program.[7] Further, if landowners anticipate that markets will be thin in the future, they will be less willing to participate, contributing to market thinness (Liski, 2001).

Finally, if TDR markets are thin and a single price does not prevail, there is no guarantee that efficient trades are taking place. At any given time, a farmer with a relatively high opportunity cost for his land may be matched with a developer with a low willingness to pay for TDRs; in these cases, some mutually beneficial trades may not take place. It might be possible for the government to step in to correct this problem by brokering agreements, banking TDRs for

future use, or participating directly in the market. However, more active government involvement is likely to increase the administrative costs of the program (Baresse, 1983).

The Role for Government. In most working TDR programs, the government plays a much larger role than is taken into account in the theoretical studies. In some cases, this government intervention reduces the efficiency of the TDR market; in others, it enhances it.

TDR markets and zoning. Underlying all real-world TDR programs are zoning restrictions, and these restrictions have an important influence on the market for development rights. Areas are typically zoned rural, commercial, industrial, or residential, with sub-classifications often set up within those four broad categories. Each classification has its own limits on dwelling units per acre (or limits on commercial and industrial activities) and often has restrictions on the extent to which TDRs can be used to relax those limits. The areas targeted for preservation are often referred to as TDR "sending areas" – and for development, so-called "receiving areas." In some programs, the baseline zoning in sending areas is radically different from that in receiving areas; in others, the differences are less pronounced. The extent of these differences, at least in part, determines the demand and supply of TDRs.

Another determinant of the demand and supply is the TDR transfer rate, which is also set by the government. The transfer rate specifies the number of TDRs needed to build an additional housing unit in a receiving area. The combination of the zoning and the transfer rate determine two important characteristics of the TDR program: the transfer ratio and the density bonus. The transfer ratio is equal to the amount of development that can be transferred from the sending site divided by the amount of development that can be built on the sending site. A high transfer ratio improves the landowner's relative payoff from selling TDRs compared to developing her land

and thus provides an incentive for the landowner to participate in the TDR program. Many TDR programs have transfer ratios much greater than one to one. Pruetz (1997) reports that some communities have TDR programs with transfer ratios as high as 40 to one. The New Jersey Pinelands program has a transfer ratio of four to one; Montgomery County, Maryland, five to one; and Dade County, Florida, eight to one.[8] The density bonus for a particular area indicates by how much developers can exceed baseline zoning in receiving areas with the use of TDRs. The density bonus rules thus provide a further incentive for development to be channeled into particular areas.

Getting the transfer ratios and the density bonuses right can be difficult in some cases. If there is little demand for high-density development in receiving areas, for example, developers will have a limited demand for TDRs. In this case, TDR prices will be low and few rights will be transferred. This can occur if the market does not demand higher density development than what the baseline zoning allows. This kind of outcome has resulted in a number of places, including the Pinelands in New Jersey and Indian River County in Florida (Pruetz, 1997).

Providing information. Government can also play a key role in enhancing efficiency in TDR markets. It can act to mitigate the transaction costs and monopoly power problems that can arise by providing information to potential participants in the market. By publicizing information about how parties can reach each other, or providing information about past sales and sales prices, government can reduce transactions costs and increase efficiency.

Government can play a larger role as auctioneer, broker, or banker. There may be a particularly strong need for banking of TDRs because of the one-time nature of the decision to

develop or preserve a parcel of land. Buyers and sellers may want to enter the market at different times, and banking would facilitate those trades over time (Stevenson, 1998).

Government as direct participant. An alternative is for government to buy and sell permits like any other participant. Government purchases or sales could serve as a guidepost for both buyers and sellers – another way of providing price information to market participants and thereby lowering transactions costs. In addition, if the government participates in the market in the right way, it could reduce the overall costs of the program. Roberts and Spence (1976) show that, when there is uncertainty about pollution cleanup costs, a system of emissions permits in which the government participates by selling permits when prices are high and buying when prices are low will be more efficient than either a pure permit or tax system.[9]

In the next section, we describe the salient features of the Calvert TDR program, including how the program works, who can participate and restrictions on the market. We then evaluate the Calvert program with respect to some of the issues we have highlighted in this section.

3. Description of Calvert County and its TDR Program

Background on Calvert County. Calvert County is located in southern Maryland on the western shore of the Chesapeake Bay. The county is a 215 square mile peninsula formed by the Bay and by the Patuxent River estuary. The county seat lies approximately 35 miles southeast of Washington, DC, and 55 miles south of Baltimore, Maryland. Figure 1 shows a map of the region.

In 1997, just over 21 percent of the land in the county was in agriculture, down from nearly 27 percent in 1973. Forests account for 51 percent of the county's land, down from 63

percent in 1973.[10] The western part of the county, particularly along the Patuxent River, is the best farmland in the county.

While agriculture is important to Calvert and a great deal of open space remains in the county, there have been development pressures in the past twenty years because of the county's proximity to major urban areas. Between 1990 and 2000, Calvert was the fastest growing county in Maryland, with a population increase of over 45 percent, well above the state average increase of 10.8 percent. Average population density remains low, however: 347 people per square mile. By comparison, Montgomery County, Maryland, located closer to Washington, D.C., has an average population density of 1,763 people/mi^2. It should be noted that Calvert is located between several other counties experiencing similar development pressures; these counties serve as potential substitute locations for many developers and homebuyers.[11]

Calvert's TDR Program. The Calvert TDR program, which began in 1978, has some features that distinguish it from other TDR programs around the country. First, it is narrowly focused on preserving farmland in order to maintain the rural character of the County. Therefore, any adequately sized property with good productive soils can enter the program and sell TDRs. Second, so-called "sending" and "receiving" areas are not completely differentiated from each other – some areas are both. And third, an entire parcel of land is permanently preserved in Calvert when a single TDR is sold off that parcel. In other words, a farmer may be allocated, based on her acreage, a total of 50 TDRs, but once she sells the first TDR off her land, her entire farm is in permanent easement status. This is in contrast to other TDR programs, such as Montgomery County's in which parts of a property can have the easement sold while other parts retain full development rights. In the Calvert program, because the landowner must make

an all or nothing decision, trust in the viability and longevity of the TDR program must be strong.

Eligibility for Selling TDRs. To make a property eligible for selling TDRs, the property owner must first submit an application to the county to form what is called an Agricultural Preservation District (APD). To be eligible for APD status, the farm or forestlands must meet certain soil productivity and acreage requirements.[12] The parcel entering the program must be at least 50 acres in size if it stands alone, or 10 acres if is adjacent to an existing APD property.[13] Once an APD is established, the property owner agrees to keep the land in agricultural or forest use for at least five years, over which time the owner is exempt from County property taxes.[14] After this time, the owner may, if she so desires, remove the property from APD status.[15] Any time a landowner has had her land designated as an APD, she is eligible to certify and sell TDRs from the property if she so chooses. Each one-acre lot that has not been previously developed on the property can be granted one transferable development right.[16] However, recall that if a single TDR is sold off the property, the entire parcel of land is placed under permanent easement.

Baseline Zoning, Transfer Ratios, and Density Bonuses. Table 1 shows the different zoning designations for Calvert County both in the initial years of the program and the revision to those rules in 1999. There are three rural classifications: Farm Community Districts (FCD), Resource Preservation Districts (RPD), and Rural Communities. These rural areas are subject to more restrictive (lower density) zoning than the residential areas. Most of the county's prime farmland and forested areas lie within the FCD and RPD areas. Land in these two zoning classifications can be broadly thought of as the areas targeted for preservation.

The residential zoning classifications are shown in the bottom rows of Table 1. These areas, along with the Rural Communities, are eligible to be receiving areas, or areas that can be developed more densely than allowed by the baseline zoning.

The transfer ratio – the amount of development that can be transferred from a sending site divided by the amount that could be built on the sending site using TDRs – was one to one in Calvert County over the period 1978-1999. Since the rural zoning in 1978 allowed 1 dwelling unit per 5 acres of land in the sending areas (see Table 1), the rules of the TDR program required a developer to purchase 5 TDRs from rural land to build one dwelling unit in a receiving area.

The second column of Table 1 shows the "density bonus" in the early years of the program, or the extra density allowed on any receiving site. Because properties in FCDs and RPDs were targeted for preservation, TDRs could not be used to increase the density of development in those areas. By contrast, land zoned R-1 was given a 300 percent density bonus, Town Centers, a 200 percent bonus, and Rural Communities, a 150 percent bonus. These percentages indicate by how much a developer could exceed the baseline zoning density by purchasing TDRs. For example, a developer could build an *additional* three houses on an acre of R-1 land with 15 TDRs. Similarly, in Rural Communities, TDRs allow up to one house per two acres instead of one house per five acres.

Thus, the county provided incentives, through the structure of the program, for owners of farmland and forested lands in FCD and RPD zones to enter the TDR program but did not force them to enter. Zoning designations for the FCDs and RPDs, did not, by any means, completely prohibit development: properties in those areas could still be developed at a rate of 1 dwelling unit per 5 acres of land through 1998. In fact, a number of developments were built in these areas during the 1980s and 1990s.

An unusual component of the Calvert TDR program is the overlap between sending and receiving areas: land in Rural Communities can be both and since 1999, FCDs and RPDs can as well. This provides more flexibility to landowners and developers than exists in many other TDR programs.

Figure 2 shows a map of Calvert County with the various zoning classifications. The areas outlined in blue and shaded with the dashed blue lines are FCDs and RPDs; yellow and orange areas are, respectively, Town Centers and R-1/R-2 residential areas; commercial and industrial are shown in purple; white indicates areas zoned as Rural Communities. For illustration purposes, land that is preserved through state, federal, or private conservation programs, or that is county or state parkland, is shown in brown. As we stated above, most of the prime farmland in Calvert is in the western part of the county, along the Patuxent River. Several major creeks flow East to West through the central and southern parts of the county. Most of the land around these creeks is also zoned as FCDs and RPDs.

In 1999, new evidence from the decade of the 1990s and forecasts of future growth required the County to rethink its overall land use plan. New development was expected to swamp the major North-South highway in the County, and because the County did not want to undertake major additions to this road, the development plan was changed. Most land had its maximum density reduced by about 50%. The last two columns of Table 1 show the new zoning and the density bonuses for the different types of land in the county.[17] In Rural Communities, the density bonus increased from 150 percent to 400 percent, and in R-1, the bonus increased from 300 to 700 percent. Thus, while the more restrictive zoning should lead to less development on a given acreage of land, the increased density bonuses counter that effect. The

pre-1999 maximum density levels can still be attained, but only with the purchase of more TDRs than before.

An example may help to clarify the program change. On the sending side, a 50-acre farm could have had 10 units built on it prior to 1999, or alternatively the owner of the property could have sold 50 TDRs; those 50 TDRs could have been used to build 10 additional units in a receiving area. After 1999, the new zoning allowed the 50-acre farm to have only 5 units built on it; however, the owner could still sell 50 TDRs off the property. In the receiving areas, the maximum potential density was not altered with the program change. For example, before 1999 a 10-acre property in R-1 could have 10 houses built on it without any TDRs or a maximum of 40 houses could be built by purchasing 150 TDRs. Since 1999, only 5 houses may be built without TDRs but a maximum of 40 houses may still be built by purchasing 175 TDRs.

The result of the 1999 tighter zoning rules is to give farmers more incentive to enter the TDR program. This is reinforced by the resulting increase in the transfer ratio (from one to one to two to one). Thus, the supply of TDRs should have increased in response to the 1999 program change. The demand should also have increased, in response to the downzoning of R-1, R-2, and Rural Communities and the resulting increase in the density bonuses.

Calvert's program allows for more flexibility in both sending and receiving areas than most other TDR programs around the country. The TDR program in Montgomery County, Maryland, for example, includes very restrictive zoning in the western portion of the county; when the program began, that area was downzoned from 1 unit per 5 acres to 1 unit per 25 acres. In the New Jersey Pinelands, the three areas targeted as sending areas have low density zoning and are only permitted residential development by special use permit and not as a matter of right. In the Long Island Pine Barrens, development is virtually prohibited in the "Core" area, the

targeted TDR sending area. The only way that landowners might be able to build on a site would be through the extraordinary hardship provisions of the Pine Barrens Protection Act. These programs are much more prescriptive than Calvert County's program is about where the sending areas are and what is permitted on the properties in those areas. Calvert's program offers more opportunity for the TDR market to decide which properties are preserved and which developed, and, thus, is likely to be more efficient.

Additional development restrictions. Certain state and local government programs may have a strong effect on the development potential of agricultural land in the County, and therefore on the TDR program. Although TDRs allow developers to create additional density in residential areas, all subdivisions created in Calvert County since 1992 have also been subject to stringent "clustering" requirements. These regulations mandate that all lots be clustered onto 50 percent of any given parcel in R-1 Districts and Rural Communities and only 20 percent of any given parcel within a Farm Community or Resource Protection District.[18] This is likely to have some effect on the profitability of development in the County and therefore on the demand for development rights. In addition, the state of Maryland passed legislation in 1984 that restricts the density of development close to the shoreline in the Chesapeake Bay watershed. Within 1,000 feet of tidal waters, density can be no greater than 20 acres per lot, and no building can occur within a 100-foot buffer zone along the shoreline. Calvert County enacted its version of the critical areas program in 1989. This program effectively downzoned many properties along the shoreline, decreasing their potential value in development and increasing the potential supply of TDRs.

The County as a Buyer of TDRs. Finally, the county government itself has had an important role in the TDR market as a direct participant. The County government began to

purchase TDRs in order to retire them, starting in 1993, under its so-called "Purchase and Retire" (PAR) program. We assess the government's role in the market more fully below, but concern over rapidly increasing development appears to be the major reason for the policy of retiring development rights. In 2001, the county instituted a "Leverage and Retire" (LAR) program. Landowners enter the LAR program, selling all of their TDRs from the property to the county, and are then compensated by the county gradually over time. For example, over a 15-year period, the landowners receive tax-free interest payments, and then are paid the principal at the end of the 15 years. Many households find this appealing, because it can reduce overall tax liability, shifting income from the sale to retirement age, when incomes are expected to be lower. The program also allows the County to retire more acreage with a smaller up-front expenditure; the county buys tax-free bonds to finance the stream of payments.

4. Evaluation of the Calvert Program

We evaluate the Calvert County TDR program in a number of ways. We look at both TDR sales and acres preserved under the program since its inception, the location of properties preserved, and prices over time. We then use this information to assess the efficiency and implementation issues set forth in Section II. Specifically, we examine the short-run changes in quantities of TDRs sold, the extent of thinness and transactions costs in the market, and the role of the government in the market.

Acres preserved in the TDR program. Figure 3 shows the cumulative acres of land in APDs in the county and the cumulative acreage in permanent easement status. As of July 2002, there were more than 19,600 acres entered into APD status. From those acres, 12,664 TDRs have been sold, resulting in the permanent preservation of nearly 13,000 acres of land. This

means that approximately 13 percent of all agricultural and forest land in the county, and nearly 10 percent of the entire county land area has been permanently preserved under the TDR program.[19] The county is aiming to reach a target of 40,000 acres of farmland preserved through all state and local land preservation programs by the year 2020.[20]

Figure 4 shows the changes in farmland and forest acreage, since the TDR program began. If we assume that all the acreage in the TDR program would have been developed in the absence of the program, the farm and forest acreage in the county was nearly ten percent greater in 1997 than it would have been without TDRs. This is, of course, an upper bound on the effectiveness of the program, since some landowners would likely have continued farming, even in the absence of the TDR program. We say more about this issue below.

Short-run performance of the program. The long-run total number of development rights that may be sold in Calvert County depends on the number of acres of undeveloped farmland that are eligible for APD status.[21] The long-run cap on development depends on the zoning rules and the TDR transfer rate. But the number of TDRs bought and sold, and thus the amount of additional land preserved and developed, can fluctuate a great deal from year to year. A range of factors influences the supply and demand for rights including housing market conditions, returns to farming, and regulatory changes that affect returns to different land uses.

Figure 5 shows the number of acres recorded as APDs in each year, and their permanent preservation status as of July 2002. Interestingly, there are properties that became APDs many years ago – note the bar graphs for 1980, 1984, and 1989, for example – that have still sold no TDRs. These properties remain in farming but have not been permanently preserved.

Figure 6 shows the significant year-to-year variation in TDR sales. The graph shows the number of TDRs sold since the program's inception, including both sales to private buyers

and sales to the County government through the PAR and LAR programs. There were few sales in the early years of the program, and then large fluctuations in sales through the latter part of the 1980s. The large number of sales in 1987 was most likely due to anticipation of a moratorium on new development that was imposed in 1988 because school capacity was at its maximum in certain parts of the County.[22] Fluctuations in sales were again large in the late 1990s.

Figure 7 shows the number of TDR transactions in each year in both the private market and the PAR/LAR programs. As can be seen from Figures 6 and 7, with the exception of 2001, private market participants engaged in more transactions and purchased more TDRs in each year than did the county. For example, in 2000, there were 21 county transactions in which the county purchased (and retired) 252 TDRs. In the same year, there were 43 private market transactions in which developers purchased a total of 989 TDRs. This means that developers in that year bought an average of 23 TDRs from each farmer, while the county bought only 12 TDRs, on average, in each of its transactions. Since the county's goal is to preserve as much prime agricultural land as possible with the money it has available and since an entire property is preserved when a single TDR is sold, the county typically buys fewer TDRs in each transaction than do private developers. Through the PAR and LAR programs, the government has permanently preserved 3,371 acres since 1993, accounting for roughly one-quarter of all preserved acreage in the TDR program.[23]

As we stated above, Calvert's program appears to be unique in that it does not completely differentiate sending and receiving areas and does not specifically designate geographic areas for preservation. Some of the same land that is highly productive in agriculture is also best for subdivision development, and the returns to agriculture and to development vary across areas of the county, according to county planning officials. Since market prices for land reflect potential

returns to both uses, it makes sense to allow the market to sort out which individual parcels should be developed, and which preserved. Thorsnes and Simon (1999) argue that most programs do not allow the TDR market to both set prices and determine land use patterns. The reason for this lack of reliance on markets, according to the authors, is that local officials are "far from confident that the market will allocate land in ways that meet public objectives" (p. 261). The Calvert County government -- in part because it sets only the relatively limited goal of farmland preservation -- has essentially allowed the market to work to allocate land among competing uses. Beyond creating broad incentives for the location of sending and receiving areas with differential zoning, the Calvert program allows for a great deal of flexibility.

It is useful, then, to look at the spatial patterns of land development and preservation that take place in this relatively free market setting. In Figure 8, we use the zoning map of Figure 2 and overlay the locations of land developed and preserved as of 2001, as a result of the county's TDR program. Areas shaded red are subdivisions that used TDRs for additional development, i.e. the receiving areas. Dark green shows permanently preserved acreage, or sending areas of the program, and light green is land that is in APD status but has not yet sold TDRs.[24]

There are several observations we draw from Figure 8. First, most properties that have entered the APD program, whether they have sold TDRs or not – i.e., the dark and light green areas – lie within the Farm Community and Resource Preservation Districts, the areas with the most restrictive zoning. Although there are some green areas within the Rural Communities, 79% of all preserved acreage (dark green) and 73% of remaining APD acreage (light green) lie in FCD and RPD zones. Thus, the County has been successful at guiding preservation to the prime farming areas, but has allowed the market to select which particular farms will be

preserved. Moreover, this market-based approach has not limited preserved farmland to FCDs and RPDs; 21% of the total lies in Rural Communities.

Second, up to 1999, the receiving areas – i.e., areas where TDRs were used to build more houses – could be R-1, R-2, Town Centers, and Rural Communities, but the map shows that they were almost exclusively Rural Communities. The red shaded areas show these receiving areas, and they are not in the areas zoned for high-density development, the R-1, R-2 and Town Centers. There will only be a demand for TDRs in the receiving areas if the profit from buying TDRs and developing more densely than the base zoning is greater than the profits of building at base zoning levels. It is evident that only in the Rural Communities is the baseline density constraining the density at which developer would like to build. In areas zoned residential, there appears to be little demand for greater density.[25]

Third, the location of receiving areas offer further evidence that TDRs have been used to increase development where markets value it most. Most of the red areas of Figure 8 are in the northern part of the county and near the major North-South highway that runs through the middle of the county. These areas provide greater access to Washington, D.C., Annapolis, and Baltimore.

Fourth, a substantial fraction of the farms that have sold TDRs are in the central and southern part of the county rather than the North. These are farms that, all else equal, have less value in development so it is no surprise that they are the properties that have been preserved. This may suggest that an adverse selection effect has been at work, however, as we discussed in section II. Some of these farms may not have been developed anyway, at least over the 1978-2001 period. This means that the TDR preservation program is less efficient than some optimal policy that could differentiate parcels that might not have developed even without TDRs.

In addition, this means that the TDR program may have led to more building than would have occurred with zoning alone. Exactly how much more building occurred is difficult to say. We know that approximately 2,130 new housing units were built with TDRs over the entire 23-year period,[26] and that a total of 10,128 new housing units were built in the county between 1990 and 2000. We do not have access to earlier figures, but if approximately 10,000 were built in the 1980s – and this is likely to be an overestimate – then the new units built with TDRs accounted for approximately 10 percent of total new construction. Of course, not all of these TDRs came from properties that would have remained undeveloped even without the TDR program. Moreover, there are factors that tend to offset the increased development that results from the adverse selection effect. First, if decisions by developers about how many houses to build are affected more by the economics of the housing market than by zoning constraints, the TDR market may serve to simply redirect the location of development not to change the actual number of houses built. Second, the county's purchases of TDRs through its PAR and LAR programs may "crowd out" private market TDR purchases and since the county does not allow the TDRs it buys to be used for additional development, these purchases counteract the extra development from the adverse selection problem.

TDR Prices. Figure 9 shows the trend in the average TDR sales price for all transactions from 1983 to 2001, in current dollars and inflation-adjusted dollars. Both the nominal and real TDR prices have risen over time.[27] The average real price has risen at an average annual rate of 6.3% from 1983 to 2001. But most of the increase occurred in the first decade of the program. Between 1983 and 1993, the average real price more than doubled, rising from $1,211 (in 1999 dollars) to $2,578. Between 1993 and 2001, on the other hand, real prices remained relatively

constant. The average TDR price, over all transactions, in 2001 was $2,582 (in 1999 dollars), virtually the same as it was in 1993.

Figure 10 provides some information about the distribution of prices in each year of the program. The graph shows the maximum and minimum TDR price in each year, as well as the price range within which 50% of all private transactions in the year occurred. In 1999, for example, the minimum and maximum price were $2,200 and $2,800, respectively, and 50% of all transactions in that year occurred at prices between $2,400 and $2,600. In 1990, the range was much greater: 50% of all transactions occurred at prices between $1,209 and $2,780 (in 1999 dollars).[28]

Both Figures 9 and 10 seem to suggest that there has been greater price stability in the Calvert TDR program over the past eight years relative to the earlier years of the program. From the program's inception up to 1993, there was a sharp upward trend in average TDR prices and a large variance in the prices of individual transactions. Since 1993, the variance has declined and the average price stayed relatively constant. Figure 11 confirms this suspicion. It shows the coefficient of variation – i.e., the standard deviation relative to the mean – in each of the years for the private market transactions.[29]

The greater price stability after 1993 is coincident with the county government entering the market to buy and retire TDRs. Since 1993, the county has purchased TDRs at an annually announced price. The county purchase price has remained relatively constant over time, rising by small amounts at periodic intervals. The county purchase prices are shown in Table 2. The information provided to the market by the announced county purchases clearly helped to stabilize prices.

Thin Markets and Transactions Costs. In the early years of the program, little information was available to potential TDR buyers and sellers. Because the county did not participate directly in the market, no published information existed on prices, and the program was new so there was no history of transactions from which to draw information.[30] There were – and still are – a large number of potential sellers, with well over 100 farmers in the county. On the other hand, only about a dozen major developers are building at any point in time in the County.[31] In the early years, developers obtained lists of potential sellers from the county Planning Department and then visited each landowner to negotiate a sale. This meant high transactions costs and thin markets.

Figure 12 shows prices of individual TDR transactions in chronological order. It is clear that there were very few transactions in the early years. In addition, there is evidence that could support the argument that developers held monopsony power early in the program. The low prices observed in the first few years are consistent with low-valued farms entering the program first, with their owners being paid just above the opportunity cost of keeping the land in farming. In fact, the farms that sold TDRs through 1983 were almost all from the south and central, interior parts of the county, where land values are the lowest. None lie in the northern third of the County.

The large variance in prices in the early years also suggests that transactions costs were high. In a competitive market, sales prices should be the same across transactions; otherwise, arbitrage among landowners would take place. High transaction costs can prevent such arbitrage, however, and this appears to have been the case for this market.

The county has taken a number of actions to provide better information to potential buyers and sellers in recent years. The Planning Office publishes a newsletter that provides

information on prices, as well as the names and telephone numbers of surveyors and engineers in the county who may know of potential buyers. Transactions costs are clearly lower, as is evident from the greater price stability and the large number of transactions in the 1990s.

It is notable that no secondary markets or much in the way of brokerage services have developed around the Calvert TDR market. Although the volume of transactions is relatively small, Figure 12 shows that there could have been clear gains from third party brokering to both buyers and sellers. Currently, with about 700 TDRs sold in the private market each year at a price of roughly $3,000 each, and a 5% return on brokerage services,[32] total returns would only be about $100,000 a year. Nonetheless, it is surprising that real estate agents or other third parties have not entered on a part-time basis.

The Further Role of Government: Zoning and TDR Program Parameters. Since the inception of the TDR program in the late 1970s, the county government has made few changes to zoning designations. Before that time, a great deal of county time and resources were devoted to zoning hearings and applications for zoning exceptions. Once the TDR program was put in place, it became clear that there would be no zoning changes, and the only avenue for changing land use from designated zoning density was through the use of TDRs. The Calvert County experience seems to support the Mills (1989) argument that combining zoning with TDR markets can mitigate the rent seeking behavior surrounding zoning designations.

In general, Calvert County has had less restrictive zoning than many other jurisdictions with TDR programs, and has certainly been less prescriptive about where preservation and development can occur. In addition, the government has changed zoning regulations to achieve preservation objectives in a couple of cases, most notably in the case of the downzoning in 1999. As we explained above and showed in Table 1, the county reduced allowed density in all areas in

1999, which effectively changed both the density bonuses and the transfer ratios in the TDR program. These changes should affect the market for TDRs. Owners of agricultural land compare the opportunity cost of entering the TDR program – i.e., of permanently foregoing development on their land – with the payoff from selling TDRs. The 1999 downzoning of rural lands lowered the value of development on those lands and thus reduced the opportunity cost of entering the TDR program. The increase in the transfer ratio reinforced that effect, thus the supply of TDRs should have increased since 1999. On the demand side, the reduction in the baseline zoning of residential land, along with the increased density bonuses, should have increased the developers' demand for TDRs.

With both the supply of and demand for TDRs increasing, we would expect to see more trading in the TDR market after 1999. As Figure 5 above showed, there was a significant increase in APD acreage in 2000. This means that new farmers registered their properties as APDs, thus taking the first step toward the possible sale of TDRs.[33] TDR sales, themselves, were high in both 1999 and in 2000, and even higher in 2001 (see Figure 6). Sales of TDRs might have been even higher still in 2001, had it not been for the fact that a moratorium on new building began in that year because of inadequate school capacity.[34] There is some preliminary evidence, then, of more TDR sales since 1999.

5. Conclusions

The data from Calvert County, Maryland's, 23 years of experience with transferable development rights provides us with a unique opportunity to evaluate the performance and efficiency of a real-world TDR market. The Calvert program is one of the first programs to allow markets to price development rights, and to allocate land between development and

preservation. It has several important features that make it particularly worthy of study. First and foremost, from an economics perspective, the limited involvement of the county government in the market is unusual and makes for an interesting case study. Specific locations have not been targeted for preservation or development – within some limits, the county lets the private market choose those locations. Also, so-called sending and receiving areas can overlap. This is quite different from many other TDR programs in operation in the United States. The government also does not act as either a broker or a banker in private market TDR transactions.

In fact, the Calvert program provides an example of the government allowing the market to move toward improved performance and efficiency. Due to likely monopsony power and high transactions costs in the early years of the program, there were very thin markets and substantial price variation. Government purchases of TDRs at announced prices, and the provision of information, through a quarterly newsletter has helped to create a single price and promote price stability. With uncertainty over the value of TDRs reduced, there has been a large increase in trading activity. This is a strong indication that the county has structured the program in the right way.[35] It is also an indication that the market fundamentals are strong – i.e., enough demand exists for increased density in some developed areas of the county to make using TDRs worthwhile, enough interest in farming exists to ensure an adequate supply, and relative price stability over a period of time appears to have reassured market participants.

One of the most important ways the TDR program has enhanced efficiency lies outside the market itself. The creation of the market has reduced the substantial costs associated with rent-seeking behavior on the part of landowners and developers who, before the TDR market, attempted to obtain zoning variances. Much of the time of the planning agency was taken up

with such negotiations, but with the introduction of TDRs, zoning rules and variances to them are prescribed and these costs have essentially disappeared.

Because the TDR program allows flexibility in exactly which properties are preserved or developed, looking at the spatial pattern of land uses in the county is particularly interesting. We find the resulting development patterns as we expected. Additional development through the use of TDRs has taken place in the northern part of the county and along an important North-South highway. It has also taken place almost exclusively in a zoning classification called "Rural Communities" rather than in the county's residential zoning classifications, revealing a lack of demand for relatively dense residential development in the county.

Preserved rural lands – the so-called TDR sending areas – lie in the central and southern regions of the county – areas not as lucrative in development. This provides some evidence of an adverse selection effect – i.e., some properties that would have remained undeveloped without TDRs entered the TDR program. As a result, some building probably took place in the county that, at least in the short run, would not have occurred in the absence of the program (Levinson, 1997).

Finally, recent evidence suggests that the market is starting to tighten significantly. Figure 13 shows the cumulative number of APD acres certified, and certified and preserved through the sale of TDRs over time. The heavy dark line shows the cumulative number of TDRs sold. The difference between the dark line and the top of the light bar shows the number of TDRs certified from preserved properties that have not yet been sold. This difference is smaller than it has ever been over the life of the TDR market, showing the tightness in the current market. Developers are having difficulty in finding sellers. Some are even attempting, for the

first time, to buy TDRs to hold for future use, and prices are rising rapidly. It will be interesting to observe this next phase in the TDR market, to see the role of government versus the private sector in stabilizing prices.

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Table 1. Zoning and Density Bonus in Calvert County TDR Program

	1978-1998		*1999 to present*	
Zoning Classification	*Base Density*	*Density Bonus*	*Base Density*	*Density Bonus*
Rural				
FC District	1 unit/5 acres	0%	1 unit/10 acres	100%
RP District	1 unit/5 acres	0%	1 unit/10 acres	100%
Rural Communities	1 unit/5 acres	150%	1 unit/10 acres	400%*
Residential				
R-1	1 unit/acre	300%	1 unit/2 acres	700%
R-2	14 units/acre	0%	1 unit/2 acres	700%
Town Centers**	4 units/acre	250%	2 units/acre	600%

*Density can go as high as 1 unit/acre within 1 mile of a TC.

** The Town Center zoning classification came into effect in 1983.

Table 2. TDR Prices Paid by Calvert County Board of County Commissioners (BOCC), 1993-2001 (in nominal dollars)*

Year	*Price*
1993	$2350
1994	$2350
1995	$2350
1996	$2400
1997	$2400
1998	$2400
1999	$2600
2000	$2600
2001	$2700
2002	$2700

*Occasionally, for certain sales, the price will vary slightly from the BOCC's stated price. Also, prices paid in the LAR program, which started in 2001, sometimes have a 10% bonus as an additional inducement for landowners to enroll; in five sales in 2001, for example, prices ranged from $2730 to $2990.

Figure 1. Calvert County in the Baltimore-Washington, D.C., Region

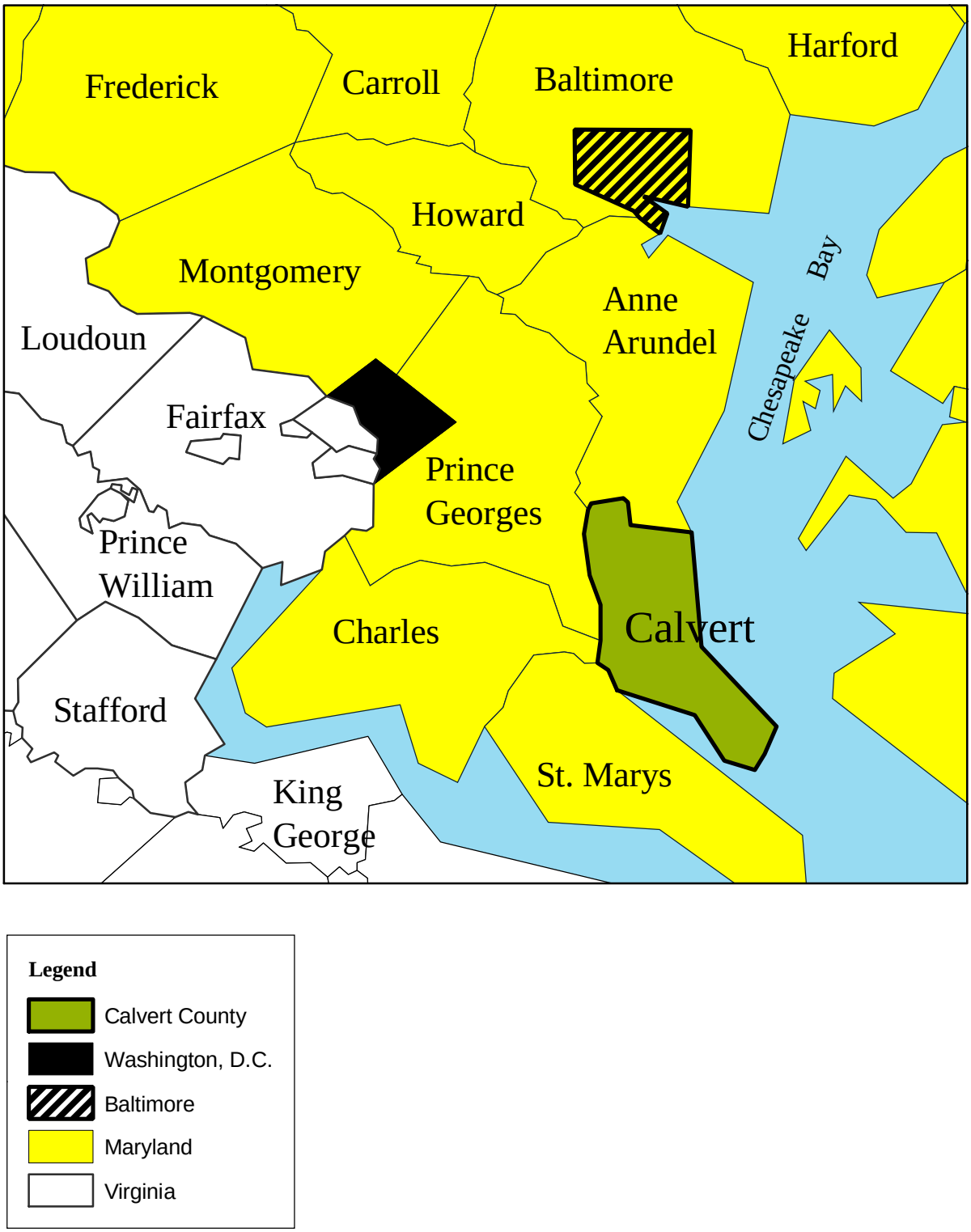


Figure 2. Zoning Map, Calvert County, MD

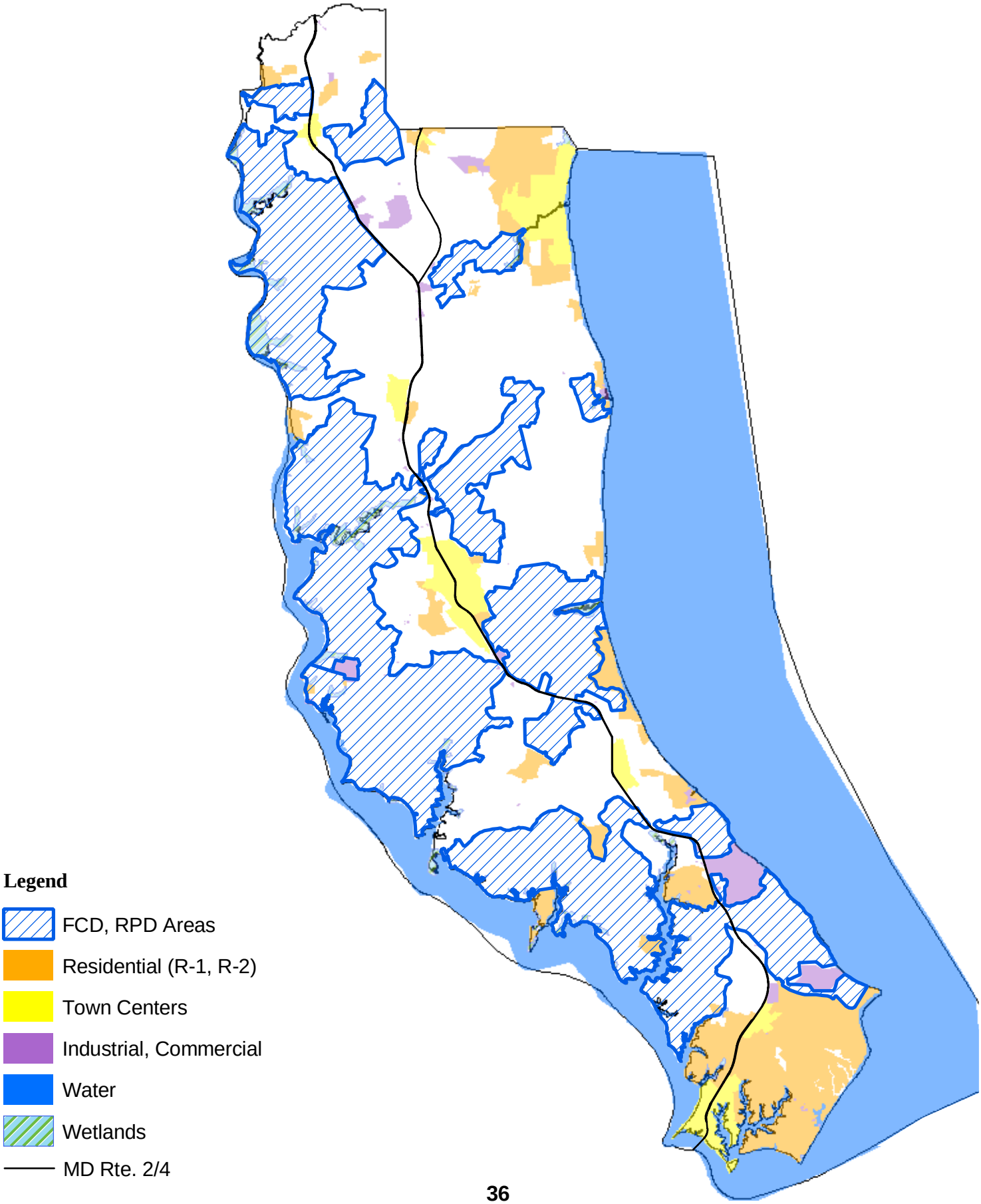


Figure 3. Cumulative APD and Preserved Acreage, Calvert County TDR Program

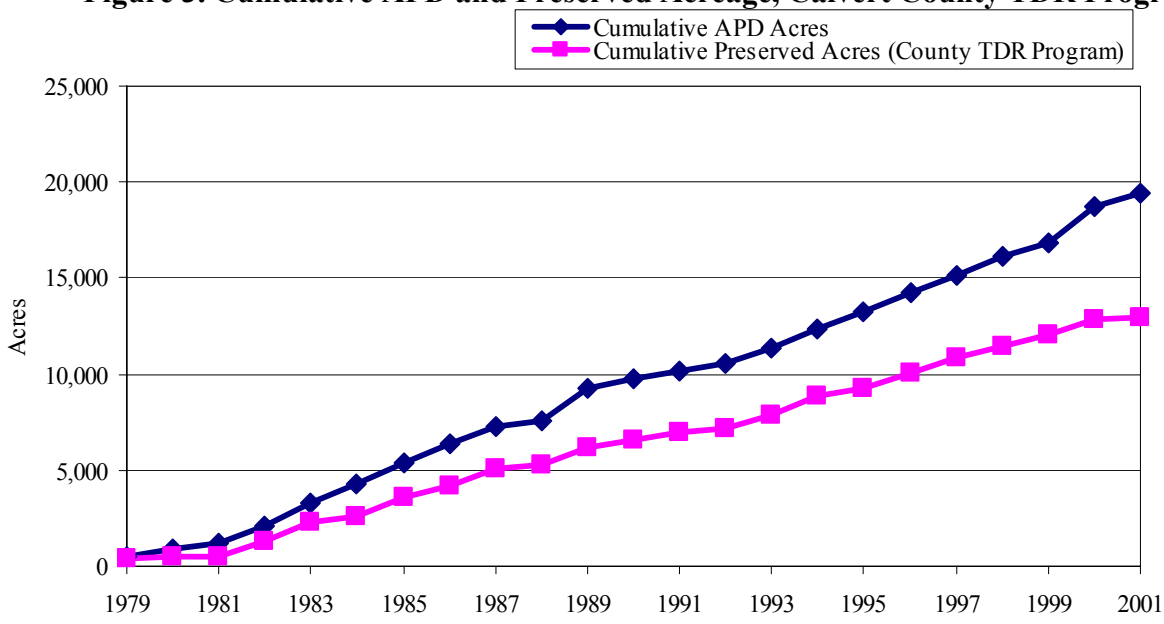
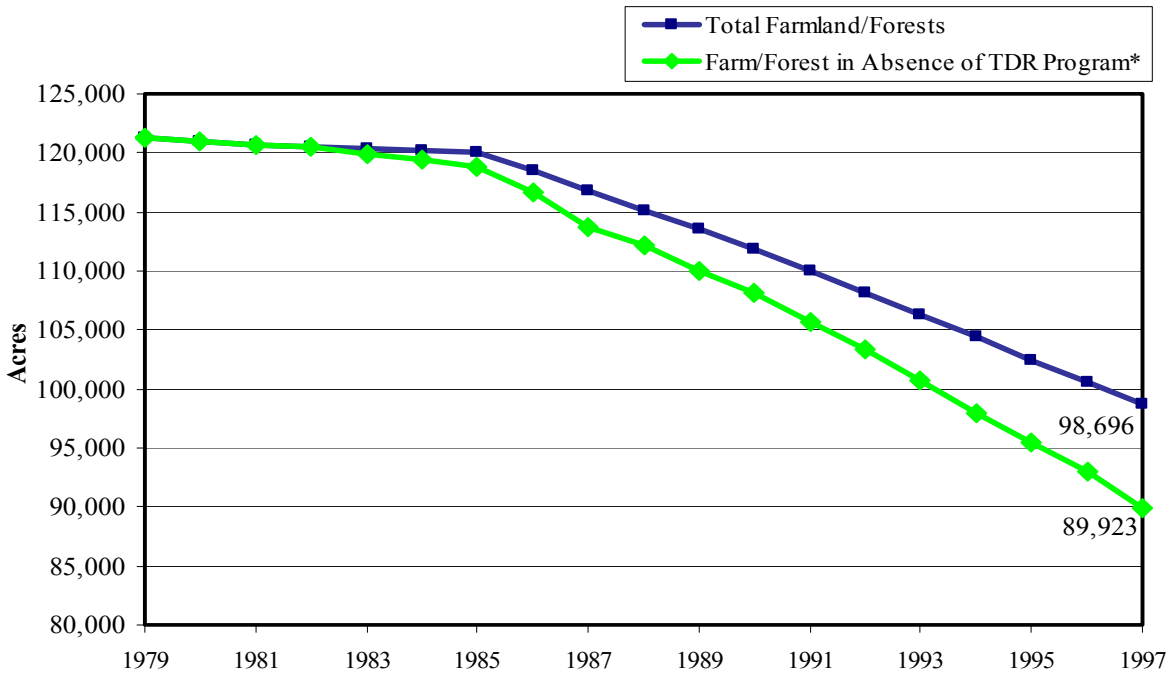


Figure 4. Farmland and Forest Acreage, Calvert County, 1979-1997



*assuming that all APD acres would have been developed in the absence of the TDR program.

Figure 5.

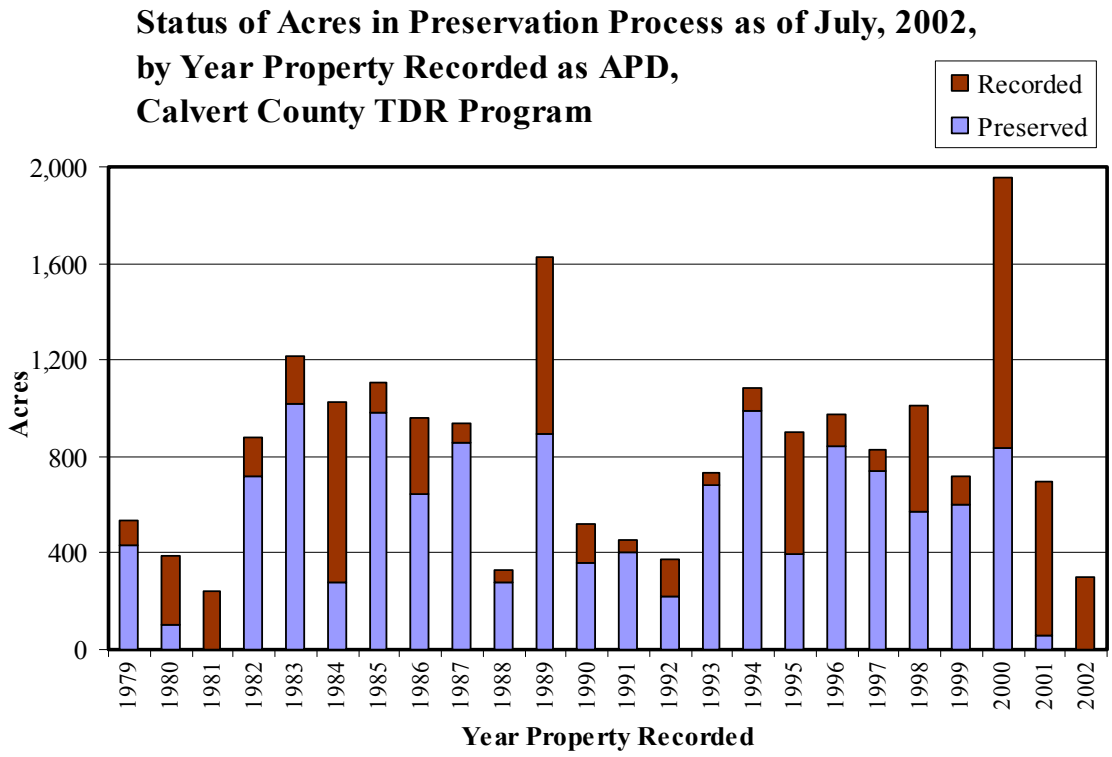

Status of Acres in Preservation Process as of July, 2002,
by Year Property Recorded as APD,
Calvert County TDR Program
Recorded
Preserved
2,000
1,600
1,200
800
400
0
Acres
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
Year Property Recorded

Figure 6.

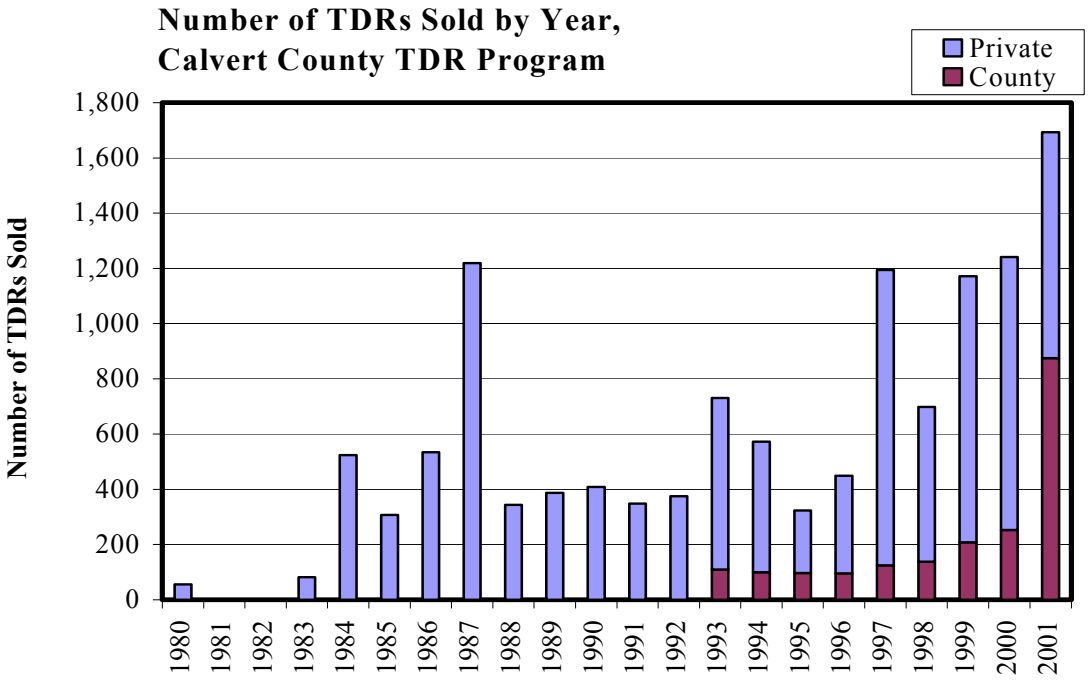

Number of TDRs Sold by Year,
Calvert County TDR Program
Private
County
Number of TDRs Sold
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001

Figure 7.

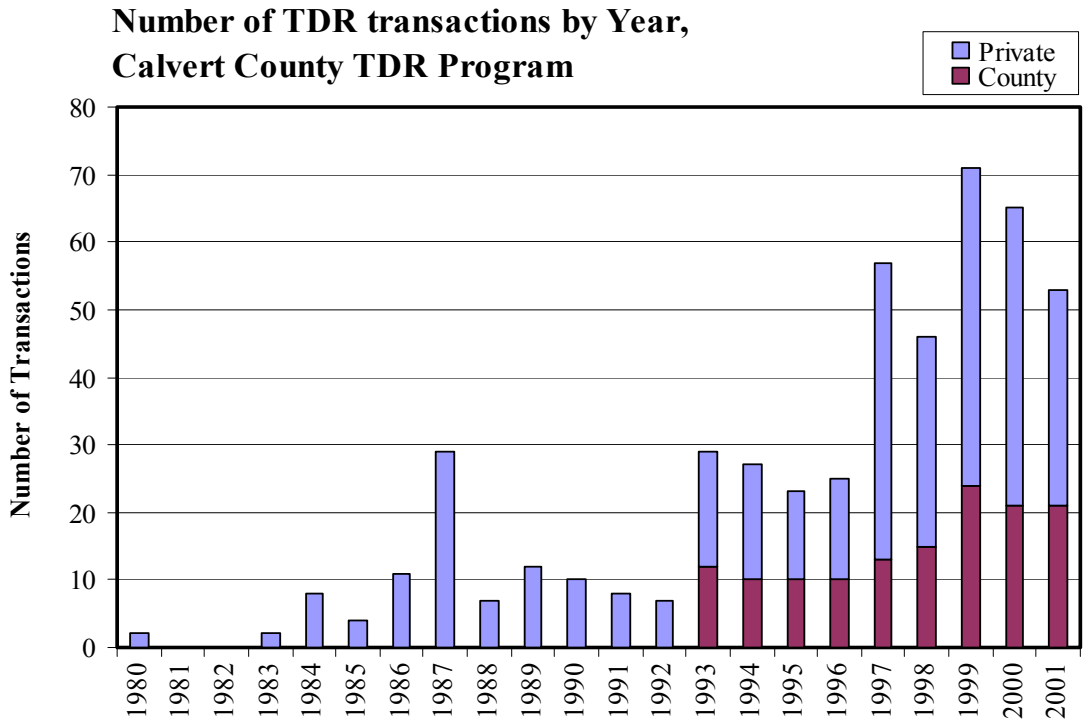

Number of TDR transactions by Year,
Calvert County TDR Program
Private
County
Number of Transactions
0
10
20
30
40
50
60
70
80
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001

Figure 8. Sending and Receiving Areas, Calvert County TDR Program

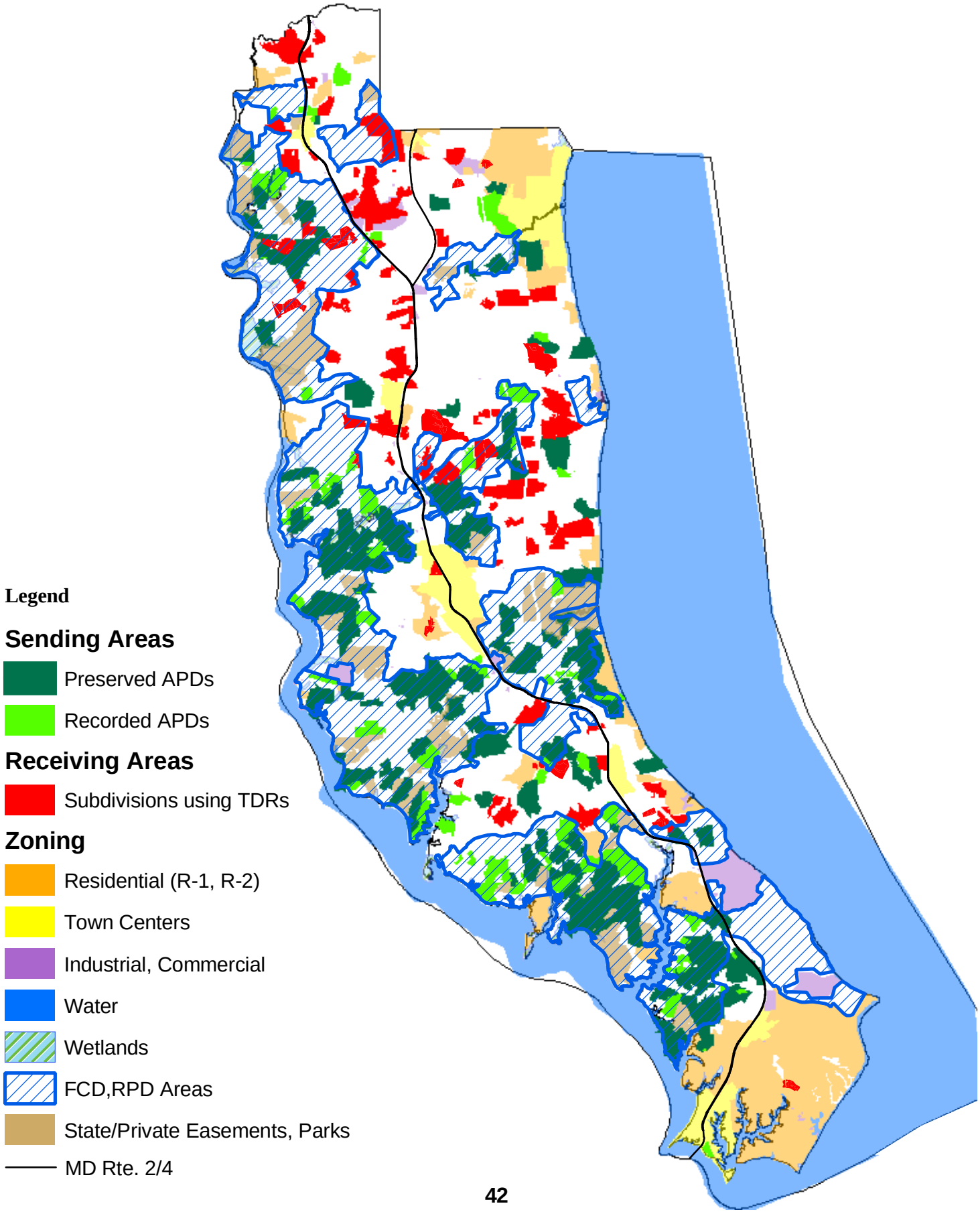


Figure 9.

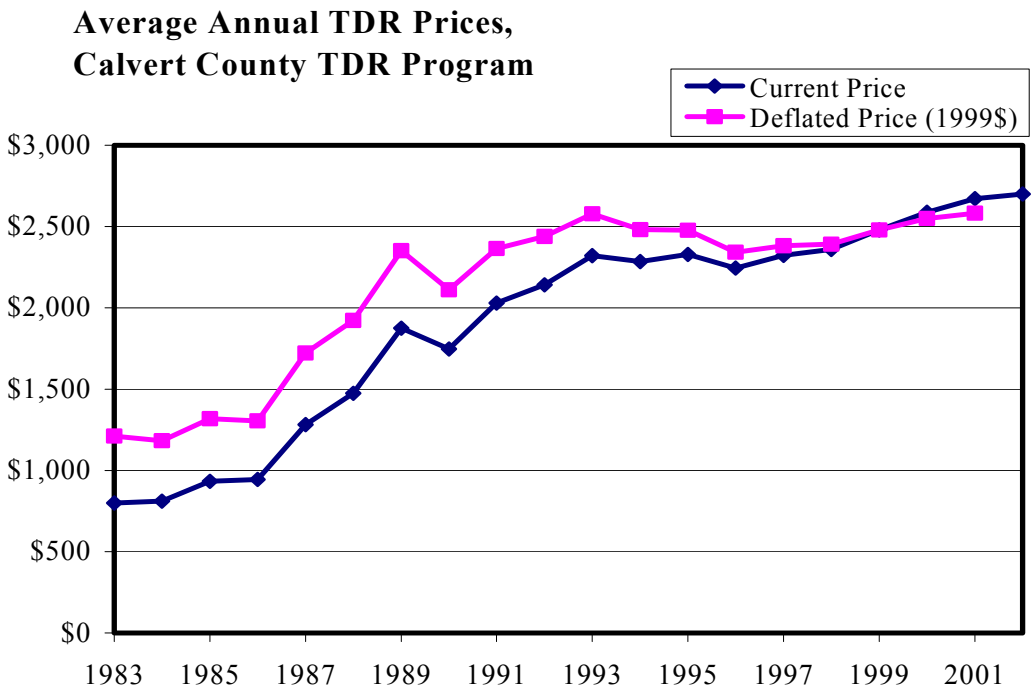

Average Annual TDR Prices,
Calvert County TDR Program
Current Price
Deflated Price (1999$)
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001

Figure 10. TDR Price Distribution, Calvert County TDR Program

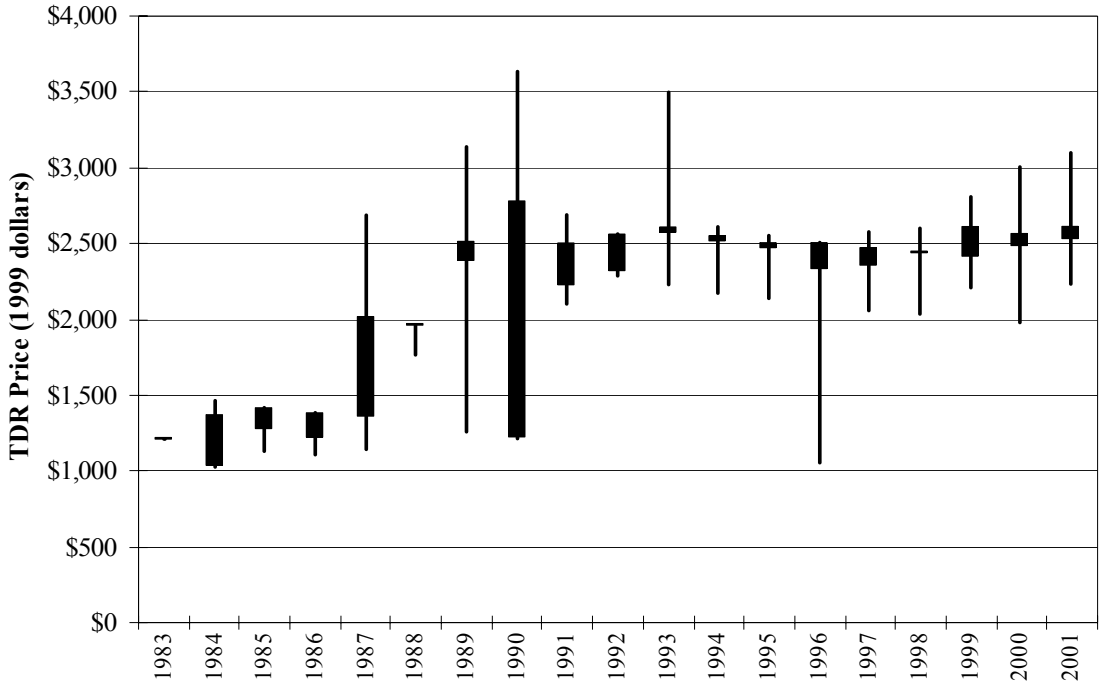


Figure 11. Coefficient of Variation in TDR Price (Private Sales Only), Calvert County TDR Program

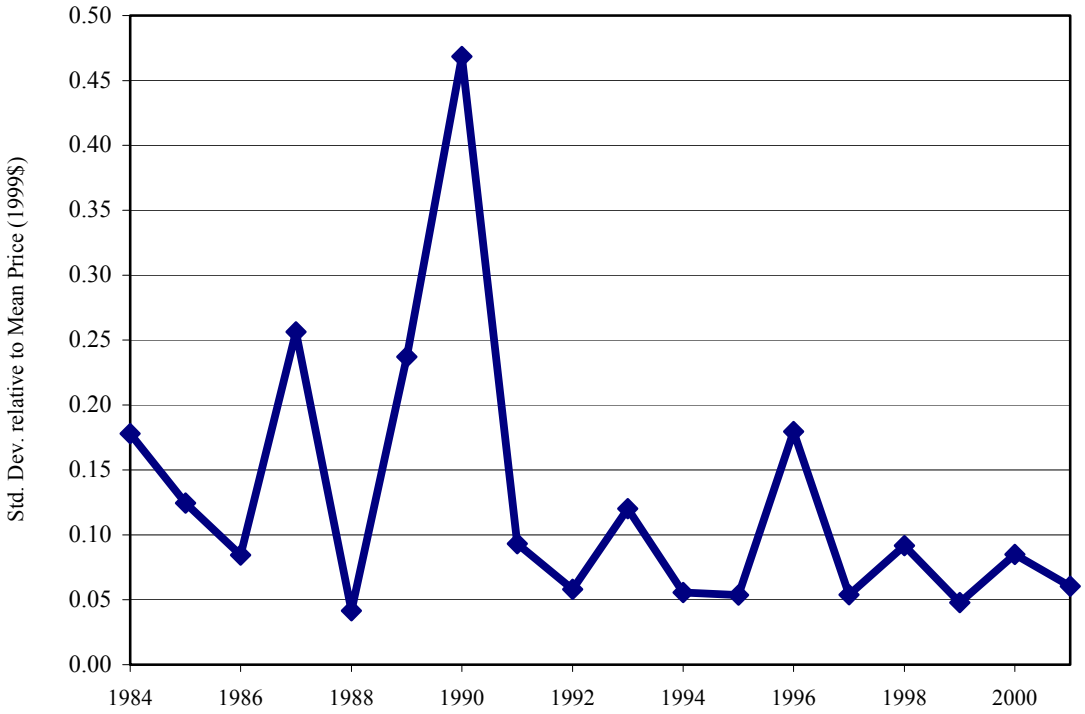


Figure 12.

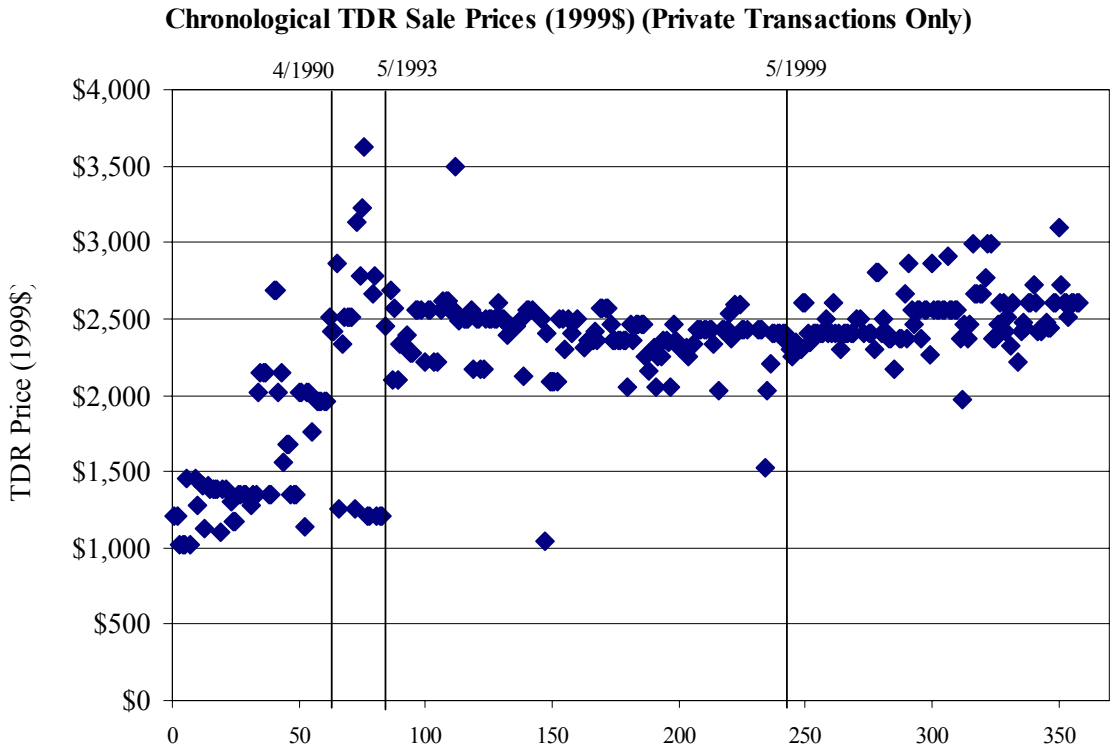
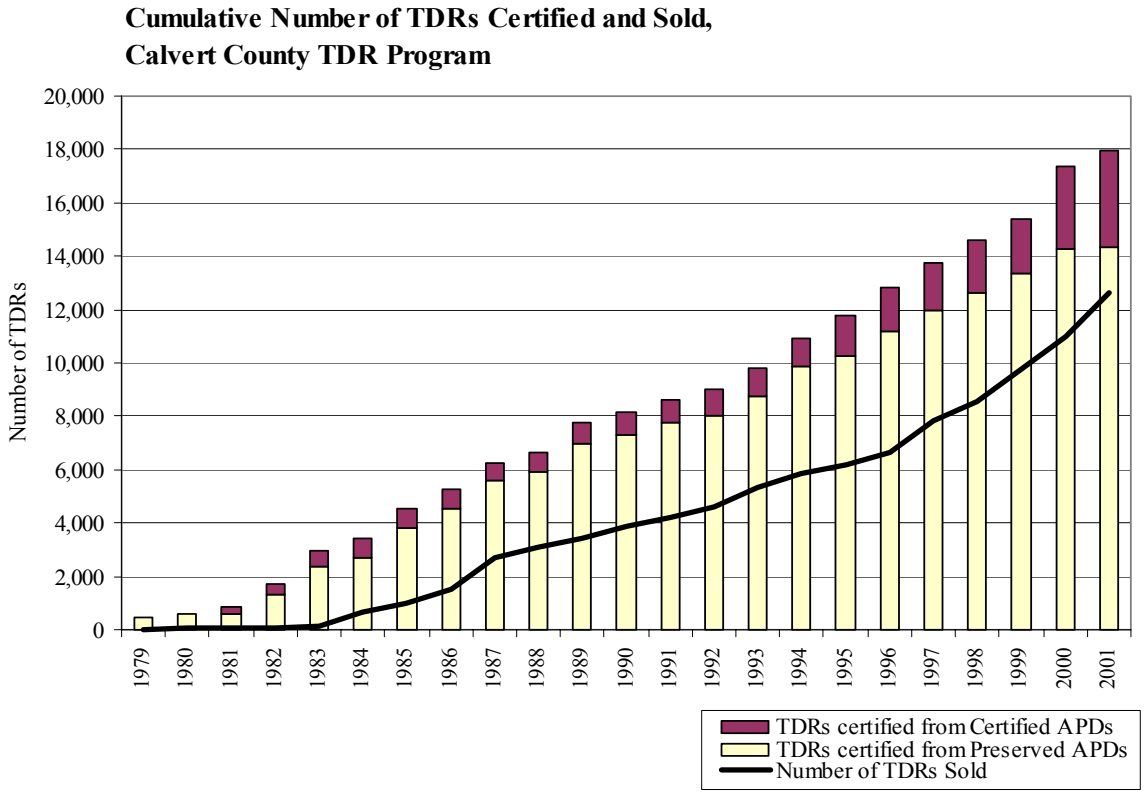

Chronological TDR Sale Prices (1999$) (Private Transactions Only)
4/1990
5/1993
5/1999
TDR Price (1999$)
$4,000
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
0
50
100
150
200
250
300
350

Figure 13.


Cumulative Number of TDRs Certified and Sold,
Calvert County TDR Program
Number of TDRs
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
TDRs certified from Certified APDs
TDRs certified from Preserved APDs
Number of TDRs Sold

[1] For a review of all current TDR programs in the U.S. see Pruetz (1997, 2002).

[2] Lynch and Musser (2001) assess farmland preservation programs in four Maryland counties. Their analysis is focused on the number of acres preserved, the types of land preserved, and whether contiguous properties are preserved in state and county purchase of development rights (PDR) and TDR programs. They provide no information on prices and no assessment of the performance of the TDR markets, however.

[3] For a criticism of farmland preservation efforts, see Gardner (1977); for empirical studies that attempt to measure the benefits of farmland preservation efforts and/or identify the different characteristics of farmland preservation that matter to consumers, see Kline and Wilchelns (1994, 1996), Hellerstein et al. (2002) and Krieger (1999). In a recent study, Thorsnes (2002) measures the value of preserved forestlands. Nickerson and Lynch (2001) examine the effect of farmland preservation status on farm values.

[4] Where the benefits of preservation depend strongly on the location of the land preserved and where those benefits are purely public – for example, wetlands preservation or protection of wildlife habitat – there may be an argument for some government restrictions on which properties may be developed. In a farmland preservation program, however, it is likely to be more efficient to allow individual farmers to make their own decisions, while imposing an overall development limit.

[5] Carpenter and Heffley (1982) suggest an alternative model in which TDR design allows local government to set the price (they call this a brokered program) and the amount of development then becomes endogenous. In such a program, the role of government is to buy and sell permits to maintain the price.

[6] Most cap and trade programs, even if they grant a permit in perpetuity, specify an annual cap.

[7] Some programs operate with middlemen and some do not. In Montgomery County, Maryland, real estate agents handle transactions, while in New Brunswick, New Jersey, the government acts as a central clearinghouse. In Calvert County, for the most part, buyers and sellers deal directly with each other with no brokers or middlemen.

[8] Often, these high transfer ratios occur in programs in which land targeted for preservation is zoned at very low density. As partial compensation, if owners sell development rights off the land, those rights are still equivalent to the density of development before the downzoning.

[9] See Pizer (1998) for an application of such a system for controlling carbon dioxide emissions.

[10] These numbers are from Debbie Weller of the Maryland Department of Planning.

[11] These include Anne Arundel County, Prince Georges County and Charles County.

[12] The requirements are that (1) land use must be of a type to permit continued initiation of viable agriculture and forestry production; (2) at least 75% of the total acreage must be suitable for cropland and/or managed forest land; and (3) at least 50% of the proposed area shall be in Class I through IV capability classes (or Woodland Suitability Group 1 or 2), or the applicant must demonstrate by crop records that the land meets the productivity normally associated with such soils through good management and operational practices.

[13] Also, if the property lies within a state Designated Agricultural Area (DAA), it can become an APD with a minimum of only 10 acres. DAAs are prime farmland areas that were identified as the most productive agricultural areas of the County in the early 1980s.

[14] If a property is agricultural use, it is allowed a low land value assessment and consequently is subject to low rates of property taxation. Hence, the County tax exemption for properties gaining APD status is not large. For example, a 100-acre property in agricultural use in Calvert County having a market value of $3,000 an acre would pay only $446 in County property taxes a year; this would also be the tax savings from entering the APD program.

[15] According to Calvert County's Deputy Director of Planning and Zoning, Greg Bowen, only three property owners have terminated their APD after the five-year grace period.

[16] To be more precise, the following formula is used to determine how many TDRs are allocated to the property: *#TDRs = (5*c)+(a-c)-(5*b)* where *c* = number of 1-acre lots authorized in the rural district under Article 5 of the County Zoning Ordinance and not previously used; *a* = total number of acres; and *b* = number of residences currently located on the parcel. Provided that no TDRs have previously been sold, 2 TDRs are granted for each acre in an APD in residential districts.

[17] R-1 and R-2 have had essentially the same zoning since 1999 except that townhouses and multifamily homes are allowed in R-2 areas and not in R-1.

[18] There are also clustering requirements in Town Centers.

[19] There are other preservation programs operating in the County as well, including five State programs: the Maryland Agricultural Land Preservation Program (MALPF), Rural Legacy Program (RLP), Maryland Environmental Trust (MET), Program Open Space (POS), and the most recently established Program GreenPrint. Over 13,000 additional acres have been preserved through these programs to date. There are also private land trusts that buy and sell TDRs.

[20] Calvert County Agricultural Land Preservation Program Newsletter, April 2, 2001, volume 4, Issue 1.

[21] Greg Bowen of the Calvert County Planning Department says there are, at the present time, at least 25,000 acres of undeveloped farmland that could be either developed or could enter the TDR program. This 25,000 acres translates into roughly 5,000 additional housing units.

[22] In 1988, the County adopted an Adequate Public Facilities (APF) ordinance that requires that school and road capacities be reviewed before development projects are approved. The capacities must satisfy specifically defined public facility capacity standards; if the standards are not met, development is curtailed or delayed until school and/or road capacity is added. The APF moratorium was applied in 1989 in Calvert and again in 2000. The ordinance stopped development in parts of the County during the 1990s and the entire county was closed to any new development as of November, 2001.

[23] This is the acreage preserved from first sales, since the first TDR sold puts an entire parcel in easement status. The county also buys TDRs from some landowners whose properties are already preserved, including those whose first sales were to private developers. We do not include that acreage in our numbers here.

[24] As in Figure 2, yellow and orange are Town Centers and residential areas (R-1/R-2), respectively, and purple are commercial/industrial areas. Areas shown in brown are lands that have been preserved under state, federal, and private conservation programs, as well as county and state parkland.

[25] The only way to channel greater density to the R-1/R-2 areas using the TDR market would be to use different transfer ratios for the different receiving areas. It is not clear that increased density in residential areas is a goal of Calvert County, but it is a goal of the state of Maryland's "Smart Growth" Initiative (see www.mdp.state.md.us/fundingact.htm)..

[26] As we stated above, 12,664 TDRs have been sold in total, 10,656 to private developers (the remainder to the county). Since 5 TDRs are needed to build one house, approximately 2,130 new units were built with TDRs.

[27] We use the GDP deflator to calculate real prices.

[28] The median price of a new house in a subdivision in the northern part of the county in 2000 was $248,170. A subdivision that used TDRs had to purchase 5 for each house, which is about $12,500 at 2000 prices or 5% of the sales price. The cost of TDRs is the same for any new house that uses TDRs to go beyond baseline zoning, so the share of the TDR cost out of the purchase price is greater for lower valued houses. Subdivision houses in the southern part of the County had a median value of only $138,000 in 2000, so their TDR share is about 9%.

[29] Since the price paid by the government in any year is fixed, we do not include TDR sales to the government when calculating this coefficient of variation.

[30] There was some information about the purchase price of easements by the State government at the time the TDR program in Calvert County was initiated. These prices were low at about $1,000 per acre, but they likely provided a floor for prices in the early years of the TDR program.

[31]This figure comes from Greg Bowen of the Calvert County Planning Office. He claims that this number has remained roughly the same over time.

[32] In SO_2 trading markets, brokers do most of the trading, and the commission on each allowance is down from 5% in the early days of trading to less than 2% of the purchase price (Joskow et al. 1998).

[33] A similar response was felt in 1989 (see Figure 5 again) in response to the creation of Critical Areas in the county. As we explained on page 20 above, these are waterfront areas that were downzoned in 1989 to 1 unit/20 acres . A significant amount of new acreage became APDs in that year.

[34] That moratorium is supposed to be lifted in 2003, when new school construction is complete. Also, data on TDR sales starting in 2001 is complicated by the fact that in that year sales of TDRs in the LAR (Leverage and Retire) program began. All of the TDRs from a property show up in our statistics for TDR sales in 2001, even though only a small number of them are actually purchased in that year.

[35] Pruetz (1997) highlights many TDR programs that have very little activity. He attributes this to the way that the programs have been set up by the local governments.